Peer review content and communication in biomedical journals

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Peer review content and communication in biomedical journals

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In front of a jury composed of:

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Abstract

Title: Peer review content and communication in biomedical journals

Aim: This research investigated roles and tasks of peer reviewers in biomedical journals, explored existing communication practices within the peer review process and identified areas for future research.

Methods: A scoping review of the literature mapped the roles and tasks of peer reviewers in biomedical journals. The use of qualitative interviews provided insight into journal editors' understanding of the roles and tasks of peer reviewers and allowed for an in-depth exploration of their experience of the communication process in their journals.

Results: A large number of roles and tasks were found. Problematic areas related to vague descriptions, contradictory statements and areas that overlap with the supposed duties of journal editors were highlighted. Several communication practices were identified that might have a negative impact on the peer review process.

Conclusion: This research confirmed that the expected roles and tasks of peer reviewers, and thereby the content expected in peer reviewer reports, is not clearly outlined and communicated. There is a need to define quality criteria for peer reviewer reports and for journal editors to critically review their communicative practices.

Keywords: Peer review, Communication, Journal editors, Roles, Tasks

Abstract in French

Titre: Contenu et communication des évaluations par les pairs dans les revues biomédicales

Objectif: Cette recherche a permis d'étudier les rôles et les tâches des pairs évaluateurs dans les revues biomédicales, d'explorer les pratiques de communication existantes dans le cadre du processus d'évaluation par les pairs et d'identifier des domaines de recherche futurs.

Méthodes: Un examen de la littérature a permis de cartographier les rôles et les tâches des pairs examinateurs dans les revues biomédicales. L'utilisation d'entretiens qualitatifs a permis de mieux comprendre la compréhension qu'ont les éditeurs de revues des rôles et des tâches des pairs examinateurs et d'explorer en profondeur leur expérience du processus de communication dans leurs revues.

Résultats: Un grand nombre de rôles et de tâches ont été trouvés. Des problèmes liés à des descriptions vagues, des déclarations contradictoires et des domaines qui chevauchent les tâches supposées des rédacteurs de revues ont été mis en évidence. Plusieurs pratiques de communication ont été identifiées qui pourraient avoir un impact négatif sur le processus d'évaluation par les pairs.

Conclusion: Cette recherche a confirmé que les rôles et les tâches attendus des pairs évaluateurs, et donc le contenu attendu des rapports des pairs évaluateurs, ne sont pas clairement définis et communiqués. Il est nécessaire de définir des critères de qualité pour les rapports des pairs évaluateurs et pour les rédacteurs des revues afin de procéder à un examen critique de leurs pratiques de communication.

Mots-clés: L'évaluation par les pairs, Communication, Rédacteurs en chef de revues, Rôles, Tâches

Abstract in Croatian

Cilj: U ovom su istraživanju ispitane uloge i zadaci recenzenata biomedicinskih znanstvenih radova, proces komunikacije tijekom postupka recenzije te su identificirane teme za buduća istraživanja u području.

Metode: Obuhvatnim pregledom literature mapiran je pregled uloga i zadataka recenzenata u biomedicinskim časopisima. Koristeći kvalitativne intervjue, ispitana su shvaćanja urednika biomedicinskih časopisa o ulogama i zadacima recenzenata te se dubinski istražena njihova iskustva vezana uz proces komunikacije tijekom procesa recenzije.

Rezultati: Pronađen je iznimno velik broj očekivanih uloga i zadataka recenzenata. Problematična područja su bila povezana s nejasnim opisima uloga i zadataka, očekivanjima od recenzenata koja su međusobno suprotstavljena te očekivanjima koja se preklapaju sa zadacima urednika biomedicinskih časopisa. Identificirane su komunikacijske prakse koje mogu imati negativne učinke na ishode procesa recenziranja u biomedicinskim časopisima.

Zaključak: Ovo istraživanje je pokazalo nejasna očekivanja u vezi uloga i zadataka recenzenata te komunikacije tijekom procesa recenzije u biomedicinskim znanstvenim časopisima. Utvrđena je potreba za jasnim kriterijima recenziranja te procesa komunikacije između urednika, recenzenata i autora biomedicinskih znanstvenih članaka.

Ključne riječi: recenzija, komunikacija, urednici časopisa, uloge, zadaci

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List of publications

1. Glonti K, Cauchi D, Cobo E, et al. A scoping review on the roles and tasks of peer reviewers in the manuscript review process in biomedical journals. BMC Med 2019;17:118. doi:10.1186/s12916-019-1347-0

2. Glonti K, Boutron I, Moher D, et al. Journal editors' perspectives on the roles and tasks of peer reviewers in biomedical journals: aqualitative study. BMJ Open Published Online First: 2019. doi:10.1136/ bmjopen-2019-033421

3. Glonti K, Boutron I, Moher D, Hren D. Journal editors' perspectives on the communication practices in biomedical journals: a qualitative study. BMJ Open (under review)

Other scientific publications

1. Glonti K, Hren D. Editors' perspectives on the peer-review process in biomedical journals: protocol for a qualitative study. BMJ Open 2018;8:e020568. doi:10.1136/bmjopen-2017-020568

2. Glonti K, Cauchi D, Cobo E, et al. A scoping review protocol on the roles and tasks of peer reviewers in the manuscript review process in biomedical journals. BMJ Open 2017;7:e017468. doi:10.1136/bmjopen-2017-017468

3. Sharp M. K., Glonti K, Hren D. Debating the merits of the STROBE Statement: "useful for any observational researcher" or "a procedural straightjacket"? JCE 2020:123 doi:/10.1016/j.jclinepi.2020.03.025.

4. Lundine J, Bourgeault IL, Glonti K, et al. "I don't see gender": Conceptualizing a gendered system of academic publishing. Soc Sci Med 2019;235:112388. doi:10.1016/j.socscimed.2019.112388

5. Gkioni E, Glonti K, Dodd S, et al. DIABRISK-SL trial: further consideration of age and impact of imputations. BMC Med 2019;17:121. doi:10.1186/s12916-019-1361-2

List of Abbreviations

Abbreviation	Expansion
BMJ	The British Medical Journal
COPE	The Committee of Publication Ethics
ICMJE	International Committee of Medical Journal Editors
JAMA	The Journal of the American Medical Association
PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews
RCT	Randomized controlled trail
WAME	The World Association of Medical Editors

French summary

Justification de la thèse

L'évaluation par les pairs des articles scientifiques a été continuellement débattue et critiquée depuis son émergence, mais à ce jour, il reste un mécanisme clé pour assurer la qualité scientifique des publications et il le restera probablement dans un avenir proche. Par conséquent, il est important de continuer à explorer les moyens d'améliorer le processus de revue par les pairs.

Les conséquences d'une revue par les pairs défaillante peuvent être dramatiques : l'étude malhonnête de Wakefield et coll. qui a échappé au processus d'examen par les pairs de The Lancet - une revue de renommée mondiale et influente dans le domaine biomédical - a aggravé l'hésitation face aux vaccins dans le monde entier et elle a eu un impact profond et étendu sur la confiance du public dans la science. Le processus d'examen par les pairs va au-delà du simple contrôle de la qualité des manuscrits scientifiques. Au sens large, il est censé être un mécanisme d'autorégulation et d'assurance qualité dans le domaine scientifique. L'examen par les pairs confère aux études publiées un sceau d'approbation et il légitime la science sous-jacente en tant que point de référence fiable pour la société en général. Il est donc essentiel de maintenir des normes élevées en matière d'examen par les pairs, à la fois pour préserver la confiance du public dans la science et pour poursuivre la promotion de la pratique (clinique) fondée sur les données probantes. Cela est particulièrement important à une époque où la production de connaissances et de l'information est rapide et importante, et où l'on observe une vague de "fausses nouvelles" et de refus de preuves scientifiques. En même temps, l'examen par les pairs n'est pas parfait. Il est essentiellement fondé sur l'interaction humaine entre les principales parties prenantes, ce qui introduit le "comportement humain" dans l'équation. Il est donc important de l'étudier sous cet angle, afin de mettre en lumière les facteurs déterminants de l'interaction entre les auteurs, les pairs et les éditeurs.

Malgré une reconnaissance et une sensibilisation croissantes, très peu de recherches ont été menées sur le contenu et la communication dans les revues biomédicales qui pourraient contribuer aux problèmes de l'examen par les pairs. Lorsque j'ai commencé cette recherche en octobre 2016, à ma connaissance, une seule étude publiée avait exploré les dimensions sociales et subjectives de l'examen des manuscrits dans l'édition biomédicale scientifique. L' étude publiée par Galipeau et coll. présentait une première tentative d'identifier systématiquement les compétences de base des éditeurs scientifiques de revues biomédicales. J'ai trouvé à la fois

intriguant et inquiétant que, des décennies après la création des revues dirigées par des éditeurs, ce n'est qu'en 2016 que des études reconnaissant la nécessité d'établir la position de éditeur de revue comme une "profession" en décrivant leurs rôles et responsabilités, et en parvenant à un consensus sur ceux-ci, aient été publiées. Cependant, bien que des progrès aient été réalisés en ce qui concerne les éditeurs de revues, il n'y a pas eu d'accord sur ce qui constitue la qualité de l'examen par les pairs ni sur les rôles et les tâches que les examinateurs doivent accomplir. Cela représente un défi majeur. L'absence d'accord sur les rôles et les tâches des pairs examinateurs et sur le contenu attendu des rapports des pairs examinateurs est un obstacle à l'élaboration de critères de qualité de l'examen par les pairs. Il peut également en résulter des malentendus qui, à leur tour, peuvent entraver la collaboration entre les parties prenantes au processus d'examen par les pairs, avec un impact sur la qualité des rapports des examinateurs.

Le processus d'examen par les pairs dans les revues biomédicales implique une collaboration entre les auteurs, les éditeurs de revues et les pairs examinateurs visant à assurer la diffusion de la recherche de haute qualité. Pour toute collaboration réussie, le principe sous-jacent le plus fondamental est que les intervenants sont conscients de leurs propres rôles et tâches et de ceux des autres, ainsi que des compétences nécessaires pour les exécuter efficacement. La science est désormais une entreprise internationale; des chercheurs du monde entier soumettent leurs travaux aux revues, et tout le monde doit donc être sur la même longueur d'onde pour que l'examen par les pairs fonctionne efficacement. De plus, des pratiques de communication efficaces sont essentielles pour assurer le bon déroulement du processus. Bien que de bonnes pratiques de communication entre ces acteurs soient essentielles pour atteindre cet objectif, les faits suggèrent qu'il existe de nombreuses failles dans le processus d'examen par les pairs, les défaillances de communication étant au cœur du problème. Par exemple, les recherches existantes suggèrent qu'un aspect essentiel de la collaboration - la compréhension mutuelle des rôles et des tâches professionnelles des parties prenantes au sein du processus - n'est pas communiqué de manière appropriée. Cela se manifeste en partie par le manque d'uniformité des lignes directrices à l'intention des pairs examinateurs dans les revues biomédicales. Les pratiques de communication inefficaces se manifestent également par le manque de transparence et la variation considérable observée dans le contenu des formulaires de notation des pairs examinateurs (utilisés pour évaluer les manuscrits originaux). Une étude visant à identifier les tâches que les éditeurs de revues attendent des pairs examinateurs qui évaluent un manuscrit ayant fait l'objet d'un essai contrôlé randomisé a révélé un écart important entre les attentes des éditeurs de revues et celles des pairs examinateurs. Cela peut avoir un impact négatif sur la qualité des rapports des pairs examinateurs, car les attentes des deux parties ne

sont pas satisfaites. Ces situations peuvent être considérées comme un gaspillage de ressources, mettant à rude épreuve un système déjà surchargé. Une autre étude souligne l'importance d'une communication efficace entre les principales parties prenantes avant et pendant l'examen par les pairs afin d'éviter les retards et la frustration qui en découle. Il y aura probablement des problèmes de communication qui iront au-delà d'une simple mauvaise communication et d'une mauvaise compréhension des rôles et des tâches professionnelles des parties prenantes. Par exemple, les pairs examinateurs aimeraient recevoir des commentaires des éditeurs de revues sur leurs rapports et voir les commentaires des autres pairs examinateurs. Cependant, ces commentaires sont rarement fournis. De telles attentes non satisfaites causées par un manque de communication peuvent influencer la volonté et la motivation des pairs examinateurs à participer au processus.

Malgré le besoin crucial de recherches approfondies et de preuves sur la communication entre les acteurs impliqués dans l'examen par les pairs, jusqu'à présent, le problème n'a pas été analysé de manière empirique et les facteurs sous-jacents n'ont pas été suffisamment évalués. Par cette thèse, je souhaite produire des données pertinentes qui permettent de clarifier le contenu et les pratiques de communication dans le cadre du processus d'examen par les pairs dans les revues biomédicales scientifiques.

Objectifs de la thèse

L'objectif global de cette thèse est de clarifier les attentes et les pratiques de communication existantes dans le cadre du processus d'examen par les pairs des revues biomédicales scientifiques.

Les objectifs spécifiques de ma recherche sont les suivants:

1. Déterminer les rôles et les tâches des pairs examinateurs dans les revues biomédicales scientifiques.
2. Acquérir une meilleure compréhension des rôles et des tâches des pairs examinateurs.
3. Explorer l'expérience des éditeurs des revues en ce qui concerne le processus de communication dans leurs revues.

Les résultats de la recherche sont rassemblés dans la discussion afin de faire des recommandations pour la recherche future.

Méthodes et résultats

Article 1: Examen approfondi des rôles et des tâches des pairs examinateurs dans le processus d'évaluation des manuscrits dans les revues biomédicales scientifiques

Afin de déterminer les rôles et les tâches des pairs examinateurs dans les revues biomédicales, j'ai d'abord effectué un examen approfondi (scoping review) de la littérature.

Lorsque j'ai commencé cette recherche, il n'y avait pas de documentation identifiant systématiquement les rôles et les tâches des pairs examinateurs dans les revues biomédicales, ni d'accord sur ce qu'ils devraient être. À l'époque, l'examen approfondi effectué par Galipeau et coll. représentait une première tentative d'identifier et de déterminer systématiquement ce que l'on savait sur les compétences de base requises pour les éditeurs scientifiques de revues biomédicales. Cet examen approfondi a produit une liste complète, dérivée d'un large éventail de sources. J'ai cherché à compléter ce travail en identifiant systématiquement les rôles et les tâches des pairs examinateurs. Toutefois, alors que Galipeau et coll. ont défini les compétences de base comme suit *"...les connaissances, les compétences et les comportements essentiels nécessaires à la pratique de la révision scientifique des revues biomédicales "*, j'ai plutôt décidé d'axer ma recherche sur les " rôles et les tâches " parce que les pairs examinateurs, contrairement aux éditeurs de revues, n'occupent pas un emploi officiel et n'ont pas de poste désigné où une telle définition est plus pertinente. Pour les besoins de ma recherche, j'ai considéré que les "rôles" faisaient référence à la nature globale de la fonction des pairs examinateurs, tandis que les "tâches" se réfèrent plus spécifiquement aux actions qui remplissent ces rôles. Par exemple, alors que le rôle d'un pair examinateur est d'être un "expert compétent dans le domaine concerné", l'une des tâches spécifiques accomplies pour remplir ce rôle est de fournir une évaluation critique de la méthodologie proposée et d'autres sections d'un manuscrit.

J'ai également utilisé l'approche méthodologique de Galipeau et coll. pour guider ma propre recherche. Par exemple, ma décision d'effectuer un examen approfondi a été en partie éclairée par l'expérience des auteurs qui ont trouvé des descriptions des compétences des éditeurs de revues dans les publications de type rédactionnel. Cela est également vrai pour l'information sur les rôles et les tâches des pairs examinateurs, que l'on retrouve souvent sous forme de commentaires et d'éditoriaux. Bien que ce genre de source ne réponde généralement pas aux critères d'inclusion d'une étude systématique, les examens approfondis ont l'avantage d'inclure un plus grand éventail de plans d'étude et de méthodologies ainsi que de la littérature grise. De plus, j'ai considéré qu'un examen approfondi était la meilleure approche pour répondre à ma

question de recherche, compte tenu de son objectif principal tel que défini par Colquhoun et coll. : *"Un examen approfondi (scoping review) est une forme de synthèse des connaissances qui porte sur une question de recherche exploratoire visant à cartographier les concepts clés, les types de preuves et les lacunes dans la recherche liée à un domaine ou à un secteur défini en recherchant, sélectionnant et synthétisant systématiquement les connaissances existantes"*, ainsi que d'autres définitions plus générales fournies dans les publications de référence sur la méthodologie des examens approfondis. Ma question de recherche était de nature exploratoire, plutôt qu'axée sur des hypothèses, et elle visait à clarifier les concepts clés tout en saisissant l'étendue, la gamme et la nature de la documentation disponible, que je m'attendais à voir hétérogène.

Dans le cadre de cet examen approfondi, j'ai utilisé le cadre méthodologique proposé par Arksey et O'Malley ainsi que les modifications apportées à ce cadre par Levac et coll., ainsi que par l'Institut Joanna Briggs. Le cadre se compose de six étapes consécutives suivantes : (1) identification de la question de recherche, (2) identification des études pertinentes, (3) sélection des études, (4) consignation des données, (5) collecte, résumé et communication des résultats, et (6) consultation.

J'ai effectué des recherches documentaires exhaustives dans Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, EMBASE, MEDLINE, PsycINFO, Scopus et Web of Science depuis le début jusqu'en mai 2017. Je n'ai appliqué aucune restriction de date, de langue et de conception d'étude. Toute étude comportant des déclarations mentionnant les rôles et les tâches des pairs examinateurs dans les revues biomédicales était admissible à l'inclusion. J'ai également cherché de la littérature grise sur des sites Web choisis.

J'ai effectué la sélection des études et l'extraction des déclarations de façon indépendante avec un autre chercheur et co-auteur du manuscrit en utilisant Excel. Deux examinateurs ont effectué la sélection des études de façon indépendante. Les déclarations pertinentes ont été extraites, colligées et classées par thèmes.

Après la sélection, 2763 citations et 600 articles en texte intégral, 209 articles et 13 sources de littérature grise ont été inclus. Au total, 1 426 déclarations liées aux rôles ont été extraites, ce qui a donné lieu à 76 déclarations uniques qui ont été regroupées en 13 thèmes émergents. Ces derniers tournaient autour de l'être des pairs examinateurs : Experts compétents dans leur domaine (3 articles), Doyen/altruiste envers la communauté scientifique (7 articles), Familiés avec la revue (2 articles), Professionnels impartiaux et éthiques (18 articles), Professionnels autocritiques (4 articles), Professionnels fiables (7 articles), Critiques compétents (15 articles),

Communicateurs respectueux (6 articles), Gardiens (2 articles), Éducateurs (2 articles), Défenseurs de l'auteur/éditeur/lecteur (3 articles) et Conseillers des éditeurs (2 articles). Les rôles qui ne relèvent pas de la compétence des pairs examinateurs ont également été identifiés (5 points). Les thèmes "Critiques compétents" et "Professionnels impartiaux et éthiques" sont apparus le plus souvent.

Au total, 2026 déclarations relatives aux tâches des pairs examinateurs ont été extraites, ce qui a donné 73 dèclarations uniques. Celles-ci ont été regroupées sous six thèmes : Organisation et approche de l'examen (10 éléments), Faire des commentaires généraux (10 éléments), Évaluer et traiter le contenu de chaque section du manuscrit (36 éléments), Traiter les aspects éthiques (5 éléments), Évaluer la présentation du manuscrit (8 éléments) et Fournir des recommandations (4 éléments). Les thèmes " Évaluer et traiter le contenu de chaque section du manuscrit " ont eu le plus grand nombre de déclarations, tandis que le thème relatif aux aspects éthiques a eu le plus petit nombre.

Comme le montrent les résultats ci-dessus, la principale conclusion de cet examen approfondi est que les pairs examinateurs des revues biomédicales sont censés assumer un grand nombre de rôles et de tâches, dont certains sont vagues, contradictoires et chevauchent les rôles et les tâches des éditeurs de revues. Quatre sujets de préoccupation ont été relevés en ce qui concerne les rôles et les tâches des pairs examinateurs. Par exemple, un rôle particulièrement vague était que les pairs examinateurs soient des "défenseurs" ; cela est apparu plusieurs fois dans la documentation incluse. On s'attend à ce que les pairs examinateurs défendent les intérêts des auteurs, des éditeurs et/ou des lecteurs. Le terme " défenseurs " doit être clarifié afin que les pairs examinateurs comprennent ce qu'on attend d'eux. Un exemple clair de contradiction a été observé dans le lien souvent peu clair entre les recommandations des pairs examinateurs et la prise de décision éditoriale - alors que la première informe généralement la seconde. L'un des rôles identifiés était que les pairs examinateurs doivent garder à l'esprit qu'ils ne sont pas des décideurs en ce qui concerne le sort final du manuscrit. En même temps, une des tâches principales des examinateurs qui ressort de cet examen approfondi a trait à la formulation d'une recommandation concernant le manuscrit (prise de décision : rejeter, accepter, etc.) qui contraste et chevauche le rôle du éditeur de la revue en tant que seul décideur du sort du manuscrit.

Il y avait également un certain nombre de contradictions en termes de tâches. Par exemple, il y avait une certaine divergence sur la question de savoir si la détection des fautes et des fraudes devait relever de la compétence des pairs examinateurs et si la révision des textes - offrant des améliorations grammaticales et linguistiques - devait relever de la compétence des pairs

examinateurs. Le niveau de détail fourni variait et certaines tâches étaient décrites de façon vague.

Article 2 : Perspectives des éditeurs de revues sur les rôles et les tâches des pairs examinateurs dans les revues biomédicales: Une étude qualitative

Afin d'avoir une idée de la compréhension des rèdacteurs de revues sur les rôles et les tâches des pairs examinateurs, j'ai utilisé une approche qualitative avec des entretiens semi-structurés.

Dans son étape finale et optionnelle, le cadre méthodologique utilisé pour l'examen approfondi suggère de mener une consultation auprès des intervenants afin de valider les résultats et de déterminer d'autres sources d'information, perspectives et significations qui pourraient améliorer les connaissances acquises lors de l'examen. Étant donné le manque de clarté et les incongruités constatés lors de l'examen approfondi, j'ai décidé d'approfondir la question pour mieux comprendre le contenu attendu des pairs examinateurs au moyen d'entrevues qualitatives avec les éditeurs des revues biomédicales. J'ai considéré que cette approche était optimale parce que les entrevues permettent aux participants à l'étude de s'exprimer librement et longuement, fournissant ainsi de riches données ancrées dans les expériences et les pratiques personnelles. Ma décision de me concentrer sur le point de vue des éditeurs des revues découle du fait qu'ils sont des figures centrales dans le processus d'examen par les pairs qui, en fin de compte, déterminent les attentes en matière de rôles et de tâches pour leur revue.

L'approbation éthique a été accordée par l'Université de Split avant le début de l'étude. Les données ont été dépersonnalisées et elles sont actuellement conservées en toute sécurité à l'Université de Split.

J'ai fourni aux personnes interrogées un formulaire de consentement à l'étude et une fiche d'information sur l'étude qui comprenait des renseignements sur les chercheurs et l'étude (c.-à-d. le but de l'étude, les procédures d'entrevue, l'éthique, la confidentialité, le financement et les coordonnées). On a demandé aux personnes interrogées de signer un formulaire de consentement écrit et on leur a demandé à nouveau de donner leur consentement verbal avant l'entrevue. Avant le début de chaque entrevue, j'ai réitéré mes objectifs d'étude et j'ai fourni des renseignements supplémentaires au besoin.

J'ai inclus des éditeurs de revues de médecine générale et de revues spécialisées qui, au moment de l'entrevue, participaient au processus de communication entre les auteurs et les pairs examinateurs et/ou qui étaient en mesure de décider du sort des manuscrits. Le recrutement a

été basé sur un échantillonnage à variation maximale intentionnelle, en puisant dans un réseau professionnel de contacts, d'éditeurs, de participants aux conférences et en faisant boule de neige. Une description détaillée du processus de recrutement est fournie dans le protocole d'étude publié.

J'ai décidé de mener des entrevues semi-structurées (toutes en anglais) en utilisant un guide de sujets pour m'assurer que les aspects clés sont saisis tout en conservant suffisamment de souplesse pour encourager les réponses non sollicitées et les renseignements pertinents supplémentaires qui n'auraient pas été abordés dans le guide de sujets. Comme la taille de l'échantillon est irréversiblement liée à la saturation, qui à son tour ne peut être opérationnalisée que pendant la collecte des données, mon approche de la collecte et de l'analyse des données a été itérative et s'est poursuivie jusqu'à ce qu'aucun nouveau code et thème n'ait été identifié à partir des données. Au total, 56 éditeurs de revues biomédicales générales et spécialisées ont été interrogés, après quoi la saturation a été obtenue et le recrutement a cessé.

Les données ont été analysées à l'aide de l'analyse thématique en six phases décrite par Braun et Clarke. J'ai suivi l'approche étape par étape proposée par Nowell et coll. sur la façon de mener une analyse thématique fiable tout au long de six phases de mon analyse afin d'assurer la fiabilité de ma recherche.

Les conclusions ont été classées en deux thèmes principaux : "Rôles des pairs examinateurs" et "Tâches des pairs examinateurs", puis caractérisées/décomposées en un certain nombre de domaines.

Dans le premier thème "Rôles des pairs examinateurs", les éditeurs de la revue ont décrit une variété de rôles, qui s'est regroupée autour de quatre domaines. Le premier domaine a montré que les éditeurs de revues s'attendent à ce que les pairs examinateurs soient des "experts compétents dans leur domaine, qualifiés pour l'examen par les pairs". Il a été convenu que les pairs examinateurs étaient les experts lorsqu'ils (1) ont une expertise et démontrent une connaissance de haut niveau dans leur domaine, (2) ils sont à jour avec les données probantes et les lignes directrices de pratique existantes et (3) ils ont l'expérience de la publication de leurs propres recherches. Toutefois, il y a eu un désaccord important sur la façon dont ces critères sont définis et compris et sur la façon dont "l'expertise" est mise en œuvre. L'une des principales conclusions de ce domaine est que les éditeurs des revues soutiennent le point de vue selon lequel l'expérience de l'auteur est la clé d'une évaluation de haute qualité, alors qu'une formation formelle à l'examen par les pairs ne l'est pas. Le deuxième domaine: "Devoir envers la

communauté scientifique par opposition aux bénévoles qui méritent d'être reconnus" a montré que les éditeurs de revues sont divisés sur cet aspect. Tandis que la majorité des personnes interrogées ont exprimé à plusieurs reprises leur gratitude envers les pairs examinateurs, qu'ils sont le plus souvent présentés comme des bénévoles qui agissent par "altruisme", seul un petit nombre d'entre elles considèrent que l'examen par les pairs est un "devoir" et " une obligation envers la communauté scientifique".

Le troisième domaine a montré que les éditeurs des revues s'attendent à ce que les pairs examinateurs soient des "professionnels". Les participants à l'étude s'accordent généralement sur la nécessité que les pairs examinateurs soient (1) des professionnels impartiaux et éthiques, (2) des professionnels fiables et (3) des critiques compétents.

Le quatrième domaine illustre le fait que les éditeurs des revues s'attendent à ce que les pairs examinateurs soient des "conseillers de l'éditeur". Les éditeurs des revues étaient explicites dans leur attribution d'un "rôle consultatif" aux pairs examinateurs et de leur propre rôle de "décideur ultime". Pourtant, la majorité a accordé une importance considérable à la fonction de recommandation des examinateurs, malgré les préoccupations concernant l'absence d'une définition commune des options disponibles, l'influence potentielle sur la prise de décision éditoriale indépendante, ainsi que le désaccord fréquent entre les pairs examinateurs.

Dans le deuxième thème " Tâches des pairs examinateurs", les éditeurs des revues ont décrit un certain nombre de tâches qui se regroupent autour de quatre domaines: (1) organisation et approche de l'examen, (2) formulation de commentaires généraux, (3) évaluation et traitement du contenu de chaque section du manuscrit, et (4) traitement des aspects éthiques. Il y avait un accord considérable concernant les tâches techniques ; cependant, il y avait une différence apparente dans les attentes des éditeurs de revues quant au niveau de profondeur et de détail. Dans l'ensemble, les résultats de ces entrevues appuient et valident les résultats de l'examen approfondi (article 1) tout en illustrant et en démêlant certaines des contradictions observées dans la documentation.

Article 3: Perspectives des éditeurs de revues sur les pratiques de communication dans les revues biomédicales: une étude qualitative

Afin d'explorer l'expérience des éditeurs en chef de revues sur le processus de communication dans leurs revues, j'ai également utilisé une approche qualitative avec des entretiens semi-

structurés. J'ai recueilli les données pour cette recherche en même temps que la recherche qualitative décrite précédemment, donc la méthodologie est la même.

L'analyse des données d'entrevues a généré quatre thèmes. Le premier thème, " Directives vagues et orientation minimale fournie aux pairs examinateurs", s'articulait autour de deux sous-thèmes qui décrivaient la façon dont les éditeurs de revues ont rationalisé le fait de fournir aux pairs examinateurs des directives vagues et une orientation minimale concernant leurs attentes. Dans le premier sous-thème "Les pairs examinateurs doivent savoir comment évaluer sans lignes directrices", j'ai constaté que l'attitude dominante est que les lignes directrices ne jouent pas un rôle essentiel dans la transmission des attentes des éditeurs de revues aux pairs examinateurs, que les pairs examinateurs doivent savoir comment évaluer un manuscrit sans avoir besoin de lignes directrices et qu'on suppose généralement que les pairs examinateurs ne lisent pas les lignes directrices. Dans le deuxième sous-thème "Les directives détaillées et la structure peuvent avoir un effet négatif", les éditeurs de revues ont exprimé la crainte que les formulaires d'examen (excessivement) structurés puissent avoir un impact négatif sur la qualité du rapport d'examen en raison de l'interrogation prescriptive plutôt que de susciter des réponses non sollicitées. Une telle "surbureaucratisation" pourrait avoir un impact sur la volonté des examinateurs de participer au processus d'examen.

Dans le deuxième thème, "Stratégies de communication pour l'engagement avec les pairs examinateurs", j'ai trouvé deux stratégies de communication opposées que les éditeurs des revues ont utilisées simultanément pour traiter avec les pairs examinateurs. La première stratégie de communication s'est articulée autour de "l'utilisation d'une communication directe et personnelle pour motiver les pairs examinateurs à participer continuellement au processus d'examen". Les éditeurs des revues étaient conscients des effets positifs de la communication directe et l'utilisaient de façon stratégique à des fins de rétention et de récompense. Malgré cette prise de conscience, la deuxième stratégie de communication: "Utilisation de la communication indirecte pour éviter les conflits potentiels qui pourraient décourager les pairs examinateurs de participer au processus d'examen" a démontré qu'ils préféraient ne pas s'engager avec des pairs examinateurs qui présentent des rapports d'examen inadéquats. Cela permet d'éviter commodément les conflits potentiels qui, selon eux, pourraient survenir à la suite de la fourniture d'un retour d'information.

Dans le troisième thème, "Préoccupation concernant l'impact du modèle d'examen sur la communication", j'ai constaté que la majorité des éditeurs de revues étaient contre l'ouverture de l'identité des pairs examinateurs aux auteurs, en faisant valoir que cela risquait d'aggraver la

qualité des rapports des examinateurs en raison du biais potentiel qui pourrait découler de la suppression de l'anonymat et de la crainte des répercussions de l'expression de critiques.

Dans le dernier thème "Pratiques divergentes dans la modération de la communication entre les auteurs et les pairs examinateurs", j'ai constaté que d'une part, il y a des éditeurs de revues qui jouent un rôle actif et qui guident les auteurs à travers les commentaires des pairs examinateurs. D'autre part, il y a des éditeurs de revues qui jouent un rôle passif et qui se contentent de transmettre les commentaires aux auteurs sans aucune orientation. Cette dernière approche n'est pas conforme à celle recommandée par les associations professionnelles, ce qui indique que certains éditeurs de revues ne suivent peut-être pas les pratiques exemplaires en matière de rédaction.

Discussion

Résumé des conclusions

Cette thèse part du principe que peu de recherches ont été menées sur le contenu et les pratiques de communication au cours du processus d'examen par les pairs dans les revues biomédicales scientfiques. Plus précisément, les rôles et les tâches des pairs examinateurs ne sont pas clairement définis et, par conséquent, le contenu attendu des rapports des pairs examinateurs n'est pas clairement exposé. De plus, il est prouvé que la communication entre les principaux intervenants n'est pas optimale.

Implications

Cette recherche a montré que l'on s'attend à ce que les pairs examinateurs remplissent un grand nombre de rôles et de tâches, dont certains sont vagues, contradictoires et ils chevauchent les rôles et les tâches des éditeurs de revues, et que la mauvaise communication actuelle ne facilite pas la compréhension des attentes parmi et entre les intervenants. En l'absence d'exigences formellement établies ou de normes communément acceptées, ainsi que de variations dans les attentes des éditeurs de revues et de la nature internationale des publications scientifiques, mes conclusions peuvent contribuer à sensibiliser les éditeurs de revues au fait qu'une attitude "implicite" (c'est-à-dire que les pairs examinateurs ne devraient pas avoir besoin de lignes directrices parce que, en tant qu'auteurs, ils devraient déjà savoir ce qu'on attend d'eux) n'est ni appropriée ni utile. Elle peut également entraver la compréhension mutuelle des rôles et des tâches entre les principaux acteurs, ce qui peut à son tour affecter la qualité des rapports des pairs examinateurs. Mes conclusions suggèrent en outre qu'il est nécessaire que les éditeurs des

revues examinent et évaluent de manière critique le contenu des instructions qu'ils donnent aux pairs examinateurs et qu'ils étudient les moyens d'améliorer leur application. Idéalement, cette évaluation devrait être mise en place sous forme d'étude scientifique, afin de créer des preuves empiriques solides sur la pratique de la gestion de l'examen par les pairs dans une revue scientifique, qui pourront ensuite être utilisées par d'autres revues. Ceci est conforme aux appels répétés en faveur d'une recherche plus approfondie sur l'examen par les pairs.

Mes conclusions ont également démontré que la plupart des éditeurs de revues sont d'avis que l'expérience de l'auteur est essentielle à la production d'examens de grande qualité, alors que la formation officielle en matière d'examen par les pairs ne l'est pas. A la lumière des enquêtes existantes qui suggèrent un besoin profond pour ce type de formation, ainsi que la multiplication des cours internationaux à grande échelle tels que ceux organisés par Publons, cette attitude risque d'être injustifiée, inopportune et non durable à long terme. L'examen des manuscrits par les pairs est une compétence qui peut et doit être développée par une formation spécifique, quelle que soit l'expérience de l'auteur. Par conséquent, l'une des implications plus larges découlant de mon étude est que la communauté scientifique doit reconnaître que l'examen par les pairs est une compétence distincte de la rédaction d'un manuscrit scientifique, et que l'établissement d'une formation formelle pour les paires examinateurs est essentiel pour affiner cette compétence. Toutefois, cela n'aurait de sens que s'il y a un accord entre les revues sur les éléments clés essentiels d'un rapport d'examen de haute qualité et une reconnaissance universelle des compétences nécessaires pour le produire. De plus, en l'absence de preuves solides établissant un lien entre l'expérience de l'auteur et les qualifications universitaires et les examens de haute qualité, ainsi que les difficultés actuelles à trouver des pairs examinateurs consentants, les éditeurs des revues devraient envisager de ne plus adresser leurs invitations à examiner uniquement les chercheurs chevronnés. Ils devraient plutôt inviter des chercheurs débutants à évaluer des manuscrits sur une base plus régulière.

De plus, cette étude a démontré que la majorité des éditeurs de revues accordent une importance considérable à la fonction de "recommandation" des examinateurs. Tout en étant pleinement conscient que l'absence de définitions communément acceptées des options de recommandation des manuscrits et la fréquence des désaccords entre les pairs examinateurs sont problématiques, il semble que l'on soit peu conscient que cette importance pourrait par inadvertance donner aux pairs examinateurs la fausse impression qu'ils sont des décideurs. Une telle impression est trompeuse et peut influencer l'orientation du rapport des pairs examinateurs en conséquence au lieu de se concentrer sur la fonction d'amélioration que la plupart des éditeurs de revues désirent.

Étant donné le risque de malentendus, mes conclusions appuient les appels à la suppression de la "fonction de recommandation" des examinateurs. Cela pourrait aider à éliminer un aspect problématique des limites malléables actuelles de l'autorité et de la responsabilité de la surveillance scientifique, en réalignant le rôle des pairs examinateurs en tant que "conseillers" tout en plaçant le éditeur de la revue au seul poste de décideur. Encore une fois, une telle intervention devrait être conçue comme une étude scientifique visant à créer des preuves pour ou contre cette étape.

Une autre implication clé découlant de ma recherche est la nécessité de s'engager auprès des pairs examinateurs qui produisent des rapports d'examen inadéquats en leur envoyant des critiques personnalisées et constructives. La pratique courante actuelle - telle que décrite par les participants à mon étude - consiste simplement à faire circuler les rapports des pairs examinateurs dans l'espoir que les pairs examinateurs peu performants tireront des leçons des efforts de leurs collègues. En tant que telle, cette pratique est intangible et elle n'aide probablement pas à obtenir un véritable effet d'apprentissage durable ni à encourager la réflexion critique sur sa propre performance en tant que pair-réviseur. Bien que la mise en œuvre de cette suggestion représente inévitablement un investissement majeur pour les éditeurs de revues, à long terme, elle pourrait rapporter des résultats substantiels, alors que la pratique actuelle ne fait que perpétuer le statu quo. Là encore, la production de données probantes et l'accord sur le domaine de la qualité donneraient aux éditeurs de revues les outils nécessaires pour évaluer méthodologiquement la qualité des rapports des pairs examinateurs. En même temps, cette étude a mis en évidence trois principaux obstacles potentiels à la mise en œuvre de cette suggestion, à savoir 1) le manque de temps des éditeurs des revues ; 2) la crainte des répercussions, y compris la perte de pairs examinateurs potentiels et 3) le désaccord sur le fait que la formation des pairs examinateurs devrait être une responsabilité des éditeurs des revues. Ces obstacles ne sont pas faciles à surmonter et ils exigent des changements systémiques importants. Il pourrait en effet être irréaliste de s'attendre à ce que les éditeurs de revues qui travaillent la plupart du temps à temps partiel fournissent une rétroaction individuelle. Par conséquent, un investissement financier substantiel de la part des éditeurs est nécessaire pour inciter les éditeurs de revues à consacrer plus de temps au travail éditorial. Il faudrait également envisager des mesures incitatives pour que les membres du comité de rédaction appuient les éditeurs des revues dans cette tâche. Pour surmonter le deuxième obstacle, le système doit être repensé à l'envers. Par exemple, la fourniture de rétroaction pourrait être une nouvelle procédure

standard qui est présentée aux pairs examinateurs comme un service en reconnaissance de leur investissement substantiel en temps, plutôt que comme une critique.

Enfin, mes conclusions suggèrent que certains éditeurs de revues utilisent une approche passive pour modérer la communication entre les auteurs et les pairs examinateurs. C'est non seulement une occasion manquée de contribuer à l'amélioration du processus d'examen par les pairs, mais aussi un manque de conformité avec les meilleures pratiques éditoriales recommandées par les associations professionnelles telles que WAME. Le manque de temps était, selon les participants à mon étude, la principale raison de s'engager dans une telle approche passive. Cette constatation souligne qu'il s'agit d'un problème majeur et récurrent qui peut avoir un impact important sur le processus d'examen par les pairs, et elle appelle à la création des incitations (financières) et à un meilleur soutien aux éditeurs des revues pour qu'ils conduisent leurs revues conformément aux meilleures pratiques. En même temps, cette constatation soulève également la nécessité de mener des recherches à grande échelle sur les pratiques éditoriales des éditeurs de revues. Bien que le manque de temps soit indéniablement un facteur important, il se pourrait bien que les éditeurs de revues ne soient pas au courant des pratiques exemplaires existantes, puisque de nombreux éditeurs de revues biomédicales fonctionnent en grande partie sans formation officielle (5). Contrairement à d'autres associations professionnelles (par exemple, les associations médicales), il n'existe pas de procédure universelle obligatoire de certification ou d'adhésion que les éditeurs de revues doivent respecter. Ainsi, les implications plus larges pour mon étude sont conformes à l'appel lancé par Moher et Altman pour que les bailleurs de fonds et les éditeurs de la recherche investissent de l'argent dans les enquêtes de journalisme, la certification et la formation continue des éditeurs de revues ainsi que des pairs examinateurs à long terme.

Points forts et limites de cette recherche

Points forts

Cette recherche a plusieurs points forts. Par exemple, des protocoles d'étude a priori qui décrivent en détail la justification, la méthodologie et les analyses de ma recherche ont été publiés à l'avance pour tous les articles. La publication des protocoles contribue à assurer la transparence du processus de recherche et à informer les autres chercheurs sur les activités de recherche en cours.

J'ai eu recours aux méthodes complémentaires et j'ai triangulé les données découlant de l'examen approfondi et de la recherche qualitative, ce qui a permis de constater une convergence substantielle des résultats entre les trois documents de recherche.

Grâce à l'examen approfondi, j'ai systématiquement identifié les rôles et les tâches des pairs examinateurs dans les revues biomédicales et j'ai produit une liste complète tirée d'un large éventail de sources. Cette liste complète les travaux existants sur les éditeurs de revues et, bien qu'elle soit axée sur le domaine biomédical, les conclusions pourraient s'appliquer plus largement aux autres domaines scientifiques.

Les projets qualitatifs ont répondu à un besoin reconnu de longue date d'une recherche (plus) qualitative sur le processus d'examen par les pairs dans le domaine biomédical. Les entretiens ont permis aux éditeurs des revues de parler librement et longuement de leurs expériences personnelles. La plupart ont été francs et directs en partageant leurs propres pratiques (y compris celles potentiellement controversées) et en exprimant des points de vue critiques et sans tabou sur le fonctionnement du processus d'examen par les pairs dans leur revue et en général. Une autre force de la recherche qualitative utilisée pour cette thèse est la diversité des participants à l'étude en termes de caractéristiques des revues, comme le large éventail de domaines de spécialité et la taille des revues atteintes.

Enfin, je crois que l'échantillon de mon étude a reflété adéquatement "l'état" actuel des revues biomédicales. Par exemple, il existe un déséquilibre entre les sexes dans les revues biomédicales en ce qui concerne les postes de rédaction: les femmes occupent moins de postes au sein des comités de rédaction et la grande majorité des éditeurs sont des hommes. C'est également le cas pour les participants à mon étude. De plus, la plupart des éditeurs de revues biomédicales travaillent à temps partiel, comme l'ont fait 50 des 56 participants à mon étude. Enfin, la plupart des revues biomédicales ont encore un processus d'examen par les pairs à simple insu, ce qui était également le cas pour les revues incluses dans mon étude.

Limitations

En même temps, en menant mes recherches, j'ai rencontré plusieurs défis conceptuels et méthodologiques, ce qui a entraîné plusieurs limites qui méritent une discussion critique. Je vais d'abord exposer les limites liées à l'examen approfondi avant de passer aux limites de la composante qualitative de ma recherche.

Premièrement, malgré la recherche systématique effectuée dans de multiples bases de données, il est possible que certains aspects des rôles et des tâches des pairs examinateurs décrits dans la documentation aient été omis. La stratégie de recherche a été conçue pour être aussi vaste et inclusive que possible, et elle a donc donné lieu à un grand nombre de résultats non pertinents. Par exemple, le terme "l'examen par les pairs" est aussi couramment utilisé dans le domaine biomédical pour désigner l'évaluation continue de la pratique professionnelle du rendement clinique dans les hôpitaux. Il est également utilisé comme stratégie éducative dans le cadre de l'enseignement de toutes les professions liées à la santé. Ma recherche a donné lieu à un total de 23 176 dossiers et elle a inclus un nombre important d'études sur les sujets susmentionnés qui n'étaient pas pertinents à ma question de recherche. Pour des raisons pragmatiques, j'ai d'abord passé au crible ce vaste ensemble de dossiers afin d'exclure les études qui semblaient complètement non pertinentes, ce qui a donné lieu à 2 763 citations jugées appropriées pour un double filtrage. Il se peut que certains documents pertinents aient été omis lors du processus initial de filtrage.

Deuxièmement, étant donné le grand nombre de dèclarations sur les rôles et les tâches obtenus, il y avait inévitablement un certain nombre d'éléments redondants et chevauchants. Des efforts considérables ont été déployés pour préserver autant que possible la formulation utilisée par les auteurs et pour saisir toutes les nuances, mais une certaine rationalisation était nécessaire pour s'assurer que la liste finale des rôles et des tâches était à la fois gérable et utile. Il est possible que cela ait entraîné une mauvaise interprétation occasionnelle des énoncés prévus par les auteurs et la perte potentielle de différences subtiles entre les éléments.

Troisièmement, aucune restriction linguistique n'a été fixée pour les recherches dans la base de données. Les données ont été extraites d'articles rédigés en anglais, en allemand, en espagnol et en portugais. Cependant, la recherche dans la base de données peut ne pas avoir inclus certaines revues qui publient dans d'autres langues. En outre, pour des raisons de faisabilité, la recherche de littérature grise a été limitée à l'anglais et elle a donc potentiellement exclu les ressources pertinentes dans d'autres langues.

Enfin, dans le protocole a priori de l'examen approfondi, j'ai décrit les étapes à suivre pour effectuer un examen complet des lignes directrices des revues biomédicales. Cependant, au cours du travail, il est devenu évident que cette proposition était trop ambitieuse et elle méritait probablement son propre manuscrit. J'ai finalement jugé qu'il n'était pas possible de la mener à bien dans un délai raisonnable, en particulier à la lumière du grand nombre de dossiers qui devaient être examinés. Cet écart par rapport au protocole a été noté au manuscrit.

Les deuxième et troisième projets de recherche partagent la méthodologie de l'étude et donc aussi ses limites. L'approche de recrutement utilisée a donné lieu à plusieurs limites dans les deux études. L'échantillonnage à variation maximale intentionnelle a été utilisé pour obtenir la plus grande diversité possible dans les caractéristiques démographiques et les caractéristiques des revues des participants à l'étude. Les personnes interrogées ont été recrutées à partir de trois sources: 1) Réseau professionnel au sein du projet Méthodes de recherche sur la recherche; 2) Deux éditeurs (groupe d'édition du BioMed Central et du British Medical Journal) et 3) Participants au huitième Congrès international sur l'examen par les pairs et la publication scientifique identifiés à partir de la liste des participants. Cette méthode de recrutement a permis d'établir un premier contact prédominant avec les éditeurs. Bien qu'on ait demandé aux personnes interrogées de participer elles-mêmes ou de recommander des collègues de la revue qui pourraient être contactés à leur place, les deux tiers des participants ont fini par devenir éditeurs de leur revue respective, ce qui a donné lieu à une relative homogénéité de l'échantillon de l'étude en ce qui concerne la position des personnes interrogées au sein des comités de rédaction des revues. Cette représentation limitée des autres membres du personnel de rédaction qui participent habituellement au processus d'examen par les pairs peut limiter la généralisation des résultats.

Conclusion

Ma recherche a confirmé que les rôles et les tâches attendus des pairs examinateurs ne sont pas clairement définis et communiqués, ce qui affecte le contenu des rapports des pairs examinateurs. J'ai identifié un grand nombre de rôles et de tâches et j'ai mis en évidence des domaines problématiques liés à des descriptions vagues, des déclarations contradictoires et des domaines qui chevauchent les fonctions supposées des éditeurs de revues. Ma recherche a permis d'expliquer ces incongruités. J'ai également examiné plusieurs pratiques de communication qui pourraient avoir un impact négatif sur le processus d'examen par les pairs.

Ces résultats suggèrent fortement qu'il est nécessaire de définir des critères de qualité pour les rapports des pairs examinateurs et que les éditeurs des revues examinent de façon critique leurs pratiques de communication.

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Introduction

Historical overview of peer review

The origins of some forms of peer review for scholarly research articles can be traced back to the 17th century [1] or earlier [2]. The concept of peer reviewing in the medical field was first applied to articles in the *Medical Essays and Observations* journal published by the Royal Society of Edinburgh in 1731 [3]. However, from a historical perspective, the current, prevailing understanding of the practice of peer review in biomedical journals is a relatively recent phenomenon. As science underwent increasing professionalization during the 19th century, the evaluation of scientific output started to be outsourced to scientists outside of the scholarly societies previously entrusted with this task. This shift was characterized by increased research diversification and specialization of scientific disciplines, which in turn led to a need for consulting experts outside of individual scientists' immediate research circle [4]. In 1893, at a meeting of the American Medical Editors' Association in Milwaukee, the editor-in-chief of the British Medical Journal (BMJ) Ernest Hart outlined how the specialization of science affected medical journal editing and advocated for the practice of using external reviewers to help with the assessment of manuscripts [4]. However, this practice only became mainstream in the post-World War II decades, primarily due to even greater expansion of science and its commercialisation. During this time, there was a shift towards a more competitive academic culture. The publication of articles in journals that employed the peer review process - which was widely understood to be a process leading to objective judgement and consensus – became increasingly recognized as a seal of quality for scientific output and therefore became a desirable goal for scientists [5].

This system of using external experts or referees was widely implemented in the 1960s and 1970s. The journal *Nature* formally adopted the peer review system in 1973 [6]. Other biomedical journals followed suit, with *The Lancet* formally establishing the process still in place today in 1976. At the same time, taking a cue from the wording used by government bodies (who employed peer reviewers to aid selective distribution of research funds), there was a shift in terminology from the frequently used term "referee" to "peer review" [2]. The rapid post-war expansion of science and the need for scientists to publish their findings led to the proliferation of scientific journals and enabled commercial publishers to become part of the process. Concurrently, the demand for space to publish in such journals was greater than available supply, inevitably giving rise to the "publish or perish" culture which is still a

predominant feature of most scientific fields today [7]. As peer review already served to legitimize scientific research, commercial publishers implemented the peer review model as a way of legitimizing their own journals. Unsurprisingly, this business model – essentially based on highly skilled labour provided for free, combined with a high underlying demand – proved to be very lucrative. Commercial publishing companies thrived and eventually came to dominate scholarly publishing [8]. Many highly prestigious biomedical journals such as Nature, The Lancet and JAMA belong to commercial publishers. Arguably, through their wholesale adoption of the peer review process, such publishers have appropriated the production and impact of science by disseminating scholarly communication in the form of journal articles [9].

Thus, whilst the diffusion of current scientific knowledge in biomedicine (and most other disciplines) largely takes place through the publication of journal articles that are initially vetted by the peer review process, this in turn is embedded within a complicated merging of a hyper-competitive publishing industry with extremely competitive academic career progression.

Peer review and the publication process

While different types of peer review exist, the quintessential publication process in biomedical journals is a fairly standard one. Across biomedical journals, the peer review process as we know it today is editor-led and consists of several stages [10]. The process starts with a manuscript submission by the author to the journal. Upon receipt, the manuscript is scrutinized by journal editors for its suitability for the journal and its overall quality. This initial editorial review is meant to relieve some of the burden from peer reviewers by screening out manuscripts of low quality that are unlikely to pass peer review [11]. Thus, if the manuscript doesn't meet the journal criteria, the authors receive a rejection without peer review - commonly known as "desk rejection". In the biomedical field the average time taken for authors to be informed about a desk rejection is 10 days [12]. If, on the contrary, the manuscript is deemed of sufficient quality and interest, the next step in the editorial process is the identification of suitable peer reviewers. While there is no strict definition of what constitutes a 'peer' [13], the term broadly refers to someone who works in the same field, has expert knowledge in the subject presented in the manuscript and typically has published on the same topic [14].

Journal editors are increasingly reporting difficulties in securing an adequate number of peer reviewers. This is particularly the case for smaller, more specialized fields [15]. A survey of biomedical journals determined that peer reviewers most commonly turn down invitations to

review due to lack of time. Concurrently, the same study found that peer reviewers are more likely to accept the invitation to review a manuscript when it is relevant to their area of interest [16]. Therefore, at the point of recruitment, journal editors have to ensure that peer reviewers' expertise and interest overlap with the manuscript at hand. There is no mandated minimum number of peer reviewers per manuscript, however, research suggests that a higher number of peer reviewers (i.e. more than two per manuscript) can lead to better quality [17]. Some journals also allow authors to recommend potential peer reviewers. A study conducted on this practice suggests that the quality of reviewer reports where reviewers were not suggested by authors is similar to that of reports by reviewers suggested by authors, but the latter are significantly more likely to recommend acceptance of the manuscript [18]. Given the potential for manipulation of the peer review process, this practice has been discontinued by a number of biomedical journals [19].

The next stage of the process starts once peer reviewers accept the invitation. Journals set guidelines around what is an acceptable timeframe for reviewing a manuscript to which peer reviewers are expected to adhere. On average, it takes 8-9 weeks from submission for authors to obtain a response from the first review round by biomedical journals [12]. During this time, peer reviewers receive a link to the submission system that takes them to the manuscript. At this point there are substantial differences between journals in terms of the setup of their peer review systems. There are two types of peer review: closed and open. The former system reflects the way the peer review process was historically set up at the dawn of peer review, and is still the type most commonly used in biomedical journals [20,21]. Closed peer review can be either 'single-blind' or 'double-blind'. In single-blind peer review, the peer reviewers' identity is concealed from the authors while the identities (names and affiliations) of authors are known to the peer reviewers. In contrast, in the double-blind review system, both authors and peer reviewers are unaware of each other's' identities. Both types are set up in this way in recognition of and as a way to combat potential bias that is introduced through the display of identity [22]. In addition, some journals also implement a triple-blind system where neither the handling editor nor the peer reviewers know the identity of the authors, however this setup is rare [23]. On the other hand, 'open peer review' is an umbrella term for several similar ways whereby peer review models can be adapted to fall in line with the ethos of the Open Science movement [24]. A systematic review (2017) of the definitions of "open peer review" found that 'open identities' - where authors and reviewers are aware of each other's identity - is one of the seven main characteristics of open peer review [25].

When journal editors receive a sufficient number of reviewer reports of good quality, they can move on to the decision-making part of the process. Reviewer reports are essential to inform their decision regarding the fate of the manuscript, however they are not the only aides to decision-making: editorial decision-making consists of multiple dimensions [26]. While the science behind the research presented is of key importance, other non-scientific aspects such as perceived reader 'interest' are also taken into consideration to maximize strategic advantage for the journal [27]. Unless journal editors decide to reject the manuscript, it then proceeds to the next stage of the process. Journal editors forward reviewer reports with any comments or feedback to the authors. The World Association of Medical Editors (WAME) stipulates that journal editors should take an active involvement by guiding authors on which revisions are essential, and which are optional. They also should provide active guidance in the case of contradictory comments [28]. While there is no research on adherence to this practice, the findings from my study (Chapter 3) suggests that this is not consistently practiced by all journal editors.

In the next step, authors are expected to address all comments and return their replies with the updated manuscript (and within the stipulated time frame) to the journal editors who then re-review it and decide whether the replies and updated manuscript meet their expectations. The manuscript can undergo multiple rounds of review until it is either accepted for publication or rejected [12].

Challenges and flaws in peer review

Not long after peer review became standard practice across biomedical journals, its many flaws became increasingly evident. As a response the first conference specifically dedicated to peer review, namely the *International Congresses on Peer Review and Biomedical Publication* was organised in 1989 by journal editors at JAMA and the BMJ. While this led to formal acknowledgment of the issues and research on this topic, the flaws remained. In 2006 Richard Smith, a former journal editor of *The BMJ*, who edited the journal for more than a decade wrote a popular and widely cited editorial that stated the following about peer review: "*So we have little evidence on the effectiveness of peer review, but we have considerable evidence on its defects. In addition to being poor at detecting gross defects and almost useless for detecting fraud it is slow, expensive, profligate of academic time, highly subjective, something of a lottery, prone to bias, and easily abused.*" [13]. Despite continuous efforts to understand and improve peer review, most of the issues outlined in the quote are still relevant today. A brief summary of the most pertaining key issues is presented below.

Slow and expensive process

One of the key criticisms of peer review is that it is too slow. It has been argued that this is detrimental to research and wider society because publication delay inhibits the timely uptake of research findings [29]. Some research indicates that it has been getting slower over the last decades, mainly because the number of review rounds has increased [30,31]. In addition, delays are common and mostly related to the fact that peer reviewers tend to take more time than expected to write their report [29]. Another factor that contributes to the slow process is the manuscript processing-time of the journal. The majority of biomedical journal editors work part-time and often only receive a symbolic remuneration whilst juggling other professional roles. Thus, delays also occur due to inefficient editorial processes [29].

Peer review is not only slow but also expensive. Although peer reviewers predominantly review manuscripts for free, the time that they spend doing so is costly. It has been estimated that the total cost of peer reviewing equates to around £1.9 billion annually [32]. Other costs include authors' time spent amending and resubmitting their manuscripts, as well as costs for editorial management and article processing [33].

Bias and fraud

Numerous studies indicate the presence of biases that impact peer review. For example, it has been suggested that the academic publishing system is 'gendered', with the preponderance of men being both a reflection and a cause of women's underrepresentation and systemic disadvantage in science [34]. Women in the biomedical field receive less research funding than men, resulting in fewer publications as senior authors [35]. Since female authors are less visible than male authors, they are also less likely to be invited to peer review manuscripts [36]. For example, in 2011 only 14% of peer reviewers in Nature were women. Despite efforts been made by the journal to increase this proportion, in 2015 the percentage of female peer reviewers rose only slightly to 22% [37]. Women are also less likely to hold editorial board positions [38,39]. Studies have reported encountering examples of conscious and unconscious gender biases that further contribute to inequities in academic publishing [36,40].

In addition to gender bias, various other types of bias in peer review have been demonstrated. A literature review by Lee et al. [41] classified bias in peer review into two groups: 'Bias as a Function of Author Characteristics' and 'Bias as a Function of Reviewer Characteristics'. The former challenges the impartiality of peer review by demonstrating that reviewers fail to

evaluate the content of manuscripts independently of the characteristics of authors. This group include prestige bias, affiliation bias, gender bias, nationality bias, and language bias. The second group challenges the impartiality of peer review by demonstrating that peer reviewers fail to evaluate the content of manuscripts independently of their own characteristics. It includes content-based bias, confirmation bias, conservatism, bias against interdisciplinary research and publication bias.

A relatively recent effort to promote transparency of the article retraction process in scientific journals, championed among others by the influential blog *Retraction Watch*, showcased the reasons behind retractions [42]. Many retractions of scientific publications can ultimately be attributed to manipulation of the peer review process [43,44]. Publications are a key form of currency in academia not only because they are inherently linked with scholarly prestige and academic promotion; they are often also linked with monetary incentives such as salary increases [45]. This creates a potential incentive to commit fraud. Cases where authors have deceived journal editors by creating fake email addresses, recommending themselves as peer reviewers using these addresses, and then writing the reviewer reports themselves have emerged [46]. Investigations by publishers such as BioMed Central have additionally highlighted that this practice is not necessary an insular one practiced by a few deviant authors; there have been systematic attempts to cheat the system involving companies that offer 'publishing services' to authors [19].

Lack of definitions, standards and professionalization

Quality screening and improvement of manuscripts are key functions attributed to peer review, however the operational definitions of these functions are not clearly defined [13]. Peer review currently lacks any form of standardization and definitions of quality criteria around what constitutes excellence in peer review are lacking [47]. Although some attempts have been made to define quality of peer reviewer reports [48], thus far there has been no consensus or uptake of these criteria, most likely due to a dearth of entities with a mandate to prescribe and enforce them [23].

Concurrently, there is a lack of professionalization of peer review in biomedical journals. Professionalization is a process whereby occupations seek to become publicly recognized as professions. This presupposes the establishment of recognised professional organisations that set out formally established criteria that outline skills, norms and values associated with becoming a member of a professional group, and awards accreditation [49]. This

professionalization aspect is also completely absent for journal editors of biomedical journals. While efforts have been made to create a set of core competencies for biomedical journal editors [50], their uptake and rate of implementation is unknown, probably because there are no professional organisations for biomedical journal editors that could implement them. Related associations such as The Committee of Publication Ethics (COPE) and The World Association of Medical Editors (WAME), have no authority to enforce any standards. Most commonly, journal editors are appointed to their position based on their contribution to a specific field as authors, and their editorial training mainly happens on the job. Evidence suggests that any preparation received is often insufficient [51]. Similarly, peer reviewers also operate without any training or certification. Despite increased recognition and calls for training for peer reviewers [52] as well as a few scattered training courses, thus far there are no mandatory criteria that peer reviewers need to adhere to in order to conduct a peer review. The vast majority of peer reviewers performs reviews on a voluntary and unpaid basis.

Research and interventions in peer review

Research on the peer review process kicked off with the first *International Congresses on Peer Review and Biomedical Publication,* organised in 1989 by journal editors at JAMA and the BMJ. Since then, the conference has taken place every four years and is closely linked to a peak in peer review research observed in the period immediately before the conference [53]. While the number of publications on the topic of peer review has doubled since 2005, a substantial proportion of the literature consists of non-research publications (i.e. editorials, book chapters or letters) and small-scale research projects [53].

Over the years, a number of interventions have been set up in an attempt to improve the quality of peer review. Several systematic reviews have identified different kinds of interventions including educational training, use of checklists and reporting guidelines, addition of specific experts (i.e. statistical peer reviewers), introduction of open or blinded peer review, and interventions to increase the speed of the peer-review process. However, due to concerns about the methodological quality of these interventions robust evidence on the kind of interventions that might work is still lacking [54–56].

Thus far, key sources of data for research on peer review, namely peer reviewer reports themselves, have been practically unavailable in the biomedical field. Although meta-data

analysis using journal peer review data has been proposed as a way to improve the peer review process and help to promote scientific integrity and quality, to date these data still retain a 'hidden' status [57,58]. It has been estimated that fewer than 3% of scientific journals allow peer review reports to be published and therefore potentially analysed [20]. Given the limited opportunities to examine these kind of data, few studies in the biomedical field have systematically analysed the content of peer reviewer reports [18,59–61].

Rationale for the thesis

Peer review has been continuously debated and criticised since its emergence as an inherent part of biomedical publishing, yet to date it remains a key mechanism for the evaluation of manuscripts and is likely to remain so for the foreseeable future. Therefore, given that published research that has undergone peer review may significantly impact clinical practice and health policies, it is important to keep exploring how it can be improved. The consequences of not doing so can be dramatic: the infamous flawed study by Wakefield et al. that slipped through the peer review process at *The Lancet* - a world-renowned and influential journal in the biomedical field - aggravated vaccine hesitancy worldwide and had a profound, broad impact on public trust in science [62]. The function of the peer review process goes beyond mere quality control for scientific manuscripts. In the broader sense, it is meant to be a mechanism for self-regulation and quality assurance in science [63]. Peer review grants published studies a seal of approval and legitimizes the underlying science as a trustworthy reference point for society in general. It is therefore vital to maintain high standards in peer review to both maintain public trust in science and continue the promotion of evidence-based (clinical) practice. This is particularly important at a time of rapid, high-volume generation of knowledge and information in tandem with an observed surge of 'fake news' and denial of scientific evidence. At the same time, peer review is not perfect. In essence, it is based on human interaction between key stakeholders, thereby introducing 'human behaviour' into equation [26]. As such, it is important to investigate it from this perspective, so as to shed light on determining factors around the interaction of authors, peer reviewers and editors.

My interest in this topic stems from the fact that, despite growing recognition and awareness, there has been very little research conducted on the content and communication in biomedical journals that may be contributing to the problems in peer review. When I started this research in October 2016, to the best of my knowledge only one published study had explored the social and subjective dimensions of manuscript review in biomedical publishing [26]. At the same time, I had come across a study by Galipeau et al. that presented a first attempt to systematically identify core competencies of scientific editors of biomedical journals [64]. I found it both intriguing and worrisome that decades after the establishment of editor-led journals it was only in 2016 that studies had been published recognising the need to establish the position of a journal editor as a "profession" by outlining their roles and responsibilities, and reaching consensus on these [50]. However, while some progress had been made with regards to journal editors, there was no agreement on what constitutes quality in peer review [48] and no agreement on what roles and tasks peer reviewers are expected to perform. This presents a

major challenge. The lack of agreement on the roles and tasks of peer reviewers and therefore the expected content of peer reviewer reports is an impediment to the development of quality criteria of peer review. It may also result in misunderstandings that in turn may hamper the collaboration between stakeholders in the peer review process with an impact on reviewer report quality.

The peer review process in biomedical journals involves collaboration between authors, journal editors and peer reviewers that aims to achieve the dissemination of high-quality research. For any successful collaboration, the most basic underlying premise is that stakeholders are aware of their own and each other's roles and tasks, and of the competencies needed to effectively perform these. Science is now an international endeavour; researchers from all over the world submit their work to journals, therefore everyone needs to be on the same page to make peer review work effectively. Furthermore, effective communication practices are key to ensure that the process works smoothly. Although good communication practices between these actors are vital, evidence suggests that there are numerous flaws within the peer review process, with communication failures lying at the heart of the problem. For example, existing research suggests that an essential aspect of collaboration – the mutual understanding of stakeholders' professional roles and tasks within the process – is not appropriately communicated. This is manifested in part through the inconsistent provision of journal guidelines for peer reviewers across biomedical journals [65]. Ineffective communication practices are also manifested through the lack of transparency and considerable variation observed in the content of peer reviewers' grading forms (used to evaluate original manuscripts) [66]. A study that aimed to identify tasks that journal editors expect from peer reviewers of a randomised controlled trial found a substantial disconnect between the expectations of journal editors and peer reviewers [67]. This can have negative impact on the quality of peer reviewer reports, as expectations on both sides remain unmet. Such situations can be considered to be wasteful of resources, straining an already over-burdened system [68]. Yet another study highlighted the importance of effective communication between the key stakeholders before and during peer review to prevent delays and the frustration that goes with it [29]. There are likely to be communication issues that go beyond mere miscommunication and misunderstanding of stakeholders' professional roles and tasks. For example, peer reviewers would like to receive feedback from journal editors about their reports and view other peer reviewers' comments. However, these are rarely provided. Such unmet expectations caused by a lack of communication might influence the willingness and motivation of peer reviewers to participate in the process [69].

Despite the critical need for in-depth research and evidence suggesting that there is miscommunication between the actors involved in peer review [67], thus far the problem has not been empirically analysed, and underlying factors have not been sufficiently assessed. Through this dissertation I aim to address this research gap, generating relevant data that provides clarity on content and communication practices within the peer review process in biomedical journals and highlighting areas for future research.

Aims and objectives

The overall aim of this thesis is to explore existing communication practices within, the peer review process in biomedical journals.

The specific objectives of my research are to:

1. Determine the roles and tasks of peer reviewers in biomedical journals. This was achieved through a scoping review of the literature (Paper 1).
2. Gain insight into journal editors' understanding of the roles and tasks of peer reviewers. A qualitative approach with semi-structured interviews was adopted (Paper 2).
3. Explore journal editors' experience of the communication process in their journals. This was undertaken using a qualitative approach with semi-structured interviews (Paper 3).

The research findings are brought together in the discussion to make recommendations for future research.

Scientific contribution of compiled publications

Currently, the relatively new field of 'meta-research' – that is, the study of research itself [70] – lacks a theoretical framework to guide the development of interventions in biomedicine. Such frameworks systematically consider contextual and individual factors that may influence delivery of interventions; they may also offer additional insight in certain situations and regarding particular behaviours, and can be used to forecast different scenarios. My research provides important observational groundwork for the development of a theoretical model or framework that will guide future interventions to improve the peer review process in the biomedical sphere. In particular, empirical knowledge of contextually relevant factors

generated by this research (such as how journal editors operate within their journal, their expectations and how they communicate with authors and peer reviewers) is likely to be critical to the design and evaluation of successful, practical interventions aiming to improve the peer-review system of biomedical journals.

In addition, this body of knowledge has practical implications for the reduction of wasteful research in biomedicine [71]. The improvement of the peer review system can ultimately help to weed out poorly conducted studies and improve the overall quality of biomedical research. The definition of roles and tasks of stakeholders within the peer review process as outlined through this study should be useful for practitioners seeking to understand the process as a whole, and highlights what needs to be done to improve peer review.

Structure of the thesis

This thesis is presented in the form of a 'publication based' style, where results are shown in the form of research papers that have already been published (Paper 1 and Paper 2) and one paper that is currently under review (Paper 3). In order to present a coherent overall narrative each paper is included after an introductory section - 'preamble' that outlines how it relates to the respective objective of the thesis by outlining study rationale, methodology, and the results which are outlined briefly to avoid overlap with the previously published study protocols [72,73] (Appendix 1 and 2) and the manuscripts themselves [74,75]. Study findings are addressed in the Discussion section which includes a summary of the key results, implication, strengths and limitations and a perspective of future research.

Chapter 1: A scoping review on the roles and tasks of peer reviewers in the manuscript review process in biomedical journals

Before I started this research, there was no body of literature systematically identifying the roles and tasks of peer reviewers in biomedical journals, nor any agreement on what these should be. A scoping review by Galipeau et al. represented a first attempt to systematically identify and determine what was known on the core competency requirements for scientific editors of biomedical journals [64]. This scoping review produced a comprehensive list, derived from a wide range of sources. I sought to complement this work by systematically identifying the roles and tasks of peer reviewers. Galipeau et al. framed their research around core competencies defined as: *"…the essential knowledge, skills, and behaviours necessary for the practice of scientific editing of biomedical journals*"[64]. However, peer reviewers, in contrast to journal editors, are not in formal employment and do not have an appointed position where such framing is more relevant. Therefore, I decided instead to frame my research around 'roles and tasks'. For the purpose of my research, I considered 'roles' to refer to the overarching nature of peer reviewers' function whereas 'tasks' refer more specifically to actions that fulfil these roles. For example, while the role of a peer reviewer is to be a "Proficient expert in the respective field", one of the specific tasks performed to fulfil this role is to provide a critical assessment of the proposed methodology and other sections of a manuscript.

I also used Galipeau et al.'s methodological approach to guide my own research. For example, my decision to conduct a scoping review was partly informed by the authors' experience of finding descriptions of journal editor competencies in editorial-type publications. This is also true for information on the roles and tasks of peer reviewers, which is often found in the form of commentaries and editorials. While this kind of source would generally not meet the inclusion criteria of a systematic review, scoping reviews have the benefit of including a greater range of study designs and methodologies, as well as grey literature. In addition, I considered a scoping review to be the most suitable approach to answer my research question based on its primary purpose as defined by Colquhoun et al.: "*A scoping review is a form of knowledge synthesis that addresses an exploratory research question aimed at mapping key concepts, types of evidence, and gaps in research related to a defined area or field by systematically searching, selecting, and synthesizing existing knowledge*." [76] as well as other broader definitions provided in seminal publications on scoping review methodology [77–79]. My research

question was of an exploratory nature, rather than hypothesis-driven, and aimed to clarify key concepts while capturing the extent, range and nature of available literature, that I expected to be heterogeneous.

Method

In this scoping review, I undertook secondary data collection and analysis of publicly available data, therefore no ethical approval was required. I used the methodological framework proposed by Arksey and O'Malley [77] as well as the amendments made to this framework by Levac et al. [80] and by the Joanna Briggs Institute [81].

The framework consists of the following six consecutive stages: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, (5) collating, summarising and reporting results, and (6) consultation. A short description of each stage as applied to this research follows in **Table 1**.

Table 1. Consecutive stages in the methodological framework by Arksey and O'Malley

Stages	Description
1. Identifying the research question	During this first stage, Arksey and O'Malley recommend that an iterative process is adopted to develop research questions. Two research questions were identified based on gaps in the literature: 1. What are the expected roles of peer reviewers in the editorial peer review process in biomedical journals? 2. What tasks are peer reviewers are expected to perform for biomedical journals? 'Roles' and 'tasks' were also clearly defined at this stage.
2. Identifying relevant studies	A comprehensive search strategy was developed in order to identify relevant literature, underpinned by key inclusion and exclusion criteria. These were in turn based on the 'Population – Concept – Context (PCC)' framework recommended by the Joanna Briggs Institute for scoping reviews, which has roots in the PICO (population, intervention, comparator and outcome) framework commonly used to focus clinical questions and develop systematic literature search strategies.
3. Study selection	Identified records (titles and abstracts) were collated and deduplicated. Initial independent screening of titles and abstracts by two reviewers to determine each article's eligibility for full-text screening (based on *a priori* inclusion criteria) was followed by retrieval and independent screening of the full text of all potentially eligible articles. Reasons for exclusion were recorded at the full-text review stage.
4. Charting the data	Data were extracted independently, and any disagreement resolved by consensus. A charting form was developed to aid the collection and sorting of key pieces of information from the selected articles. Pilot testing of the form led to some refinement. Detailed information on each eligible study was collected, including general and specific descriptions of expectations and competencies of peer reviewers, variations according to journals and their peer review models, and whether peer reviewers should provide specific recommendations. Additional categories that emerged during data extraction were also added.
5. Collating, summarising and reporting results	All expectations and competency-related statements retrieved from all sources were combined in order to create a useful summary of the data, producing a list of unique statements on the roles and tasks of peer reviewers. These were subsequently organised iteratively into categories.
6. Consultation	This final stage refers to consultation with stakeholders in the field of peer review to inform and validate findings from the scoping review. Journal editors were consulted through qualitative interviews to explore their views and perspectives on the roles and tasks of peer reviewers.

The Peer Review of Electronic Search Strategies (PRESS) 2015 Guideline statement was used to guide the electronic literature search strategies [82]. These were further refined in collaboration with a Health Sciences Librarian at the University of Split. I conducted comprehensive literature searches in Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, EMBASE, MEDLINE (**Table 2**), PsycINFO, Scopus and Web of Science from inception up to May 2017. I did not apply any date, language and study design restrictions in order to be as comprehensive as possible. Only biomedical journals were searched to ensure feasibility of the study, and journals from the disciplines of psychology, education, physical or natural sciences were deemed ineligible. Concurrently, a preceding scoping review of competencies for scientific editors of biomedical journals [83], led us to expect that a substantial proportion of relevant statements would be identified in non-research-based publications such as book chapters, commentaries and editorials, as well as grey literature. Therefore, any study of any design that referred to the roles and tasks of peer reviewers in biomedical journals was eligible for inclusion. Websites belonging to JAMA, Nature and Science were hand searched using key words related to peer review to identify any additional literature that was not detected by the search strategy. I also searched for grey literature on websites of existing networks related to peer review (e.g. EQUATOR Network, New Frontiers of Peer Review (PEERE)), biomedical journal publishers (e.g. BMJ Publishing Group, Elsevier, Springer Nature, Taylor & Frances, Wiley), and organizations that offer educational resources or courses aimed at peer reviewers (e.g. Cochrane and Publons). Relevant blogs, newsletters (e.g. The METRICS Research Digest), surveys and reports of authors/reviewer workshops, as well as abstracts published as part of various International Congresses on Peer Review and Scientific Publication, were hand-searched [84,85]. However, articles referring solely to other types of peer review (e.g. grant peer review, professional performance review, and peer review of teaching) were not considered.

Table 2. Search strategy for MEDLINE

1	((reviewing or reviewer or peer reviewer or peer-revie* or peer review) adj5 (abilit* or aptitud* or capabilit* or capacit* or character* or competen* or criteri* or educat* or effectiv* or evaluat* or expertise or integrit* or knowledg* or learning or proficien* or qualifi* or qualify or recommend* or responsibilit* or role or roles or skill or skills or standard or standards or talent* or task or tasks or training)).tw.
2	exp *peer review, research/
3	professional competence/
4	responsibility/
5	3 or 4
6	2 and 5
7	1 or 6
8	**4821** [MEDLINE UNIQUE HITS]

After de-duplicating identified records (titles and abstracts), these were imported into an online systematic review manager (Covidence™) that facilitates independent screening by multiple reviewers. This first level of screening, as well as subsequent full-text screening, was performed independently with another researcher and co-author of the manuscript. Disagreements between reviewers regarding eligibility were resolved by consensus.

A data extraction form was developed *a priori* on Microsoft Excel. General study characteristics extracted were: first author name, year of publication, country of first author, language of publication, and study design. For grey literature we also extracted the URL, title of the document, language of publication, and who produced the document. In addition, for all documents, we collected descriptions of any statements potentially relating to the roles and tasks of peer reviewers. I carried out data extraction together with another reviewer. In the first step, I extracted all relevant statements (full sentences) related to roles from all data sources into the data extraction form. Subsequently, the other reviewer compared the full-text of each eligible document with the extracted data on Microsoft Excel to ensure that all relevant information had been included.

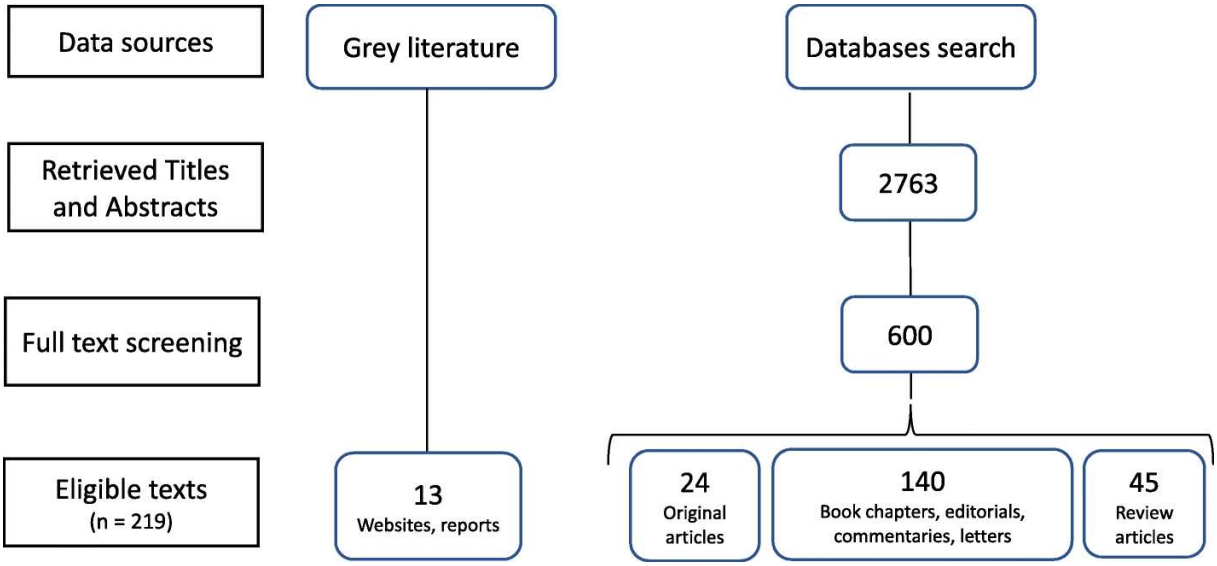
Subsequently, each sentence was coded into smaller text units that were semantically as close as possible to the original, full sentence. Overlapping or duplicate text units were merged, resulting in a list of unique statements for roles that was developed iteratively. Finally, we grouped these statements into emergent overarching themes to provide a better overview of

results. All relevant statements (full sentences) related to tasks from all data sources were also extracted and mapped using pre-defined categories adapted from work carried out by Hirst and Altman [86]. In order to produce a meaningful list, we only included tasks that would apply to all types of studies. Tasks that are not common to all types of studies (e.g. those related specifically to RCTs and systematic reviews), were not extracted.

Results

I used the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist to report on results [87]. After screening 2763 records by title and abstract (stage 1 screening) and 600 full-text papers (stage 2 screening), 209 publications met the inclusion criteria. There were 24 original research articles, 45 review articles, and 140 book chapters, editorials, commentaries, letters and tutorials. We also included 13 grey literature sources (**Figure 1**).

Figure 1. Study flow diagram for the scoping review



A total of 1426 statements related to roles were extracted, resulting in 76 unique statements that were grouped into 13 emergent themes (**Table 3**). These revolved around the peer reviewers being: Proficient experts in their field (3 items), Dutiful/altruistic towards scientific community (7 items), Familiar with journal (2 items), Unbiased and ethical professionals (18 items), Self-critical professionals (4 items), Reliable professionals (7 items), Skilled critics (15 items), Respectful communicators (6 items), Gatekeepers (2 items), Educators (2 items), Advocates for author/editor/reader (3 items) and Advisors to editors (2 items). Roles that do not fall within the remit of peer reviewers were also identified (5 items). The 'Skilled critics' and 'Unbiased and ethical professionals' themes appeared most frequently.

Furthermore, a total of 2026 statements related to peer reviewers' tasks were extracted, resulting in 73 unique statements (**Table 4**). These were grouped under six themes: Organisation and approach to reviewing (10 items), Make general comments (10 items), Assess and address content for each section of the manuscript (36 items), Address ethical aspects (5 items), Assess manuscript presentation (8 items) and Provide recommendations (4 items). The themes 'Assess and address content for each section of the manuscript' had the highest number of statements while the theme related to ethical aspects had the lowest number.

Table 3. Role-related statements

Peer reviewers should be…	**Item [a]**		**#[b]**
Proficient experts in their field	1	Be expert in the subject area/matter/field and/or be familiar with/trained in research methods and statistics	70
	2	Be actively involved in research, have experience of conducting research and publishing scientific papers	15
	3	Be familiar with reporting guidelines	5
Dutiful/altruistic towards scientific community	4	Consider peer reviewing to be a responsibility, duty and obligation to the field and to the scientific community	26
	5	Consider the act of peer reviewing as an honour and privilege	8
	6	Indicate willingness to re-review the manuscript	7
	7	Be aware of one's role, responsibilities and rights as a peer reviewer	4
	8	Perform reviewing task altruistically/gratis	2
	9	End one's appointment as reviewer to create opportunity for others	1
	10	Act regularly as peer reviewer	1

Familiar with journal	11	Be familiar with journal's mission, review process, review criteria, guidelines (i.e. both author and reviewer guidelines) and forms prior to starting the review	39
	12	Guide the substance and direction of a journal	1
Unbiased and ethical professionals	13	Declare/avoid potential or actual conflict of interest	66
	14	Maintain confidentiality of the manuscript, avoiding disclosure/discussion with others	52
	15	Be fair; evaluate manuscript in a fair manner	39
	16	Be objective; objectively judge all aspects of the manuscript	36
	17	Be unbiased in their assessment. Peer reviewers should have an unbiased attitude towards an author's gender, previous work, institution and nationality	32
	18	Review ethically: they should not use the obtained information in any way	17
	19	Be honest/frank	13
	20	Maintain integrity of the peer review process and not communicate with authors during the review process	12
	21	Inform editor if a colleague will help or has helped with review	11
	22	Review ethically: they should not copy and plagiarize	6
	23	Be aware of their own biases. Peer reviewers should recognize their potential biases and hold them in check	6
	24	Upon completing the review manuscript, illustrations, and tables should be destroyed	5
	25	Review ethically. In general terms peer reviewers are expected to undertake task in an ethical and diligent manner	4
	26	Be familiar with fundamental issues of publication integrity	4
	27	Decline review request if these cannot be performed in an unbiased manner	4
	28	Review ethically: they should not ask for their own articles to be cited	4
	29	Review ethically: they should not delay publications purposefully	4
	30	Be transparent and perform review in a transparent manner	2
Self-critical professionals	31	Prior to accepting review request, determine whether the manuscript is within one's area of expertise (only review manuscripts in one's own field of expertise)	35
	32	Be aware of own limitations; recognize and communicate them to the editors. If needed, recommend review by an expert (e.g. statistician)	22
	33	Be innovative and open to new ideas	13
	34	Peer reviewers should consider reviewing as a learning exercise and evaluate one's own performance as a reviewer i.e. read other peer reviewers' reviews and thereby improve their own understanding of the topic and/or decision reached	8

Reliable professionals	35	Timeliness – Meet journal deadline	81
	36	Consider one's time availability prior to accepting review request	36
	37	Be willing to devote sufficient time and attention to the review task	23
	38	Respond to review requests in a timely manner	21
	39	Inform the editor as soon as possible if proposed deadline to be exceeded	12
	40	Immediately communicate to journal when cannot perform review	9
	41	Suggest other reviewers if unable to review	7
Skilled critics	42	Provide constructive criticism	87
	43	Improve manuscript	84
	44	Be thorough/comprehensive/detailed/accurate	35
	45	Be critical/sceptical; evaluate a manuscript in a critical manner	27
	46	Be specific; provide authors with specific guidance on how to improve their manuscript	26
	47	Support comments with evidence. Reviewers should document their comments and substantiate their points by referring to appropriate references and resources	20
	48	Be clear; clearly explain concerns	14
	49	Provide relevant comments. Offer meaningful and reasonable comments that can be addressed.	12
	50	Be consistent with comments to authors and editors. Comments provided to the authors should be in line with confidential comments provided to editor in order to facilitate editors' decision making, ensure consistency and avoid miscommunication.	11
	51	Be systematic and methodological	11
	52	Be balanced; provide a balanced critique	9
	53	Be logical; provide logical arguments	5
	54	Be concise/incisive	5
	55	Evaluate manuscripts in a consistent manner	4
	56	Have intuitive capacity to detect faults and recognize quality	2
Respectful communicators	57	Be polite/courteous/respectful in the communication with authors	41
	58	'Do unto others as you would have them do unto you'. Treat others as we expect to be treated	22
	59	Be positive. Peer reviews should be written in a positive attitude and offer praise for work well done	13
	60	Be nice/kind/considerate	12
	61	Be helpful; provide helpful comments	12

	62	Be collegial; treat each manuscript as if it had been written by a valued colleague	8
Gatekeepers	63	Maintain and improve manuscript quality and scientific rigor	15
	64	Weed out unsuitable manuscripts that are not scientifically valid	11
Educators	65	Educate and mentor authors; provide a learning opportunity	15
	66	Encourage authors. Peer reviewers should encourage authors to improve manuscript	11
Advocates for author/editor/reader	67	Be an advocate for the editor	6
	68	Be an advocate for the author	6
	69	Be an advocate to readers	2
Advisors to editors	70	Advise editors on the merits of manuscripts	40
	71	Provide confidential comments to editor	32
Peer reviewers should not…	72	Be decision makers. They should acknowledge that the final decision on the publication of a manuscript rests with the editor	22
	73	Be copy editors (i.e. offer editorial comments about grammar and spelling)	21
	74	Ask for unreasonable or pivotal change	11
	75	Be overtly critical or too detailed. Peer reviewers be generous and shouldn't 'nit-pick' or overwhelm the authors	9
	76	Add additional requests in subsequent reviews that are not related to the original revisions	2

[a] The statements are ranked by numerical frequency.

[b] Number of extracted role statements across all data sources in the scoping review

Table 4. Task-related statements

Theme	Item[a]	Tasks…	#[b]
Organization and approach to review	1	Identify strengths and weaknesses	31
	2	Identify flaws	29
	3	Provide summary of key points	29
	4	Differentiate between major and minor comments	17
	5	Follows reviewer guidelines provided by the journal	11
	6	Differentiate between fatal vs. addressable flaws	10
	7	Address all aspects of the manuscript	9
	8	Differentiate between general and specific comments	6
	9	Identify missing information	5

	10	Number each statement chronologically	5
Make general comments	11	Determine validity / quality / technical merit / rigor	69
	12	Assess originality	55
	13	Assess novelty	54
	14	Assess importance / significance	48
	15	Comment upon relevance to practice /science (clinical relevance)	45
	16	Comment upon contribution to the field	42
	17	Highlight whether current literature is covered	35
	18	Determine timeliness of the manuscript – is it topical?	16
	19	Determine whether reporting guidelines were followed (i.e. appropriate selection and adherence by authors)	5
	20	Comment upon conceptual / theoretical framework	4
Assess and address content for each section of the manuscript	Title		
	21	Title is accurate	28
	Abstract		
	22	Accurate / conclusions consistent with results	26
	23	Sufficiently detailed	23
	24	Adequacy of abstract (in general)	18
	25	Use of salient keywords	7
	Introduction		
	26	Clarity of study purpose and hypothesis	50
	27	Adequacy of introduction (in general)	37
	28	Appropriateness and adequacy of the literature review	22
	29	Relevance of problem	19
	Methods		
	30	Adequacy of methods (in general)	65
	31	Study design	56
	32	Data analysis (methods and tests)	42
	33	Use of statistics	42
	34	Sampling strategy	34
	35	Clarity and validity of statistical methods	33
	36	How data was collected / reproducibility of methods	33
	37	Methods appropriate for the research question	29

	38	Risk of bias	25
	39	Definition and measurement of variables	22
	40	Inclusion / exclusion criteria	15
	41	Follow up	12
	42	Assess different analysis parts separately	11
	43	Reliable and appropriate tools used	11
	44	Power analysis	10
	Results		
	45	Clarity of tables and figures	54
	46	Adequacy of results (general)	46
	47	Neutral and logical presentation of results	25
	48	No interpretation of results	12
	49	Accuracy of raw data / appendices	8
	Discussion / Conclusion		
	50	Interpretation supported by data	92
	51	Adequacy of discussion (general)	53
	52	Study limitations addressed	22
	53	Research and policy implications (suggestions for future studies)	17
	54	Summary reflects contents of the article	13
	55	Generalizability of study conclusions	5
	References		
	56	Appropriateness and accuracy of references	52
Address ethical aspects	57	Consider general ethical aspects and report on any specific ethical concerns (including manipulation of data, plagiarism, duplicate publication, inappropriate treatment of animal or human subjects)	55
	58	Report on ethical approval	11
	59	Check specifically for plagiarism / fraud	4
	60	Highlight competing interests of authors	4
	61	No need to detect fraud	2
Assess manuscript presentation	62	Overall readability	41
	63	Presentation (general)	40
	64	Coherence / clarity and logical flow of the text	37

	65	Grammar and spelling	30
	66	Organization of the manuscript	25
	67	Use of language	21
	68	Length of the manuscript	12
	69	Check adherence to authors' guidelines (i.e. journal guidelines for authors)	9
Provide recommendations	70	Recommendations on publication (e.g., no / minor / major revisions, reject)	74
	71	Comment on interest to journal readership / relevance for journal scope	52
	72	Complete (numerical) rating / checklist	26
	73	Recommend another more suitable journal	2

[a] The statements are ranked by numerical frequency.

[b] Number of extracted tasks statements across all data sources in the scoping review

As evident from the above results, the key finding from this scoping review is that peer reviewers of biomedical journals are expected to perform a large number of roles and tasks, some of which are vague, contradictory and overlap with the roles and tasks of journal editors. Four areas of concern were identified around the roles and tasks of peer reviewers. For example, one particularly vague role was for peer reviewers to be 'advocates'; this appeared several times in the included literature. Peer reviewers are variously expected to be advocates for authors, editors and/or readers. The term 'advocates' needs to be unpacked and clarified in order for peer reviewers to understand what is expected from them. A clear example of a contradiction was observed in the often unclear link between peer reviewers' recommendations and editorial decision-making—where the former typically informs the latter. One of the roles identified was for peer reviewers to keep in mind that they are not decision-makers regarding the ultimate fate of the manuscript. At the same time, a key reviewer task emerging from this scoping review relates to the provision of a recommendation regarding the manuscript (decision-making: reject, accept, etc.) which contrasts and overlaps with the role of the journal editor as the sole decision-maker on the fate of the manuscript.

There were also a number of contradictions related to peer reviewers' tasks. For example, there was discrepancy as to whether detection of misconduct and fraud should fall within the remit of the peer reviewers and whether copy editing – offering grammatical and linguistic improvements – should fall under the remit of peer reviewers. There were variations in the level of detail provided, and certain tasks were vaguely described.

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A scoping review on the roles and tasks of peer reviewers in the manuscript review process in biomedical journals

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Abstract

Background: Although peer reviewers play a key role in the manuscript review process, their roles and tasks are poorly defined. Clarity around this issue is important as it may influence the quality of peer reviewer reports. This scoping review explored the roles and tasks of peer reviewers of biomedical journals.

Methods: Comprehensive literature searches were conducted in Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, EMBASE, MEDLINE, PsycINFO, Scopus and Web of Science from inception up to May 2017. There were no date and language restrictions. We also searched for grey literature. Studies with statements mentioning roles, tasks and competencies pertaining to the role of peer reviewers in biomedical journals were eligible for inclusion. Two reviewers independently performed study screening and selection. Relevant statements were extracted, collated and classified into themes.

Results: After screening 2763 citations and 600 full-text papers, 209 articles and 13 grey literature sources were included. A total of 1426 statements related to roles were extracted, resulting in 76 unique statements. These were grouped into 13 emergent themes: proficient experts in their field (3 items), dutiful/altruistic towards scientific community (7 items), familiar with journal (2 items), unbiased and ethical professionals (18 items), self-critical professionals (4 items), reliable professionals (7 items), skilled critics (15 items), respectful communicators (6 items), gatekeepers (2 items), educators (2 items), advocates for author/editor/reader (3 items) and advisors to editors (2 items). Roles that do not fall within the remit of peer reviewers were also identified (5 items).
We also extracted 2026 statements related to peer reviewers' tasks, resulting in 73 unique statements. These were grouped under six themes: organisation and approach to reviewing (10 items), make general comments (10 items), assess and address content for each section of the manuscript (36 items), address ethical aspects (5 items), assess manuscript presentation (8 items) and provide recommendations (4 items).

Conclusions: Peer reviewers are expected to perform a large number of roles and tasks for biomedical journals. These warrant further discussion and clarification in order not to overburden these key actors.

Keywords: Biomedical, Roles, Tasks, Competencies, Journal, Peer reviewer, Scoping review

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Background

Evidence indicates that there is a need to improve the quality of peer reviewer reports in biomedical journals [1, 2]. Published biomedical papers may have a direct impact on clinical practice and inform policy. Therefore, it is crucial that peer reviewer reports, a screen before the diffusion of new knowledge, are of the highest quality possible to inform editors' decision on the fate of the manuscript [3, 4].

Unlike other professional groups, many editors and peer reviewers of biomedical journals operate largely without formal training. It is assumed that having expertise as an author provides, by default, the skills necessary to be a scientific editor and/or peer reviewer. However, this assumption is problematic, potentially having a number of negative implications for the overall quality of biomedical publishing [5].

Alongside the lack of standardised training, the lack of a clear, accepted definition of the roles and tasks of peer reviewers has also been highlighted [6]. A systematic review evaluated the impact of interventions aimed at improving the quality of peer review of randomised controlled trials (RCTs) for biomedical publications. The authors concluded that clarification of the roles and tasks of peer reviewers would be a step forward in quality improvement of peer reviewing [2]. In fact, a recent study showed that the most important tasks in peer review, as perceived by peer reviewers evaluating RCTs, were not congruent with the tasks most often requested by journal editors in their guidelines to reviewers [6].

Organisations such as the Council of Science Editors provide a general overview of reviewer roles and responsibilities [7]. However, within the biomedical field, the roles and tasks of peer reviewers are often closely related to the structural characteristics of the editorial process itself. For example, some (but not all) journals require peer reviewers to assess novelty and/or clinical relevance of articles in addition to assessing scientific rigour. Journal expectations of how a reviewer report should be written may vary. Some journals encourage reviewers to follow a specific structure in their reporting, whereas other journals prefer free text. Additionally, there may be differences between journals' requests for peer reviewer recommendations regarding whether an article should be accepted for publication or not. Furthermore, differences in roles and tasks between journals may also be linked to the organisational set-up and resources of the journals and publishers. Given these differences, we believe that it is important to distil the core roles and tasks to enable peer reviewers to meet basic, global standards. In order to do this, we first need to compile a comprehensive list of the different roles and tasks described in the literature.

While core competencies for biomedical journal editors have already been systematically identified [8] and agreed upon [9], we are unaware of any body of literature looking into peer reviewers' roles and tasks.

The aim of this scoping review is to determine the roles and tasks of peer reviewers as depicted in biomedical literature. For the purposes of this research, we consider 'roles' to refer to the overarching nature of peer reviewers' function, whereas 'tasks' refer more specifically to actions that fulfil these roles.

Our specific objectives were to answer the following two research questions while summarising the existing literature:

1. What are the expected roles of peer reviewers in the editorial peer review process in biomedical journals?
2. What are the range of tasks that peer reviewers are expected to perform for biomedical journals?

Methods

This scoping review was guided by the methodological framework proposed by Arksey and O'Malley [10], as well as the amendments made to this framework by Levac et al. [11] and by the Joanna Briggs Institute [12]. The framework consists of six consecutive stages: (1) identifying the research question, (2) identifying relevant studies; (3) study selection; (4) charting the data; (5) collating, summarising and reporting results; and (6) consultation. We performed the last stage through qualitative interviews, with results to be reported separately [13]. A study protocol containing all methodological details was published before conducting this scoping review [14]. Although initially specified in the protocol, we did not carry out the review of journal guidelines to peer reviewers. Due to the extensive volume of the initially proposed work, this aspect of the research will be carried out and published separately.

We used the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist to report our results (Additional file 6) [15].

Study selection: inclusion and exclusion criteria

Any article with a specific focus and/or statements mentioning roles, tasks and competencies pertaining to the contribution of peer reviewers to the journal editorial process was included. Articles referring solely to roles and tasks that were not related to manuscript peer reviewing in biomedical journals (e.g. grant peer review, professional performance review and peer review of teaching) were excluded. There were no date and language restrictions.

Disciplines

We adopted MEDLINE's journal selection criteria for our definition of health. This definition includes journals

that are 'predominantly devoted to reporting original investigations in the biomedical and health sciences, including research in the basic sciences; clinical trials of therapeutic agents; effectiveness of diagnostic or therapeutic techniques; or studies relating to the behavioural, epidemiological, or educational aspects of medicine'. In order to ensure feasibility of the study, we did not include journals from the disciplines of psychology, education, physical or natural sciences.

Study designs

The review considered all study designs to be eligible. Based on findings from a preceding scoping review of competencies for scientific editors of biomedical journals [8], it was anticipated that a substantial proportion of relevant statements would be identified in publications that are not only presenting the results of research (subsequently termed 'research-based publications') but also in non-research-based publications including book chapters, commentaries and editorials, as well as grey literature. Therefore, we also searched for non-peer-reviewed resources on websites.

Search strategy for peer-reviewed literature

The Peer Review of Electronic Search Strategies (PRESS) 2015 Guideline statement was used to guide the electronic literature search strategies [16]. These were further refined in collaboration with a Health Sciences Librarian. Subsequently, the following databases were searched: Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Educational Resources Information Centre (ERIC), EMBASE (via Ovid), PsycINFO (via Ovid), MEDLINE (via Ovid), Scopus and Web of Science. There were no date or language restrictions. The search strategy for MEDLINE can be found in the online Additional file 1. In addition, we hand-searched websites of JAMA, Nature and Science using keywords related to peer review to identify any additional literature that was not detected by the search strategy.

Grey literature search

We searched for grey literature on websites of existing networks (e.g. EQUATOR Network, New Frontiers of Peer Review (PEERE)), biomedical journal publishers (e.g. BMJ Publishing Group, Elsevier, Springer Nature, Taylor & Francis, Wiley) and organisations that offer resources for reviewers (including educational courses, for example those provided by Cochrane and Publons) . Relevant blogs, newsletters (e.g. The METRICS Research Digest), surveys and reports of authors/reviewer workshops were also searched. We further hand-searched available abstracts from the various International Congresses on Peer Review and Scientific Publication [17, 18].

Screening

Following the execution of the search strategy, the identified records (titles and abstracts) were collated in a reference manager (Endnote) for de-duplication. The final unique set of records was imported into a systematic review paper manager (Covidence) that facilitated independent screening by two reviewers. The screening of titles and abstracts and subsequent full-text screening was performed independently by two reviewers (KG and DC). Disagreements between reviewers were resolved by consensus.

Charting the data

A data extraction form was developed a priori to capture information on each eligible document included in the review. General study characteristics extracted were as follows: first author name, year of publication, country of first author, language of publication and study design. For grey literature, we extracted the URL, title of the document, language of publication and who produced the document.

In addition, for all documents, we collected descriptions of any statements potentially relating to the roles and tasks of peer reviewers. Two people (KG, DC) carried out the data extraction. In the first step, data were extracted from eligible full texts into Microsoft Excel by KG. Subsequently, DC compared the full text of each eligible document with the extracted data on Microsoft Excel to ensure that all relevant information had been included.

Collating, summarising and reporting the results

Initially, all relevant statements (full sentences) related to roles from all data sources were extracted into a Microsoft Excel sheet by KG. Subsequently, each sentence was coded into smaller text units semantically as close as possible to the original, full sentence. Overlapping or duplicate text units were collated following discussion and agreement with DC, resulting in a list of unique statements for roles. Finally, we grouped these statements into emergent overarching themes to provide a better overview of results. All relevant statements (full sentences) related to tasks from all data sources were also extracted into a Microsoft Excel sheet by KG and mapped using pre-defined categories adapted from work carried out by Hirst and Altman [19]. In order to produce a meaningful list, we only included tasks that would apply to all types of studies. Tasks that are not common to all types of studies, for example, those related specifically to RCTs and systematic reviews, were not extracted (Additional files 7 and 8).

Results

Literature search

A total of 23,176 records were returned by the search strategy which included a substantial number of records

related to 'hospital peer review'. In the first step, one researcher (KG) screened all irrelevant records out by title and abstract, leaving 2763 possibly relevant articles which were then screened by two reviewers by title and abstract (KG and DC). Six hundred records were eligible for full-text screening. Disagreements regarding eligibility were resolved through discussion and achieving consensus between the two reviewers. Subsequently, 391 biomedical publications were excluded, leaving 209 publications that met the inclusion criteria (Fig. 1) . From these 209 publications, there were 24 original research articles, 45 review articles and 140 book chapters, editorials, commentaries, letters and tutorials. We also included 13 grey literature sources.

Research-based publications

A total of 24 publications from the database search were considered relevant to the roles and tasks of peer reviewers in biomedical journals (Additional file 2).

Only one of these articles was primarily focused on roles and tasks. Seven studies reported on surveys, eight were descriptive studies and two were randomised controlled trials (RCT). The remaining five articles comprised a randomised trial, two intervention studies and two systematic reviews. Publication dates ranged from 1991 to 2016. Most of the studies were published in 2013 ($n = 4$) and 2005 ($n = 3$).

All articles were written in English. Eleven of the studies' first authors were based in the USA, three in the UK, two in France and one each in Australia, Canada, Hong Kong, India, Italy and Japan. The remaining two studies did not include details on the first authors' country affiliation.

Non-research-based publications

A total of 185 non-research-based publications were considered relevant.

Overall, 45 publications were review articles (Additional file 3). For the review articles, the date of publication ranged from 1974 to 2016; 2008 ($n = 6$), 2014 ($n = 5$) and 2015 ($n = 5$) were the three years with the most studies. Two review articles were in Spanish and 41 in English. This sample included 23 studies with first authors originating from the USA, five from the UK, four from Australia and Spain and one from Canada, Greece, India, Japan, Korea and Palestine.

The remaining 140 publications consisted of 122 editorials, two book chapters, 12 commentaries, two letters and two tutorials (Additional file 4). The publication dates ranged from 1983 to 2017; 2016 ($n = 15$) and 2014 ($n = 15$) were the two years with the most studies. All articles were written in English except for two articles that were written in Portuguese. This sample included 48 studies with first authors based in the USA; 10 in the UK; nine in Canada; seven in Australia; four in Brazil; three in Germany; two in Denmark, India, Portugal and Spain; and one each in Austria, Croatia, The Netherlands and Singapore.

Search of networks and publishers

The search of networks and publishers resulted in 13 additional documents from websites. Among the sample, four documents were blogs/column, five were training/webinar documents and two were guidelines from professional associations, societies and organisations. Lastly, two were guidance documents by publishers (Additional file 5).

Collating and summarising the data

In an effort to create a useful summary of the data, we collated and combined the statements retrieved from all included sources in Table 1 and Table 2, where we present a detailed breakdown of all themes and related

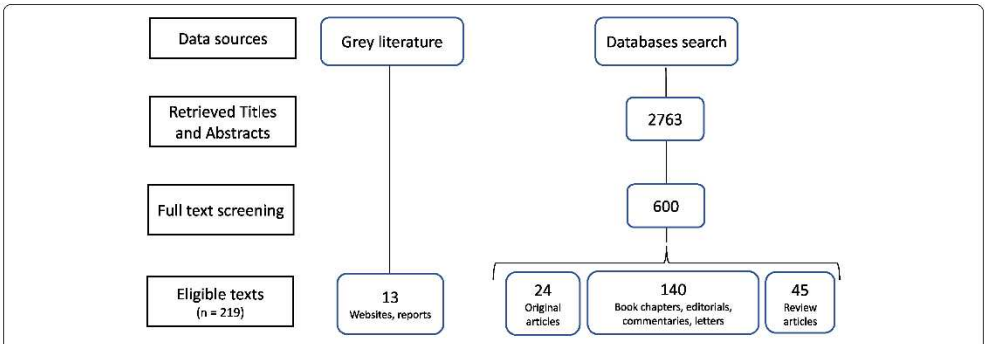

Fig. 1 Study flow diagram

Table 1 Role-related statements ('roles' refer to the overarching nature of peer reviewers' function. The statements are ranked by numerical frequency. Each statement is linked back to the specific papers in the Additional files 2, 3, 4 and 5)

	Item[a]		#[b]
Peer reviewers should be…			
Proficient experts in their field	1	Be expert in the subject area/matter/field and/or be familiar with/trained in research methods and statistics	/0
	2	Be actively involved in research and have experience of conducting research and publishing scientific papers	15
	3	Be familiar with reporting guidelines	5
Dutiful/altruistic towards the scientific community	4	Consider peer reviewing to be a responsibility, duty and obligation to the field and to the scientific community	26
	5	Consider the act of peer reviewing as an honour and a privilege	8
	6	Indicate willingness to re review the manuscript	7
	7	Be aware of one's role, responsibilities and rights as a peer reviewer	4
	8	Perform reviewing task altruistically/gratis	2
	9	End one's appointment as reviewer to create opportunity for others	1
	10	Act regularly as peer reviewer	1
Familiar with journal	11	Be familiar with journal's mission, review process, review criteria, guidelines (i.e. both author and reviewer guidelines) and forms prior to starting the review	39
	12	Guide the substance and direction of a journal	1
Unbiased and ethical professionals	13	Declare/avoid potential or actual conflict of interest	66
	14	Maintain confidentiality of the manuscript, avoiding disclosure/discussion with others	52
	15	Be fair: evaluate manuscript in a fair manner	39
	16	Be objective: objectively judge all aspects of the manuscript	36
	17	Be unbiased in their assessment: peer reviewers should have an unbiased attitude towards an author's gender, previous work, institution and nationality	32
	18	Review ethically: they should not use the obtained information in any way	17
	19	Be honest/frank	13
	20	Maintain integrity of the peer review process and not communicate with authors during the review process	12
	21	Inform editor if a colleague will help or has helped with review	11
	22	Review ethically: they should not copy and plagiarise	6
	23	Be aware of their own biases: peer reviewers should recognise their potential biases and hold them in check	6
	24	Upon completing the review, manuscript, illustrations and tables should be destroyed	5
	25	Review ethically: in general terms, peer reviewers are expected to undertake task in an ethical and diligent manner	4
	26	Be familiar with fundamental issues of publication integrity	4
	27	Decline review request if these cannot be performed in an unbiased manner	4
	28	Review ethically: they should not ask for their own articles to be cited	4
	29	Review ethically: they should not delay publications purposefully	4
	30	Be transparent and perform review in a transparent manner	2
Self critical professionals	31	Prior to accepting review request, determine whether the manuscript is within one's area of expertise (only review manuscripts in one's own field of expertise)	35
	32	Be aware of own limitations: recognise and communicate them to the editors. If needed, recommend review by an expert (e.g. statistician)	22
	33	Be innovative and open to new ideas	13
	34	Peer reviewers should consider reviewing as a learning exercise and evaluate	8

Table 1 Role-related statements ('roles' refer to the overarching nature of peer reviewers' function. The statements are ranked by numerical frequency. Each statement is linked back to the specific papers in the Additional files 2, 3, 4 and 5) *(Continued)*

		one's own performance as a reviewer, i.e. read other peer reviewers' reviews and thereby improve their own understanding of the topic and/or decision reached	
Reliable professionals	35	Timeliness: meet journal deadline	81
	36	Consider one's time availability prior to accepting review request	36
	37	Be willing to devote sufficient time and attention to the review task	23
	38	Respond to review requests in a timely manner	21
	39	Inform the editor as soon as possible if proposed deadline to be exceeded	12
	40	Immediately communicate to journal when cannot perform review	9
	41	Suggest other reviewers if unable to review	7
Skilled critics	42	Provide constructive criticism	87
	43	Improve manuscript	84
	44	Be thorough/comprehensive/detailed/accurate	35
	45	Be critical/sceptical: evaluate a manuscript in a critical manner	27
	46	Be specific: provide authors with specific guidance on how to improve their manuscript	26
	47	Support comments with evidence: reviewers should document their comments and substantiate their points by referring to appropriate references and resources	20
	48	Be clear: clearly explain concerns	14
	49	Provide relevant comments: offer meaningful and reasonable comments that can be addressed	12
	50	Be consistent with comments to authors and editors: comments provided to the authors should be in line with confidential comments provided to editor in order to facilitate editors' decision-making, ensure consistency and avoid miscommunication.	11
	51	Be systematic and methodological	11
	52	Be balanced: provide a balanced critique	9
	53	Be logical: provide logical arguments	5
	54	Be concise/incisive	5
	55	Evaluate manuscripts in a consistent manner	4
	56	Have intuitive capacity to detect faults and recognise quality	2
Respectful communicators	57	Be polite/courteous/respectful in the communication with authors	41
	58	'Do unto others as you would have them do unto you': treat others as we expect to be treated	22
	59	Be positive: peer reviews should be written in a positive attitude and offer praise for work well done	13
	60	Be nice/kind/considerate	12
	61	Be helpful: provide helpful comments	12
	62	Be collegial: treat each manuscript as if it had been written by a valued colleague	8
Gatekeepers	63	Maintain and improve manuscript quality and scientific rigour	15
	64	Weed out unsuitable manuscripts that are not scientifically valid	11
Educators	65	Educate and mentor authors: provide a learning opportunity	15
	66	Encourage authors: peer reviewers should encourage authors to improve manuscript	11
Advocates for author/editor/reader	67	Be an advocate for the editor	6
	68	Be an advocate for the author	6
	69	Be an advocate to readers	2
Advisors to editors	70	Advise editors on the merits of manuscripts	40

Table 1 Role-related statements ('roles' refer to the overarching nature of peer reviewers' function. The statements are ranked by numerical frequency. Each statement is linked back to the specific papers in the Additional files 2, 3, 4 and 5) *(Continued)*

	71	Provide confidential comments to editor	32
Peer reviewers should not…	72	Be decision makers: they should acknowledge that the final decision on the publication of a manuscript rests with the editor	22
	73	Be copy editors (i.e. offer editorial comments about grammar and spelling)	21
	74	Ask for unreasonable or pivotal change	11
	75	Be overtly critical or too detailed: peer reviewers should not be generous and should not 'nit pick' or overwhelm the authors	9
	76	Add additional requests in subsequent reviews that are not related to the original revisions	2

[a]Corresponds to the 'Role item(s)' columns in the tables related to roles in the additional files
[b]Number of extracted roles statements across all data sources in the scoping review

statements. Each statement is linked back to the specific papers in the Additional files 2, 3, 4 and 5.

A total of 1462 statements related to roles were extracted, resulting in 76 unique statements. These were grouped into 13 emergent themes where peer reviewers were considered to be proficient experts in their field (3 items), dutiful/altruistic towards scientific community (7 items), familiar with journal (2 items), unbiased and ethical professionals (18 items), self-critical professionals (4 items), reliable professionals (7 items), skilled critics (15 items), respectful communicators (6 items), gatekeepers (2 items), educators (2 items), advocates for author/editor/reader (3 items) and advisors to editors (2 items). Roles that do not fall within the remit of peer reviewers were also identified (5 items).

The 'skilled critics' and 'unbiased and ethical professionals' themes appeared most frequently. Figure 2 shows the identified themes according to the number of associated statements, with larger circles denoting a higher number.

We also extracted 2026 statements related to peer reviewers' tasks, resulting in 73 unique statements. These were grouped under six themes: organisation and approach to reviewing (10 items), make general comments (10 items), assess and address content for each section of the manuscript (36 items), address ethical aspects (5 items), assess manuscript presentation (8 items) and provide recommendations (4 items). The themes 'assess and address content for each section of the manuscript' had the highest number of statements while the theme related to ethical aspects had the lowest number (Fig. 3).

Discussion

This scoping review produced a comprehensive list of roles and tasks of peer reviewers, derived from a wide range of sources. We sought to complement an existing scoping review on competencies for scientific editors of biomedical journals [8]. While the focus of the scoping review is biomedicine, it is possible that many of the roles and tasks identified could apply more broadly to the discipline of science (e.g. Science, Technology, Engineering and Mathematics (STEM)).

From our analysis, we found incongruities between the position of the peer reviewer and the position of the editor as reported in the literature. For example, the link between peer reviewers' recommendations and editorial decision-making—where the former typically informs the latter—is often unclear. One of the roles identified in this article is for peer reviewers to keep in mind that they are not decision-makers regarding the ultimate fate of the manuscript. Such decision making is typically made by the editors who 'Synthesize reviews and make ultimate editorial decisions in light of peer reviewers' comments and other editors' comments' [9], to take this decision. At the same time, a key reviewer task emerging from this scoping review relates to the provision of a recommendation regarding the manuscript (decision-making: reject, accept, etc.). While peer reviewers should be expected to offer advice to editors on the merits of a manuscript, reviewer recommendations around whether or not to publish the manuscript might actually have a more substantial impact on final editorial decision-making than intended, thereby endangering any aspirations of editorial independence. Research indicates that peer reviewer recommendations have a direct influence on editorial decisions [20]. This becomes a problem when the quality of peer reviewer reports is questionable or when one of the many forms of bias that reviewers may display is present. Lee et al. describe bias as a 'function of author characteristics' which includes prestige bias, affiliation bias, nationality bias, language bias and gender bias. There might also be 'bias as a function of reviewer characteristics', such as when peer reviewers display content-based bias, confirmation bias, conservatism, bias against interdisciplinary research and publication bias [21].

Evidence from the field of meta-research—the study of science itself—indicates that the biomedical literature is replete with low-quality publications [20, 21] which have evidently successfully passed peer review. This in turn

Table 2 Task-related statements ('tasks' refer to specific actions that fulfil 'roles' that refer to the overarching nature of peer reviewers' function. The statements are ranked by numerical frequency)

Theme	Item[a]	Tasks…	#[b]
Organisation and approach to review	1	Identify strengths and weaknesses	31
	2	Identify flaws	29
	3	Provide summary of key points	29
	4	Differentiate between major and minor comments	17
	5	Follows reviewer guidelines provided by the journal	11
	6	Differentiate between fatal vs. addressable flaws	10
	7	Address all aspects of the manuscript	9
	8	Differentiate between general and specific comments	6
	9	Identify missing information	5
	10	Number each statement chronologically	5
Make general comments	11	Determine validity/quality/technical merit/rigour	69
	12	Assess originality	55
	13	Assess novelty	54
	14	Assess importance/significance	48
	15	Comment upon relevance to practice/science (clinical relevance)	45
	16	Comment upon contribution to the field	42
	17	Highlight whether current literature is covered	35
	18	Determine timeliness of the manuscript—is it topical?	16
	19	Determine whether reporting guidelines were followed (i.e. appropriate selection and adherence by authors)	5
	20	Comment upon conceptual/theoretical framework	4
Assess and address content for each section of the manuscript	Title		
	21	Title is accurate	28
	Abstract		
	22	Accurate/conclusions consistent with results	26
	23	Sufficiently detailed	23
	24	Adequacy of abstract (in general)	18
	25	Use of salient keywords	7
	Introduction		
	26	Clarity of study purpose and hypothesis	50
	27	Adequacy of introduction (in general)	37
	28	Appropriateness and adequacy of the literature review	22
	29	Relevance of problem	19
	Methods		
	30	Adequacy of methods (in general)	65
	31	Study design	56
	32	Data analysis (methods and tests)	42
	33	Use of statistics	42
	34	Sampling strategy	34
	35	Clarity and validity of statistical methods	33
	36	How data was collected/reproducibility of methods	33
	37	Methods appropriate for the research question	29
	38	Risk of bias	25
	39	Definition and measurement of variables	22
	40	Inclusion/exclusion criteria	15
	41	Follow-up	12

Table 2 Task-related statements ('tasks' refer to specific actions that fulfil 'roles' that refer to the overarching nature of peer reviewers' function. The statements are ranked by numerical frequency) *(Continued)*

Theme	Item[a]	Tasks…	#[b]
	42	Assess different analysis parts separately	11
	43	Reliable and appropriate tools used	11
	44	Power analysis	10
	Results		
	45	Clarity of tables and figures	54
	46	Adequacy of results (general)	46
	47	Neutral and logical presentation of results	25
	48	No interpretation of results	12
	49	Accuracy of raw data/appendices	8
	Discussion/conclusion		
	50	Interpretation supported by data	92
	51	Adequacy of discussion (general)	53
	52	Study limitations addressed	22
	53	Research and policy implications (suggestions for future studies)	17
	54	Summary reflects contents of the article	13
	55	Generalizability of study conclusions	5
	References		
	56	Appropriateness and accuracy of references	52
Address ethical aspects	57	Consider general ethical aspects and report on any specific ethical concerns (including manipulation of data, plagiarism, duplicate publication, inappropriate treatment of animal or human subjects)	55
	58	Report on ethical approval	11
	59	Check specifically for plagiarism/fraud	4
	60	Highlight competing interests of authors	4
	61	No need to detect fraud	2
Assess manuscript presentation	62	Overall readability	41
	63	Presentation (general)	40
	64	Coherence/clarity and logical flow of the text	37
	65	Grammar and spelling	30
	66	Organisation of the manuscript	25
	67	Use of language	21
	68	Length of the manuscript	12
	69	Check adherence to authors' guidelines (i.e. journal guidelines for authors)	9
Provide recommendations	70	Recommendations on publication (e.g. no/minor/major revisions, reject)	74
	71	Comment on interest to journal readership/relevance for journal scope	52
	72	Complete (numerical) rating/checklist	26
	73	Recommend another more suitable journal	2

[a]Corresponds to the 'Role item(s)' columns in the tables related to tasks in the additional files
[b]Number of extracted tasks statements across all data sources in the scoping review

suggests that the filtering function of journal editors is not being properly fulfilled. Thus, the question is whether the responsibility for publication of low-quality manuscripts is shared by both peer reviewers and editors or whether it should be borne solely by editors.

Another example of tension between these two stakeholders is the overlap that exists across certain tasks. For example, a key competency of journal editors should be to 'evaluate the scientific rigor and integrity of manuscripts' [9]. A study that analysed editorial discourse in a high-

impact journal to provide insight into editorial decision-making found that factors related to science—such as research design and methods—were most often addressed during the internal discussion among the editors [22] . Concurrently, peer reviewers are expected to dedicate time to the evaluation and scoring of manuscripts' scientific rigour and integrity, in what seems to be a duplication of effort for potentially limited impact. Another perspective on this could be that the editor has made an evaluation and is asking the peer reviewers to do likewise, so it could be perceived as a validation of the editor's views concerning the scientific validity of the submission. It could also be seen as a way of using collective intelligence during the review process. However, peer reviewers are primarily consulted as experts in their field whose knowledge and expertise can at times be broader than the editors'. Thus, the pertinent question here revolves around their authority as experts and whether they are simply rubber-stamping the editors' decision.

Furthermore, the advocacy role of peer reviewers appeared several times in the included literature. According to some included articles, peer reviewers are variously expected to be advocates for authors, editors and/or readers. Whether this is a justifiable (and feasible) role is open to debate. Is it possible to be an advocate to all stakeholders simultaneously? If not, which stakeholders should take precedence and what would the order of priority be? The term 'advocates' needs to be unpacked and clarified in order for peer reviewers to understand what is expected from them in this particular area.

This overlap of roles, and the existence of apparently malleable boundaries between editors and peer reviewers, may have significant implications for the overall peer review process because there is the potential for misunderstandings to occur, as shown by Chauvin et al. [6]. Given the three problematic discrepancies described above, questions remain around their implications for reviewers' roles and tasks in terms of authority and responsibility.

The 13 themes identified in the list of reviewers' roles (Table 1) provided a clear construct of the ideal peer reviewer. Box 1 summarises these attributes, based on the most frequent statements identified in our review and the incongruities between the position of the peer reviewer and the position of the editor. Although this is a useful summary of the literature included, these roles need to be discussed critically beyond merely listing them for academic purposes. Instead, a more holistic approach, where these roles are critically discussed within the context of the broader scientific publication system in a way that acknowledges and recognises the complex and dynamic social relations that characterise the peer review process, should be adopted. Box 2 poses questions about the incongruities between the position of the peer reviewer and editor that need to be critically examined.

Box 1 Construct of a peer reviewer

Reviewers should be proficient experts in their field with training in research methods or statistics who out of a sense of scientific responsibility and duty—provide unbiased, objective, thorough and specific yet constructive criticism to authors on how to improve their manuscript. Importantly, prior to commencing reviewing, self-critical reviewers should be confident about their availability and competence to review and be familiar with the journal's mission and review criteria and guidelines. Any potential or actual conflict of interest should be declared upfront or avoided entirely, in line with ethical norms. Reviewers should offer advice to editors on the merits of the manuscript while keeping in mind that they are not decision-makers regarding the fate of the manuscript. A polite, collegial attitude that promotes education of authors is vital. Lastly, they should maintain confidentiality throughout and deliver the report in a timely matter.

Complementary to the roles above, we identified 73 unique tasks that peer reviewers may variously be expected to perform. The large number of potential tasks identified is arguably excessive, especially since the majority of peer reviewers are not paid to perform these tasks and often receive little recognition for their work [23]. However, not all journals share all of these expectations. For example, a recent study on content of grading forms across a range of surgical journals found considerable variation in content, with relatively few journals requiring reviewers to address specific components of a manuscript. The study suggests that substantial variation exists in the grading criteria used to evaluate manuscripts submitted for peer review in this field, with a different emphasis placed on certain criteria correlated to journal impact factors. Grading forms of higher impact factor surgical journals more frequently addressed statistical analysis, ethical considerations and conflict of interest, whereas lower impact factor journals more commonly requested qualitative assessments of novelty or originality, scientific validity and scientific importance [24].

Box 2 Critical questions related to roles and tasks of peer reviewers

- What is the link between peer reviewers' recommendations and editorial decision-making?
- Who is responsible for publication of low-quality manuscripts?
- Is there overlap across certain roles and tasks (e.g. expert evaluation, advisors)?
- What are the consequences of existing malleable boundaries of authority and responsibility on the review process?

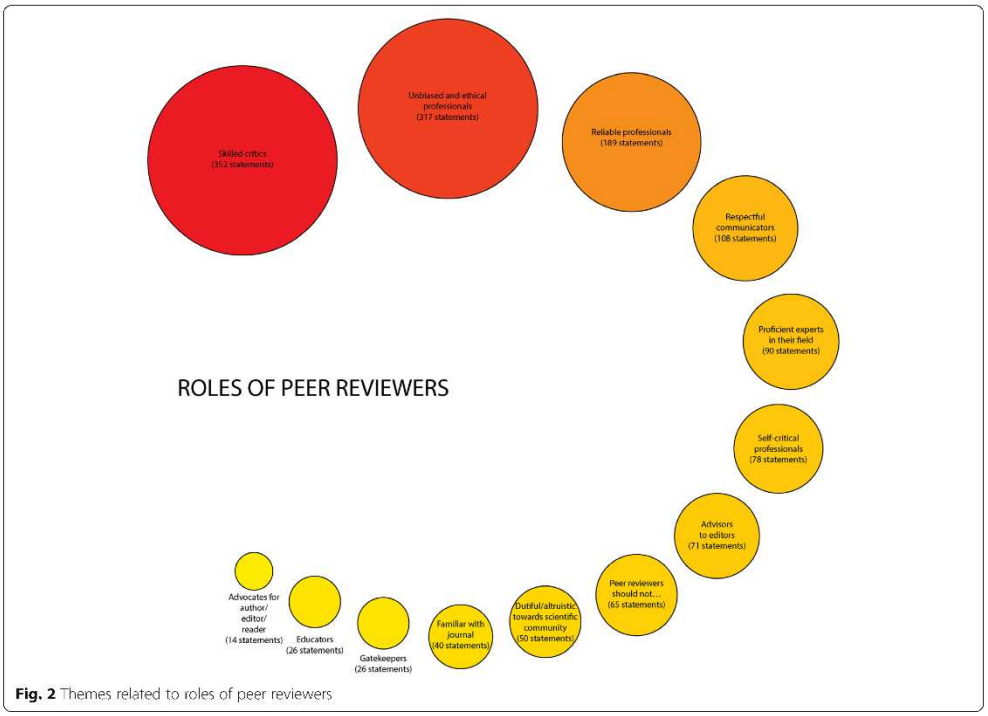

Fig. 2 Themes related to roles of peer reviewers

We also observed several contradictions. For example, there was some discrepancy as to whether detection of misconduct and fraud should fall within the remit of peer reviewers. However, in order to be able to detect fraud, it is likely that reviewers would need to check and verify the raw data of a study. Besides being impractical, this would almost certainly discourage prospective reviewers from participating in the already time-consuming peer review process. Research suggests that a small portion of the scientific community is already carrying out a disproportionate amount of peer reviewing [25], with the potential of contributing to downgraded peer review standards. Furthermore, journals often have more opportunities to check certain aspects related to misconduct, for example by using software to detect plagiarism. A study that identified 'highly rated' competency-related statements for biomedical editors found widespread agreement among editors that identifying and addressing allegations of fraud or plagiarism was a key competency [26] that should be performed by the editor, not by the peer reviewer.

There was also discrepancy regarding whether peer reviewers should engage in copy editing. Although the majority of included articles stated that copy editing does not fall within the duty of peer reviewers, several articles specifically mentioned that reviewers should offer grammatical and linguistic improvements. One could argue that this is the role of the copy editing team members at the journal, who are specifically trained to identify and address such aspects of the manuscript, whereas peer reviewers might not necessarily be sufficiently familiar with linguistic nuances to do so. The time potentially taken up by copy editing is also worth considering. A study found that lack of time is the principal factor for peer reviewers of biomedical journal in their decision to decline a peer review [27]. The time of peer reviewers is precious; therefore, their primary focus should be on the improvement of scientific content rather than the linguistic fine-tuning.

We found variation in the level of detail provided. Certain tasks were vaguely described. For example, statements such as 'check adequacy of abstract' or 'assess manuscript presentation' were not specific enough in terms of what exactly is required. Such generic statements are not helpful in explaining what editors expect, particularly to new or inexperienced peer reviewers. Vague guidance may result in vague peer review. One simple

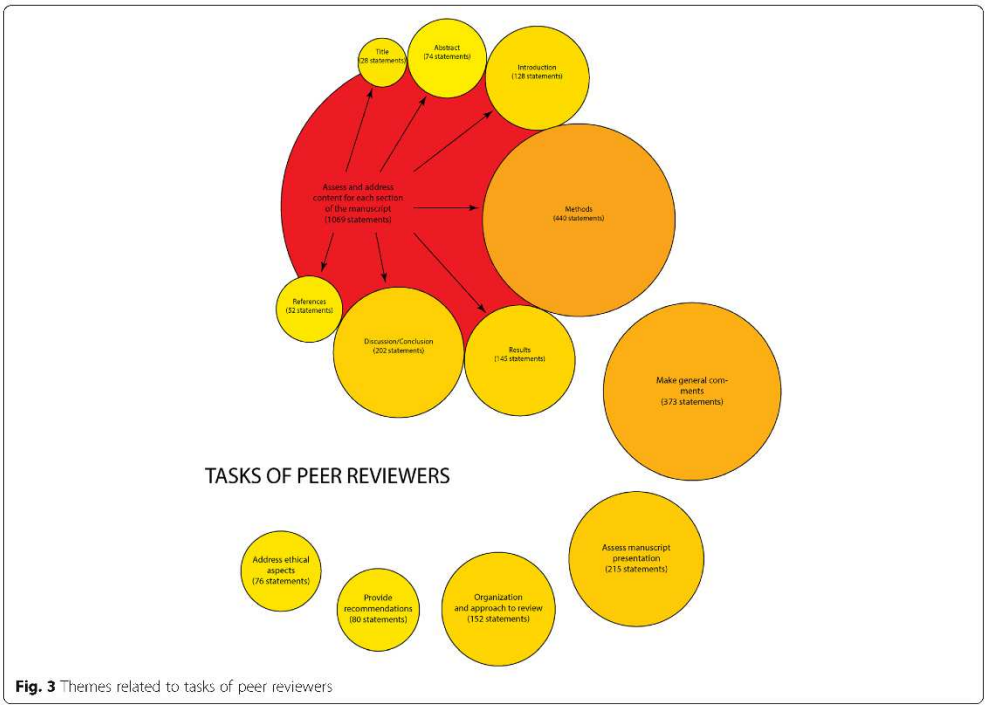

Fig. 3 Themes related to tasks of peer reviewers

but straightforward way of addressing this would be to thoroughly review and revise guidance provided to peer reviewers.

The term 'advocate' appeared several times in the included literature. According to some included articles, peer reviewers are variously expected to be advocates for authors, editors and/or readers. Whether this is a justifiable role is open to debate. Is it possible to be an advocate to all stakeholders? If not, which stakeholders should take precedence and what would the order of priority be? The term 'advocates' needs to be unpacked and clarified in order for peer reviewers to understand what is expected from them in this particular area.

Based on findings from a preceding scoping review of competencies for scientific editors of biomedical journals [8], it was anticipated that a substantial proportion of relevant statements would be identified in grey literature, rather than in peer-reviewed literature. Therefore, sources of grey literature were searched to supplement the database search strategy in the identification of task and role-related statements. Due to the sheer quantity of potentially relevant grey literature available on the web (e.g. websites of publishers), we have taken a pragmatic approach and focused on selected sources from official organisations that deal with peer review and which were also identified in the scoping review of editor competencies [8]. We also included some popular training courses for peer reviewers. However, we recognise that this is by no means comprehensive and we may have missed some potentially useful documents.

We were able to extract data from articles written in English, German, Spanish and Portuguese, but we are aware that the database and grey literature searches may not have included all available relevant literature due to language restrictions. Additionally, despite our best efforts, it is possible that we may have missed some aspects of peer reviewers' roles and tasks in our search. We preserved the wording used by authors to describe roles and tasks wherever possible and tried to ensure that any changes to wording reflected the spirit of what was being said when editing was necessary. However, it is possible that at times the subjective and selective nature of data extraction may have resulted in occasional misinterpretation of authors' intended statements. For example, some streamlining was necessary to ensure that the final list of roles and tasks was both manageable and useful; hence, it is possible that subtle differences between tasks or roles might have been smoothened out in an effort to remove

redundant or overlapping items. We expect that some missing items will appear in the next stage of our research, where statements will be refined and expanded during a qualitative study with journal editors.

Conclusion

To our knowledge, this scoping review is the first attempt to systematically identify possible roles and tasks of peer reviewers in biomedical journals. This is the counter piece of the existing scoping review on competencies for scientific editors of biomedical journals [8].

As a standalone research piece, this study will primarily be helpful in demonstrating the extent and nature of existing literature on this topic, as well as displaying the type of roles and tasks requested (Additional files 7 and 8). As such, this will be relevant to a variety of audiences, including publishers, editors, peer reviewers and authors. For example, journal editors may be inspired to review their instructions to peer reviewers, whereas course developers might opt to update the content of training courses for peer reviewers.

In addition, a possible training initiative could include the use of 'open reports' (i.e. peer review reports and the authors' responses that are published alongside the relevant articles) which, according to a systematic review (2017) of the definitions of 'open peer review,' is one of the seven main characteristics of open peer review [28]. These can be used as an educational tool for authors, editors and peer reviewers alike to unpick the different roles and tasks and to encourage a discussion on this subject. The reports can be prepared in such a way that they would reflect the emergent themes that we identified within our scoping review. Potential settings for such an educational intervention could be events such as faculty development meetings at Universities, where authors, editors and peer reviewers often mingle. The different themes could be presented using the concept of snippets [29] which are short, generally limited to 20–30 min. The focus of a snippet is a single overriding communication objective (SOCO). Our identified themes are well suited to be transformed into snippets and can be taught in the allotted time using carefully curated open reports. This review will also inform a subsequent qualitative study with journal editors, with the aim of gaining further insight into their understanding of peer reviewers' roles and tasks [13] and eventually laying the groundwork for the development of a set of core competencies for peer reviewers of biomedical journals that could then be facilitated through a consensus exercise.

Additional files

Additional file 1: Search strategy. (DOCX 21 kb)
Additional file 2: Original articles. (DOCX 62 kb)
Additional file 3: Reviews. (DOCX 122 kb)
Additional file 4: Editorials. (DOCX 241 kb)
Additional file 5: Grey literature. (DOCX 32 kb)
Additional file 6: Prisma_ScR_Checklist. (DOCX 105 kb)
Additional file 7: Data_Roles. (XLSX 188 kb)
Additional file 8: Data_Tasks. (XLSX 178 kb)

Abbreviations

EQUATOR: Enhancing Quality and Transparency in Health Research; PRISMA-ScR: Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews; RCT: Randomised controlled trial; SOCO: Single overriding communication objective; STEM: Science, Technology, Engineering and Mathematics

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Authors' contributions

All authors have made substantive intellectual contributions to the development of this manuscript. KG, DH, EC, IB and DM jointly contributed to the study conception and design. KG conceptualised the review approach and led the writing of the manuscript. DC contributed to the screening and analyses. DH led the supervision of the manuscript preparation. All authors provided detailed comments on earlier drafts and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The lead author (KG) has an advisory role with Publons Academy as well as DM. Two authors from this manuscript are members of the editorial board of BMC Medicine (DM and IB) under the 'Health Economics, Quality and Reporting' section. DM is also the co-Editor-in-Chief of Systematic Reviews and receives a small stipend for this function. The remaining three authors declare no competing interests.

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Publisher's Note

Chapter 2: Journal editors' perspectives on the roles and tasks of peer reviewers in biomedical journals: A qualitative study

In its final and optional step, the methodological framework used for the scoping review suggests conducting a stakeholder consultation to validate the findings and to identify additional sources of information, perspectives, and meanings that may enhance the knowledge gained from the review [77]. Given the lack of clarity and incongruities found in the scoping review, I decided to delve deeper to try to gain greater understanding of the content expected from peer reviewers through qualitative interviews with biomedical journal editors. I considered this to be the optimal approach because interviews enable study participants to speak freely and at length, thereby providing rich data embedded in personal experiences and practices. My decision to focus on the journal editors' perspective stems from the fact that they are central figures within the peer review process who ultimately determine the expectations of roles and tasks for their journal. Underlying this qualitative approach is an understanding that the expectations, understandings, perceptions and thoughts of journal editors are largely intangible aspects that cannot be unpacked using predefined categories or viewed independently from the purposes of the peer review process itself.

Ethical approval was granted by the University of Split prior to the start of the study (Appendix 3). The data collected were de-identified and are currently securely stored at the University of Split. I decided to interview journal editors of general medicine and specialty journals who were, at the time of the interview, involved in the communication process between authors and peer reviewers and/or who were in a position to decide about the fate of manuscripts. Recruitment was based on purposive maximum variation sampling [88], drawing from a professional network of contacts, publishers, conference participants, and snowballing. This sampling method enabled conceptual exploration using the characteristics of individuals and journals as the basis of selection in order to reflect the diversity and breadth of the sample population (and therefore having different characteristics that influence their perspectives), rather than achieving population representativeness [89]. A detailed description of the recruitment process is provided in the published study protocol [73] (Appendix 2).

Careful consideration was given to achieving saturation in this part of my research. The term 'saturation' refers to a core guiding principle to determine sample sizes in qualitative research [90]. In this study, the seven parameters that influence saturation described by Hennink et al [91] were used to determine our final sample size and demonstrate the grounds upon which saturation would be assessed and achieved. These are briefly outlined in **Table *5***.

Table 5. Parameters of saturation and determinants of sample size

Parameters	Sample size determinant for each parameter	Determinant definition
Purpose	Capture themes	The thematic analysis method will be used to identify themes and patterns of meanings across the dataset in relation to the research question
Population	Heterogeneous	Journal editors with different characteristics (i.e. demographic characteristics, journal discipline and characteristics)
Sampling strategy	Iterative sampling	Iterative sampling using established networks; enlarged through snowballing
Data quality	Thick data	Experiences and opinions will be captured with the aim to provide deep and rich insights
Type of codes	Conceptual codes	Explicit and subtle
Codebook	Emerging codebook	Inductive coding derived from data content including broad range of codes
Saturation goal and focus	Data saturation	Referring to saturation as the point where no new issues or themes are identified from the data

According to Hennink et al, the sample size of a qualitative study is determined by the combined influence of all parameters, rather than any single parameter. Prior to starting the interviews, some parameters indicated a need for a smaller sample to reach saturation while other parameters indicated a larger sample, suggesting the need for an intermediate sample size overall. The first parameter is the *purpose of the study*, which in this case was to capture themes

from the data using the thematic analysis method. With regards to the second parameter – *population* – I aimed to speak with a wide variety of biomedical journal editors with different demographic, journal specialty and journal characteristics in order to obtain a heterogeneous sample. The *sampling strategy* followed was an iterative one that involved continual data collection until a wide variety of experiences and viewpoints was achieved. I aimed to collect 'thick' *data* in order to provide deep and rich insights and capture both explicit and concrete *codes*, as well as conceptual codes that capture subtle issues. I therefore anticipated an 'emerging' *codebook* that included a broad mix of explicit, subtle and conceptual codes. Lastly, the *saturation goal and focus* of this part of my study was to achieve data saturation, that is, the point where no new issues or themes are identified from the data [91]. Prior to starting the interview process, I followed the approach suggested by Fugard and Potts [92] of estimating sample size required to achieve code saturation for studies that use thematic analysis. This calculation indicated that I required a sample size of around 40 participants to detect, with 90% power, two instances of a theme with 10% prevalence. This was in line with other with similar studies [93]. Since sample size is irreversibly linked to saturation, which in turn can only be operationalized during data collection, my approach to data collection and analysis was iterative and continued until no new codes and themes were identified from the data [94]. Ultimately, 56 general and specialty biomedical journal editors were interviewed for this part of my research (**Table 6**), after which saturation was obtained and recruitment ceased.

Table 6. Characteristics of interviewed journal editors

Demographic characteristics	
Sex	Female (n=16), Male (n=40)
Position	Junior Editor (n= 1), Senior/Associate Editor (n=11), Co-Editor-in-Chief (n=4), Editor-in-Chief (n=39), Editorial Director (n=1)
Commitment	Part-time (n=50), Full-time (n=6)
Geographic location	Asia (n=2), Africa (n=1), North America (n=19), South America (n=3), Europe (n=28), Oceania (n=3)
Journal characteristics	
Journal specialty	General medicine and Mega journals* (n=13), Specialty (n=43)
Indexing status	Yes (n=53) No (n=3)
COPE Membership	Member (n=27), Not a member (n=29)
Peer review model	Single-blind (n= 38), Double-blind (n=7), Triple-blind (n=1), Open peer review (n=9), Post-publication (n=1)
Open access, Subscription, Mixed	Open access (n=35), Subscription (n=4), Mixed (n=17)
Publishers	Academic (n=9), Commercial (n=34), Mixed model** (n=13)

*A peer-reviewed academic open access journal designed to be much larger than a traditional journal by exercising low selectivity among accepted articles.

** Refers to journals that are either co-owned by medical societies and commercial publishers, or owned entirely by medical societies but operated through a commercial publisher

I provided prospective interviewees with a study consent form and a study information sheet (Appendix 4) that consisted of information about the researchers and the study (i.e. study aim, interview procedures, ethics, confidentiality, funding and contact details). Interviewees were asked to sign a written consent form and asked again for verbal consent prior to being interviewed. Before the start of each semi-structured interview, I reiterated my study objectives and provided additional information where necessary.

During each semi-structured interview I used a topic guide (**Table 7**) to ensure that key aspects are captured while retaining sufficient flexibility to encourage unsolicited answers and additional relevant information that might have not been covered in the topic guide [95]. Development of the topic guide was informed by the outcomes of the previously conducted scoping review of the literature [96]. It was also piloted on four editors to assess usefulness and meaningfulness of the questions, the ease of administration, language and length, and was later refined in an iterative process as more interviews took place.

Table 7. Topic guide for interviews

Key area of investigation	Topics	Questions and prompts
Background information	- Explore personal background - Level of experience - Roles and tasks as an editor	• Tell me about your journal and the job you have. • How long have you been in this position? • Did you hold any other editorial position before your current position? If yes, what were your responsibilities then? Prompt: percentage of time devoted to editorial duties (e.g., part time, full time) • What are your current responsibilities (roles and tasks)?
Journal set-up	- Explore journal set-up	• Tell me about your journal - how does it work? Prompt: availability of resources (e.g. human and financial resources), relationship with publisher • How does the peer review process work in your journal? Prompt: submission system, peer review model (e.g., single blind etc) • What do you do within the process? Prompt: Interaction with peer reviewers
Opinion on peer reviewers roles and tasks	- Roles and tasks of peer reviewers - Expectations	• What do you expect from peer reviewers in terms of their roles and tasks? • What about training for peer reviewers? Prompt: use items from scoping review (roles and task related), attitudes and beliefs (e.g. on training, how they peer review themselves) , organisational expectations • How do you let your reviewers know what you expect from them? Prompt: journal guidelines • Can you tell me about a specific situation when you were not satisfied with a review report or with a peer reviewer? • What did you do in that a situation? Prompt: probe for factors other than being late with a review, or not doing a review once you they have accepted it • Can you tell me about a situation when you were exceptionally satisfied with a review or with a peer reviewer? • Were there situations (in regards to the roles and task of reviewers) when you disagreed with the other editors you work with? What about? What happened? • What about other journals, do roles and tasks differ among journals in your field? Prompt: if yes (i.e. differences exist), then: • How does this affect the process?

		• How does it affect your communication? • How do you negotiate those differences? Does it matter?
Communication between editors, peer reviewers and authors	- Communication between the three parties - Potential conflicts - Power	• Can you describe your experience of the communication process between editors, authors and peer reviews? • How do you communicate with authors and peer reviewers? • Can you give me some specific examples of situations where this communication is challenging? Prompt: What are potential conflicts? When do disagreements arise? What happens if there is disagreement between peer reviewers?
Conclusion	- Snowballing - Documents - Final comments	• Is there anybody else whom you think I should speak to? • Any articles/documents I can access/should look at? • Any final comments? Is there anything else that you think is important to mention?

The most widely used criteria for evaluating qualitative analysis are those developed by Lincoln and Guba [97], who introduced the concept of 'trustworthiness' to parallel the conventional quantitative assessment criteria of validity and reliability. Trustworthiness is determined by applying the concepts of credibility, transferability, dependability and conformability to qualitative research. Credibility corresponds to the concept of validity, whereby researchers seek to ensure that a study measures what it is actually intended to measure. Transferability corresponds to external validity, or the extent to which the research can be transferred to other contexts. Dependability corresponds with reliability, or whether the research process is methodologically consistent and correct, whether the research questions are clear and logically connected to the research purpose and design, and whether findings are consistent and repeatable. Confirmability is concerned with establishing that the researcher's interpretations and findings are clearly derived from the data, requiring the researcher to demonstrate how conclusions and interpretations have been reached [98].

Data collected during the semi-structured interviews were analysed using the six phase thematic analysis as described by Braun and Clarke [99]. I followed the step-by-step approach proposed by Nowell et al., on how to conduct a trustworthy thematic analysis [100] throughout the six

phases of my analysis so as to ensure trustworthiness of my research [97]. The methodological techniques that I undertook to ensure a trustworthy analysis are presented in **Table 8**.

Table 8. Actions undertaken to establish trustworthiness of analysis

Phases of thematic analysis	Techniques for establishing trustworthiness
Phase 1: Familiarizing with the data	Prolonged engagement with data (credibility) - KG performed multiple readings of all transcripts Reflexive journaling (confirmability) - Documentation of thoughts and potential codes/themes were taken during phase 1 and throughout the entire data analysis
Phase 2: Generating initial codes	Member-checking and peer debriefing (credibility) - The first six interviews were coded independently by two researchers (KG and DH) leading to the creation of the initial codebook **Audit trail** (confirmability) - Codebook was updated after every new interview creating an audit trial of the code generation
Phase 3: Searching for themes	Researcher triangulation (confirmability) - Regular team meetings to review findings from different perspectives - Diagramming/drawing to make sense of theme connections
Phase 4: Reviewing themes	Researcher triangulation (confirmability) - Regular team meetings to vet themes and subthemes **Audit trail** (confirmability) - We returned to raw data to check for referential adequacy
Phase 5: Defining and naming themes	Researcher triangulation (confirmability) - Team consensus on themes
Phase 6: Producing the report	Thick description (transferability) - The methodological approach and analytical choices were described in detail in previously published study protocol - We provide detailed descriptions of study results - Peer debriefing with researchers outside of the core group (IB and DM)

The findings were categorised into two overarching themes: 'Roles of peer reviewers' and 'Tasks of peer reviewers', and then characterised/unpacked into a number of domains (**Figure *2***).

Figure 2. Roles and Tasks of peer reviewers

In the first theme 'Roles of peer reviewers', journal editors outlined a variety of roles, which coalesced around four domains. The first domain showed that journal editors expect peer reviewers to be: 'Proficient experts in their field qualified to peer review'. There was agreement that peer reviewers are experts when they (1) have expertise and demonstrate high-level knowledge in their subject area, (2) are up to date with existing evidence and practice guidelines and (3) have experience of publishing their own research. However, there was substantial disagreement on how these criteria are defined and understood and how 'expertise' is operationalised. A key finding from this domain was that journal editors support the perspective that authorship experience is key to high-quality reviews, while formal training in peer reviewing is not.

The second domain: 'Dutiful towards the scientific community versus volunteers who deserve recognition' showed that journal editors are divided on this aspect. While the majority of interviewees repeatedly expressed their gratitude towards peer reviewers, whom they most

commonly framed as volunteers who perform out of ‘altruistic motives’, a small number considered the act of peer reviewing to be a ‘duty’ and ‘obligation to the scientific community'.

The third domain showed that journal editors expect peer reviewers to be: ‘Professionals’. There was general agreement among study participants on the need for peer reviewers to be (1) unbiased and ethical professionals, (2) reliable professionals and (3) skilled critics.

The fourth domain illustrated that journal editors expected peer reviewers to be: ‘Advisors to the editor’. Journal editors were explicit in their attribution of a primarily ‘advisory role’ to peer reviewers and their own role as the ‘ultimate decision makers’. Yet the majority gave considerable importance to the reviewers' recommendations function, despite concerns regarding the lack of a commonly agreed-upon definition of the available options, the potential influence on independent editorial decision making, as well as frequent disagreement among peer reviewers.

In the second theme 'Tasks of peer reviewers' journal editors outlined a number of tasks that coalesced around four domains: (1) organisation and approach to reviewing, (2) making general comments, (3) assessing and addressing content for each section of the manuscript, and (4) addressing ethical aspects. Considerable agreement existed concerning technical tasks, however there was an apparent difference in journal editors’ expectations of the level of depth and detail.

Overall, findings emerging from these interviews support and validate the results of the scoping review (Paper 1) while illustrating and unpacking some of the contradictions observed in the literature.

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Journal editors' perspectives on the roles and tasks of peer reviewers in biomedical journals: a qualitative study

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ABSTRACT

Objective Peer reviewers of biomedical journals are expected to perform a large number of roles and tasks, some of which are seemingly contradictory or demonstrate incongruities between the respective positions of peer reviewers and journal editors. Our aim was to explore the perspectives, expectations and understanding of the roles and tasks of peer reviewers of journal editors from general and specialty biomedical journals.

Design Qualitative study.

Setting Worldwide.

Participants 56 journal editors from biomedical journals, most of whom were editors-in-chief (n=39), male (n=40) and worked part-time (n=50) at journals from 22 different publishers.

Methods Semistructured interviews with journal editors were conducted. Recruitment was based on purposive maximum variation sampling. Data were analysed thematically following the methodology by Braun and Clarke.

Results Journal editors' understanding of the roles and partly of tasks of peer reviewers are profoundly shaped by each journal's unique context and characteristics, including financial and human resources and journal reputation or prestige. There was a broad agreement among journal editors on expected technical tasks of peer reviewers related to scientific aspects, but there were different expectations in the level of depth. We also found that most journal editors support the perspective that authorship experience is key to high-quality reviews, while formal training in peer reviewing is not.

Conclusion These journal editors' accounts reveal issues of a social nature within the peer-review process related to missed opportunities for journal editors to engage with peer reviewers to clarify the expected roles and tasks. Further research is needed on actual performance of peer reviewers looking into the content of peer-reviewer reports to inform meaningful training interventions, journal policies and guidelines.

Strengths and limitations of this study

- ► This study is one of few qualitative studies that explore biomedical journal editors' views regarding the roles and tasks of peer reviewers.
- ► The participants were diverse in terms of characteristics related to the journals.
- ► The majority of the participants were editors-in-chief, which may limit the generalisability of the results.

INTRODUCTION

Peer reviewers of biomedical journals are key stakeholders in the editorial ecosystem, helping authors to improve manuscripts and providing advice to scientific editors on their decision regarding the acceptability of publishing papers. Despite their importance for scientific publishing, fundamental principles such as the roles, tasks and core competencies of peer reviewers—including a minimum standard of knowledge, skills and characteristics that are needed to effectively deliver high-quality reviewer reports—are neither well defined, agreed on nor formally established.[1] While core competencies have been to some degree established for journal editors,[2] thus far, this is not the case for peer reviewers. A recent scoping review (2019) showed a large number of roles and tasks that peer reviewers of biomedical journals are expected to carry out, some of which seem to contradict each other or display incongruities between the position of the peer reviewer and the position of the journal editor.[3] These findings were reflected in a study that aimed to identify the tasks that journal editors expect from peer reviewers who evaluate a manuscript reporting a randomised controlled trial, where a substantial disconnect between the expectations of journal editors and peer reviewers was found.[4] A mutual understanding of expectations and responsibilities is one of the key factors that determine the quality of reviewer reports and satisfaction of the actors with the review process. However, biomedical journals differ in their guidance provided to peer reviewers, in their publishing capacity and resources available, as well as the reviewer pool.[5] Therefore, it is likely that journal editors might have diverging opinions about the roles and tasks peer reviewers are supposed to perform, something that has not been previously explored in depth.

Given that peer review is a social process that goes beyond the quality control of manuscripts,[6] qualitative methods may lead to a deeper examination of the complexities of these processes compared with quantitative approaches and may provide important context to improve the understanding of different editorial realities and practices.

Our aim was to examine the experience of general and specialty biomedical journal editors and to characterise their perspectives, expectations and understanding of the roles and tasks of peer reviewers.

METHODS

Study design

We conducted semistructured interviews with biomedical journal editors from general and specialty journals. The design of the study and reporting of study results were informed by relevant guidance for reporting qualitative research.[7] Key methodological components are presented further; a detailed description of the study methodology is available elsewhere.[8]

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination of our research, sampling and recruitment.

Sampling and recruitment

We used purposive maximum variation sampling[9] to obtain as much diversity in the demographic and journal characteristics of study participants as possible. Interviewees were recruited from multiple sources, including the lead author's professional network within the Methods in Research on Research project[10] ; from two publishers, namely, BioMed Central and British Medical Journal publishing group; and attendees of the Eighth International Congress on Peer Review and Scientific Publication.[11] A total of 543 prospective interviewees were approached via email, and 69 journal editors responded positively to the request. In addition, interviewees were asked to recommend other editors who would potentially be interested in contributing to this study.

Since sample size is irreversibly linked to saturation, which in turn can only be operationalised during data collection,[12] our approach to data collection and analysis was iterative. Thus, recruitment continued until saturation—conceptualised as the point at which no new codes and themes were identified from the data—was achieved. After 56 interviews, saturation was obtained and no further journal editors were contacted and interviewed.

Data collection

All interviews were conducted between October 2017 and February 2018 by the lead author (KG). Interviews were conducted either face-to-face or by telephone to accommodate for the geographical diversity and availability of study participants. They lasted 25–60 minutes.

A topic guide (online supplementary additional file 1) was used during the semistructured interviews. The guide was initially informed by the outcomes of the scoping review[1] and was piloted and further refined over the course of the study, particularly after the first four interviews.

Prospective interviewees were provided with a study consent form and a study information sheet that consisted of information about the researchers and study information (aim, interview procedures, ethics, confidentiality, funding and contact details). Interviewees were asked to sign a written consent form prior to being interviewed. Before starting the interview, study objectives were reiterated and additional information was provided where necessary.

KG was a PhD student at the time of the interviews. She has previously experienced the peer-review process in biomedical journals as an author and peer reviewer and had undergone training in conducting qualitative interviews prior to data collection. She was supervised by DH, who has extensive experience of the peer-review process in biomedical journals as an author, peer reviewer and journal editor.

Analysis

Interviews were transcribed verbatim and fieldnotes were written up after every interview.

All documents were then imported into NVivo V.12 and were subjected to thematic analysis, as described by Braun and Clarke,[13] and outlined in the protocol.[8] In summary, a preliminary codebook was generated by two researchers (KG and DH) independently from a subset of six interviews[14] using both deductive codes from topics in the interview guide and inductive content-driven codes. The remaining 50 interviews were coded by the lead researcher (KG), supervised by DH through regular meetings. In line with the iterative process of data collection and analysis, interviews were analysed in the order in which they were conducted. To assess saturation, the lead researcher documented the process of code development, updating the codebook after analysing each transcript. Saturation was achieved after 56 interviews.

To establish trustworthiness in this research, the step-by-step approach proposed by Nowell *et al*, which provides a detailed description of how to conduct a trustworthy thematic analysis, was followed.[15] This approach used criteria for trustworthiness in qualitative research proposed by Lincoln and Guba [16] show how these can be achieved throughout the six phases of thematic analysis. The methodological techniques that we undertook to ensure a trustworthy analysis throughout our study are presented in online supplementary additional file 2.

RESULTS

A total of 56 biomedical journal editors were interviewed (table 1). Of these, the majority were male editors-in-chief who were based in 21 different countries. Most

Table 1 Sample characteristics

Demographic characteristics	
Sex	Female (n=16), male (n=40)
Position	Junior editor (n=1), senior/associate editor (n=11), coeditor-in-chief (n=4), editor-in-chief (n=39), editorial director (n=1)
Commitment	Part-time (n=50), full-time (n=6)
Geographical location	Asia (n=2), Africa (n=1), North America (n=19), South America (n=3), Europe (n=28), Oceania (n=3)
Journal characteristics	
Journal specialty	General medicine and mega journals* (n=13), specialty (n=43)
Indexing status† COPE membership	Yes (n=53), no (n=3) Member (n=27), not a member (n=29)
Peer-review model	Single-blind (n=38), double-blind (n=7), triple-blind (n=1), open peer review (n=9), postpublication (n=1)
Open access, subscription, mixed	Open access (n=35), subscription (n=4), mixed (n=17)
Publishers	Academic (n=9), commercial (n=34), mixed model‡ (n=13)

*A peer-reviewed academic open-access journal designed to be much larger than a traditional journal by exercising low selectivity among accepted articles.
†Refers to indexing status on MEDLINE, Scopus and Web of Science.
‡Refers to journals that are either co-owned by medical societies and commercial publishers, or owned entirely by medical societies but operated through a commercial publisher.
COPE, Committee on Publication Ethics.

journal editors worked part-time at their respective journals, which were mainly specialty journals. Most journals employed a single-blind review process. Most interviewees were editors of journals that were published through commercial publishers.

An overview of the different domains within our two themes (roles of peer reviewers and tasks of peer reviewers) are presented in online supplementary additional file 3.

Roles of peer reviewers

Journal editors outlined a variety of roles, which coalesced around four domains. Peer reviewers should be (1) proficient experts in their field qualified to peer review, (2) dutiful towards the scientific community versus volunteers who deserve recognition, (3) professionals and (4) advisors to the editor.

Peer reviewers should be 'proficient experts in their field qualified to peer review'

There was agreement among journal editors that peer reviewers are experts in their field when they (1) have expertise and demonstrate high-level knowledge in their subject area, (2) are up to date with existing evidence and practice guidelines and (3) have experience of publishing their own research. However, there was substantial disagreement on how these criteria are defined and understood and how 'expertise' is operationalised.

One common narrative was that qualified peer reviewers are 'experienced authors' who have a strong reputation and publication record in 'high-impact journals'. Concurrently, a number of journal editors linked the quality of the peer-review report with the reviewers' writing and analytical skills, which they believed are gained through extensive authorship in their field. In their view, authorship hones both writing and reviewing ability, since authors are theoretically able to learn from review reports on their own submitted manuscripts:

> You learn by doing and if you have published let's say 200 articles then normally you are also a good reviewer… and if you are a bad author of manuscripts then you are a bad reviewer. And your opinion leaders are the sought after reviewers because they know the field and can write well and can also analyse a manuscript from another author quite well. (Editor-in-chief, specialty journal).

Interviewees also indicated that they had a preference for seasoned authors and opinion leaders in the field over junior researchers. Here, their main concern was about fulfilling authors' expectations of an objective peer review by recruiting an expert to review their manuscript:

> Well first of all I think our reviewers … are seasoned, they have to be experts, I mean otherwise why are they reviewing? That is not fair to the author. (Coeditor-in-chief, specialty journal)

However, several journal editors commented that the actual level of expertise needed to deliver a high-quality review report does not necessarily depend on publication record and seniority level. Some journal editors considered reviewing to require a different type of skill set that is not necessarily developed through writing or present

by default. Other key factors drive review quality, such as 'dedication of sufficient time' and 'hands-on experience with the methods used'. This is often the case with junior researchers, who go through an active learning experience of applying methods for their own research and receiving feedback on their work. Less experienced researchers' greater motivation to peer review was also mentioned as a major driver of high-quality reviewer reports. For these reviewers, receiving the invitation to review is in itself a confirmation of growing personal reputation and recognition by the journal and by the broader scientific community. At the same time, their supposed lack of self-confidence due to their current low career status/standing within the scientific field could also drive the delivery of high-quality reviewer reports in a desire to establish and maintain their status within the scientific community:

> I will say that junior faculty and post doctorate fellows often write the best reviews because they tend to be insecure and tend to over-compensate and to be very careful in doing a good job. (Editor-in-chief, specialty journal).

In the same vein, a number of journal editors from non-high-ranking journals commented that senior reviewers' increasing scientific status and 'self-regard' might lead to declining review report quality, most commonly demonstrated by the 'lack of detailed comments' or 'two-line' review reports that did not aim to help 'to improve a manuscript', but only to judge publication potential. That being said, 'experienced' peer reviewers were still highly sought after by all interviewees. Since they typically receive a high volume of reviewer requests, journal editors suspect that they prioritise their reviewing time in favour of highly ranked journals, a behaviour that multiple journal editors reported practising themselves when asked to perform a peer review. Although the least experienced reviewers are generally more available, most editors feel that they lack the degree of experience required to conduct a good peer review and 'focus excessively on technical details', instead of the 'bigger picture' that more experienced reviewers are able to provide.

Regardless of preference for the type of peer reviewer, the vast majority of interviewees—except for those journal editors working for high-ranking journals—acknowledged that it is hard to solicit peer reviewers in general, particularly experienced ones:

> And one of the things that we face is that we have on one side younger investigators, willing to do the job. Sometimes they lack you know, the view and then you will have the very established scientist who in most cases do refuse to make reviews. And so we have to balance out …these two extremes. (Editor-in-chief, specialty journal).

Lastly, while peer reviewers were expected to fulfil the previous outlined criteria to some degree, interviewees did not consider the completion of a training or a course on peer reviewing as a prerequisite or necessary qualification to become a peer reviewer. All interviewees stated that they learnt to peer review manuscripts 'by just doing it', without having had previous training, and suggested that this was also the case for the majority of the peer reviewers in biomedical journals. Journal editors explained how one way of honing reviewing skills is through indirect feedback and comparisons with fellow reviewers' reports (ie, operationalised through comparing their own feedback with that of other peer reviewers for the same manuscript) and through the final decision taken by the editor-in-chief on the fate of the manuscript.

> We also tried to train our reviewers in an indirect way that is when a decision was completed and when we send the decision letter to the author we usually carbon copy the decision along with the comments of all the reviewers to all the reviewers so that every reviewer can see and compare their comments, their own comments with the comments of other reviewers and that would be a form of training for them. (Editor-in-chief, specialty journal).

There was a division of opinions on the usefulness of courses that aim to teach peer-reviewing skills. While several editors were receptive to the idea, others felt that they could only be useful to less experienced researchers because they can only teach about the technicalities of the process and cannot replace experience gained over time:

> I learnt on the field. First, as an author and then, you know, when I become more established a scientist, as a reviewer it is a long process, and difficult process… (with) courses, you can learn the technicalities of the process but you know experience is very relevant… courses do not help established scientists, they may help young scientists but the courses won't give them experience in actually in the field. (Editor-in-chief, specialty journal).

Peer reviewers should be 'dutiful towards scientific community versus volunteers who deserve recognition'

The majority of interviewees repeatedly expressed their gratitude towards peer reviewers, whom they most commonly framed as volunteers who perform peer review out of 'altruistic motives'. Being occasional reviewers themselves, journal editors were well aware of the many competing duties of peer reviewers in the biomedical field—including research, teaching and/or clinical responsibilities—between which reviewing has to be squeezed in. Many interviewees emphasised that reviewing is 'time-consuming' and repeatedly described it as an 'unpaid' and largely 'unrecognised' role:

> Most of the work that is done on journals is uncompensated, and … you are already dealing with people who are very busy people in their professional lives, and so you are really asking them to do things

at nights and weekends for which they get really very little recognition. And very little compensation if any. (Editor-in-Chief, specialty journal).

Given that the majority of journal editors face difficulties finding peer reviewers, several considered peer reviewers to be a 'precious resource' that needs to be treated with 'care'. Interviewees reported doing so through careful screening of submissions to ensure that only sufficiently good-quality manuscripts are forwarded to peer reviewers, not overburdening good peer reviewers with too many invitations, and provision of recognition and rewards. Several recognition and reward schemes were mentioned, which can be broadly divided into two categories : (1) financial rewards (free access to journal/publication discount) and small tokens of appreciation (eg, mugs, books) and (2) rewards aimed at boosting career progress through official professional development (eg, continuing medical education points; official letters for continuing professional development; and through journal rewards aimed at enhancing peer reviewers' visibility, reputation and credibility within the scientific community (eg, being invited to become editors and/or editorial board members, names published on journal website and invitations to social events).

In contrast to the more common perception of reviewers as 'volunteers', a small number of editors commented that peer reviewers should consider the act of peer reviewing to be a 'responsibility', 'duty' and 'obligation to their field' and to the scientific community in general. In their view, the entire process relies on—and only works because of—the principle of reciprocity and researchers perpetuating the development of their own research community. In their view, reciprocity should be a strong motivational drive for peer reviewers:

> Those of us who have a track record in publication get solicited for doing an awful lot of reviewing and you have got to fit that in around your other time and you are doing it because the process is important and you want your next paper to get properly reviewed so you want to peer review the paper that you have been sent. (Interim editor-in-chief, specialty journal).

A few editors were more critical of the rationale for reviewing 'for free', suggesting that the concept of duty in peer reviewing had originally been coined and continued to be fostered by publishers for profit-making purposes and is now dated:

> I mean they… they say this is your duty, you know it is your duty as a scientist to, you know, do these things … and give back, but … really the journals … certainly are profiting now the authors are paying pretty good page charges, the reviewers aren't getting paid, and you know this could be an issue. (Editor-in-chief, specialty journal).

Peer reviewers should be 'professionals'

There was general agreement on the need for reviewers to be (1) unbiased and ethical professionals, (2) reliable professionals and (3) skilled critics.

Editors outlined three aspects related to their expectation that peer reviewers should be 'unbiased and ethical professionals', consistent with 'scientific ideals'. These were (1) being 'fair' and 'objective' (ie, peer reviewers are expected to evaluate and judge manuscripts in a fair and objective manner); (2) 'maintain confidentiality' (ie, peer reviewers are expected keep manuscript content confidential avoiding disclosure to others); and (3) 'declare/avoid potential or actual conflict of interest'. Editors emphasised the importance of the latter most frequently. Some editors explained that conflict of interest could potentially contribute to increased review quality but stressed that transparency is key. They emphasised their own position as 'decision makers' within the peer-review process to assess and decide whether the reported conflict of interest is prohibiting a fair and objective assessment.

Journal editors also unanimously agreed that peer reviewers should be 'reliable professionals' who should 'respond promptly to peer-reviewer requests'. They should either accept or decline, but not 'ignore the invitation to review', which is the more common frustrating practice reported by interviewees from non-high-ranking journals. The common understanding among all editors was that a good peer-reviewer report takes a substantial amount of time to be written, something that peer reviewers should be aware of prior to accepting. They should be willing to devote sufficient time and attention to the evaluation of manuscripts yet deliver the reviewer report within the agreed timeline out of 'respect' and 'fairness' to authors, to the journal and the publisher.

Lastly, the majority of interviewees considered helping authors to 'improve their manuscript' to be the primary purpose of the peer reviewer, not to suggest a rejection or to 'filter it out'. Therefore, the need for reviewers to be 'skilled critics' was explicitly and implicitly voiced throughout the interviews. As part of the improvement role, it was expected that peer reviewers provide 'constructive criticism embodying specific and addressable comments'. Peer reviewers were also expected to be 'thorough and detailed' and to 'systematically address every aspect of the manuscript'. Another aspect emphasised by interviewees was the need for an 'evidence-based review', where peer reviewers' statements should be 'supported by references' that aid the author and guide the editor.

Journal editors expected peer reviewers to be 'respectful communicators'. They outlined basic principles of courtesy, such as 'respect for the work of the authors'. Peer reviewers were expected to provide comments that 'serve a scientific purpose' while keeping in mind that they are criticising the manuscript, not the authors. Appropriate communication was deemed to be crucial. Based on editors' accounts that peer reviewers should be 'kind' and offer 'positive' comments to nurture and 'encourage'

authors to improve their work, it became evident that peer reviewing should go beyond the mere technical assessment of manuscripts and thus has also a supportive role:

> I often think the peer reviewers are incredibly negative, and they rarely have anything positive to say. And I tend to feel, you know if somebody was reviewing my manuscript I would want them to try to say at least one tiny little positive thing about what I have done. (Editor-in-chief, specialty journal)

Peer reviewers should be 'advisors to the editor'

Journal editors were explicit in their attribution of a primarily 'advisory role' to peer reviewers. Our interviewees perceived and stressed their own role as the 'ultimate decision makers' who take decisions based on the sum of the factors outlined earlier. They have the authority to 'override peer reviewers recommendations' and 'ignore their opinion', if necessary, thereby directly or indirectly exerting influence on authors to modify their manuscripts:

> …the peer reviewer is really playing an advisory role to the editors…it's only the editors that make a decision on whether to accept or not and how they want the paper to be written. (Editor-in-chief, specialty journal).

Journal editors made it clear that decision making within the editorial process is shaped and influenced by the interplay of a complex web of factors, including (1) the editors' own expert knowledge and ability to assess different aspects of manuscripts, (2) peer-reviewer reports, (3) authors' replies, (4) discussions between editors and editorial board members during manuscript meetings where manuscripts considered for publication are discussed, (5) the number and type of submissions received, (6) the strategic approach of the journal, (7) consideration of readership and (8) subjects related to publishers. Thus, while peer-reviewer reports play a key part, they are not the only element within the equation. While scientific quality and the value of submitted manuscripts were at the foreground, interviewees were largely open about the influence of other non-scientific factors that play into their decision-making process. Nevertheless, the peer-reviewer report was consistently regarded as a key pillar supporting publication decisions, including peer reviewers' advisory role of providing the editor with a 'recommendation on the fate of the manuscript'. With few exceptions, most journal editors reported that their journal submission systems ask peer reviewers to indicate whether the manuscript should be accepted (with major/minor revisions) or rejected:

> …the most important thing for me is actually at the end, the advice to reject the paper or have it revised. (Editor-in-chief, specialty journal).

Most journal editors were open about the substantial influence of peer-reviewer recommendations on their decision making. This was rationalised in a variety of ways, which often coexist. Journal editors partly deferred their decision to peer reviewers when they felt uncertain about their own knowledge and ability to assess the manuscript adequately, referring to the 'trust' they extend towards experts in the field to help in decision making. Ticking the recommendation box was also useful to justify editorial decisions to authors when the peer-reviewer report did not convey a clear direction for the manuscript, and the journal editor wants them to 'come off the fence'. Many editors reported deferring to additional peer reviewers in case of disagreements between the initially selected peer reviewers, described as a common occurrence. Another problematic aspect of the recommendation function was the lack of a common understanding of what the individual recommendation categories actually mean. Since this is a subjective recommendation, there are inherent variations in reviewers' views.

Peer-reviewer tasks

Journal editors outlined a number of tasks that coalesced around four domains: (1) organisation and approach to reviewing, (2) making general comments, (3) assessing and addressing content for each section of the manuscript, and (4) addressing ethical aspects.

Organisation and approach to reviewing

At the beginning of the reviewer report, journal editors prefer to see a 'summary of the key points' of the manuscript, which functions as a 'quality check' for editors 'to be confident that they (the peer reviewers) have read it and understood it (the manuscript)'. The majority of journal editors expect reviewers to provide a balanced view by identifying both 'strengths and weaknesses of the manuscript'. Editors also expect peer reviewers to 'identify flaws' and differentiate between 'fatal and addressable flaws' in order to understand and assess whether the manuscripts could be improved. Furthermore, a number of journal editors suggested that it is helpful to differentiate between 'major and minor comments'. It became evident that the approach to peer review is mostly aimed at helping journal editors in their decision-making process.

Make general comments

Journal editors specified that they expect to see some general and overarching comments that provide an 'overall picture' of the 'importance and significance' of the manuscript, as well as 'relevance to field and (clinical) practice'. Additional comments should focus on the general aspects of 'validity', 'quality', 'technical merit' and 'rigour'. The assessment of 'novelty' and 'originality' was mentioned by a number of editors; however, there was a clear divide between high-ranking journals and other journals, with editors from the latter repeatedly acknowledged that manuscripts with 'novel findings' tend to be preferentially submitted to high-ranking journals.

Assess and address content for each section of the manuscript

The majority of journal editors expected peer reviewers to thoroughly appraise the content of each manuscript section. The 'soundness of the methodology used' was most frequently mentioned by peer reviewers. Generally, the level of detail expected of peer reviewers seemed to differ according to the resources that journals had, as well as the editors' own abilities. While this was oftentimes implicit, it was apparent in the example of 'statistics'. For example, while a number of journals reported to employ a 'statistical review by default' other had to rely heavily on peer reviewers for that to supplement their own limitations:

> …bringing expertise such as looking at the statistical analysis which is not my strong point at all. So bringing that sort of expertise to it. (Coeditor-in-chief, specialty journal).

Another aspect that was repeatedly mentioned was the focus on 'spin' in the discussion/conclusion section. Although not explicitly named as spin, editors want peer reviewers to look out for any 'claims that are not supported by the results', 'overenthusiasm' and 'extrapolation'.

Address ethical aspects

Journal editors reported that their submission systems typically offers two text boxes to peer reviewers: one for comments to the authors and the other one for confidential comments to the editors. The latter should be used by peer reviewers to advise the journal editor on any aspects related to 'ethics' and 'research integrity', such as suspicion of research misconduct and detrimental and questionable research practices. The confidential comments are a means of avoiding any potential conflict arising from such criticism between authors and reviewers.

DISCUSSION

This study provided an in-depth, behind-the-scenes account of 56 journal editors' experiences with, and expectations towards, peer reviewers. We found that journal editors' understanding of the roles and tasks of peer reviewers are profoundly shaped by each journal's unique context and characteristics, including financial and human resources and journal reputation. Thus, in line with existing literature, we found that editorial decision making and expectations towards peer reviewers are unavoidably shaped by social externalities that at times may have little to do with the scientific content of the manuscript.[6 17] We found that the majority of our interviewees gave considerable importance to the reviewers' recommendation function, despite concerns regarding the lack of a commonly agreed-upon definition of the available options, frequent disagreement among peer reviewers[18] and existing bias.[19] Given these limitations, journal editors should seriously consider removing the reviewers' 'recommendation function', where they are expected to provide the editor with their recommendation regarding the article's suitability for publication. This is in line with existing research on the relationship between external reviewers' recommendations and the editorial outcome of manuscripts.[20] This would help to realign the role of peer reviewers as 'advisors' rather than convey the idea that they are decision makers. It would also help to delete some of the existing malleable boundaries of authority and responsibility on the review process placing the journal editor in the sole decision-maker position. Considerable efforts should be made to communicate to peer reviewers to place their focus on the evaluation of strengths and weaknesses, major and minor flaws of manuscripts across multiple dimensions, and suggestions for improvement. Furthermore, journal editors should encourage peer reviewers to refer to appropriate reporting guidelines to ensure the completeness of information provided by authors in their studies. One way of achieving this could be through provision of feedback to peer reviewers by journal editors; that is, editors could send follow-up emails to peer reviewers requesting clarification of any missing points. This is time-consuming but might help to improve peer-reviewer reports.

Furthermore, although we found considerable agreement among editors concerning technical tasks of manuscript reviewing, there was an apparent difference in journal editors' expectations of the level of depth and detail they would like to see in a reviewer report. Our study sample showcases the status quo of the journal editors' market, where there are a few full-time journal editors. The remainder work on a part-time basis, usually for a symbolic or stipend-like payment, and combine their editorial responsibilities with research, education and/or clinical duties. Therefore, it might be the case that their own limited time might lead to expectations of greater detail from reviewers. Journal resource availability might also have an impact on their expectations, such as requests for comments related to statistical analysis in the case of journals with fewer resources. Given these existing contextual journal differences and hence peer-review report requirements, better ways of communicating editorial expectations to peer reviewers (who might review for different journals having different expectations) are needed. Currently, these expectations are communicated through publishers and journal-specific guidelines. However, various studies in this area suggest that these are often not readily available, or are generic and non-specific[21] and thus do not properly convey expectations.

Another key finding was interviewed journal editors' apparent lack of appreciation of the importance of formal peer-reviewer training. The majority embraced a somewhat simplistic and 'linear' view that 'good' authors (ie, usually defined as authors with extensive authorship in prestigious journals) make 'good' peer reviewers. However, there is no evidence to support this perspective; evidence linking authorship experience and academic qualifications to high-quality reviews is very limited. The only substantial study in this field was unable to predict reviewer performance from easily identifiable types of

experience or qualifications. The study authors also found that, contrary to the beliefs prevalent among our interviewees, factors such as academic rank and seniority do not predict performance.[22] In fact, studies that have attempted to determine whether some combination of peer-reviewer experience could predict the quality of their subsequent reviews found that the highest-rated reviewers tended to be young and that the quality of peer review did not correlate with academic rank.[23–26] However, most of these studies were relatively limited in size, were a subanalysis of a study of some other intervention and were more than 20 years old; hence, the evidence base for this finding is limited. Thus far, in the absence of additional research demonstrating the contrary, there are no criteria that predict good peer-reviewer performance.

Given this situation, we believe that the skillset required to be a good author is not necessarily the same as that required to be a good peer reviewer. In a recent study (2019) by Superchi *et al* that systematically reviewed tools used by journal editors to assess the quality of peer-review reports, the authors identified nine quality domains pertaining to peer-reviewer skills, of which five (ie, relevance and originality of the study, interpretation of study results, strength and weaknesses, manuscript presentation and organisation) arguably overlap with the skillset of authors. The remainder are directly concerned with skills related to structure and delivery of the peer-review report,[27] which we believe may not automatically follow from being a prolific author. Therefore, we propose that the following four domains can, and in principle should, be taught to prospective reviewers: (1) structure of the reviewer's comments; (2) characteristics of reviewers' comments, including concepts such as clarity, constructiveness, detail/thoroughness, fairness, knowledgeability and tone; (3) timeliness of the review report; and (4) usefulness of the review report to editorial decision making and manuscript improvement. Thus, it appears that helping to improve the manuscript entails providing not only specific and detailed comments about scientific aspects of the manuscript but also comments that empower and motivate authors, a skill that is closely aligned to the supportive function of peer reviewers that also emerged from our study.

Notwithstanding various surveys on the educational needs of young clinicians and researchers across different biomedical fields having revealed a strong interest in attaining better reviewing skills,[28] such training is still not commonly included in biomedical postgraduate education programmes. At the same time, existing educational interventions have shown underwhelming results, and their wider applicability remains questionable due to their relatively poor methodological quality.[29]

Given this lack of evidence, we think it would be helpful to conduct research on the actual content of peer reviewers' reports to help establish educational needs for peer reviewing.[30]

According to the majority of our interviewees, it is becoming increasingly difficult to find experienced authors to review manuscripts. On the other hand, junior researchers are often more willing to accept invitations, including those from lower-ranking journals. This is in line with existing evidence[31] and is likely to be due to differing levels of motivation.[32] Thus, there is an opportunity for acknowledging that the breadth and variety of reviewing roles and tasks may require a more granular approach by editors when assigning peer reviewers to a manuscript. Achieving a balance of senior and junior reviewers would cater to their wide range of reviewing motivations, as well as to their individual expertise. At the same time, the question of how to attract this ideal mix of reviewers remains. The rewards and incentives offered by most journal editors among our sample are likely to be more attractive for junior peer reviewers than senior reviewers. Based on editors' comments on the lack of effectiveness of the provided incentives and the general difficulty to get peer reviewers to accept invitations across the biomedical field[33 34] and offering higher-level rewards is key. For example, the majority of reviewers are affiliated to academic institutions, which are therefore critical stakeholders in the peer-review process. If peer reviewing is incentivised and rewarded as part of one's academic career advancement, it is likely to be as important—if not more important—than whatever journals can offer. For example, the University of Glasgow[35] has started rewarding peer-reviewer and editorial responsibilities as a core requirement for academic promotion and achieving tenure. However, this is the only example we were able to identify. The peer-review process is part of the social infrastructure of research[36]; therefore, it is the responsibility of all actors to contribute to better research. Academic institutions and other stakeholders such a funders can play a key role to implement alternative measures of research quality[37] and a stronger focus on research quality.

LIMITATIONS

Our recruitment approach gave rise to a key limitation of this study. Based on our collective experience as researchers and a former staff member of a biomedical journal (DH), who struggled with response rates involving studies with editorial staff, we anticipated that it would be challenging to recruit journal editors to participate in our research. The majority of journal editors of biomedical journals are part-timers who concurrently work as practitioners, researchers and educators and may have other additional roles. In the light of this situation, our employment of purposive maximum variation sampling resulted in predominant contact with editors-in-chief. While one of the strengths of this study is that research participants were diverse in terms of demographic characteristics and characteristics related to their journal (table 1), two-thirds of participants had this role within their respective journal. Although the lead researcher asked potential interviewees either to participate themselves or to recommend suitable journal colleagues who could be contacted in their stead, it is likely that this approach led to the

relative homogeneity of our study sample. This may limit the generalisability of the results due to the limited representation of other editorial staff members involved in the peer-review process. Our insights from the interviews and wider author and team experiences suggest that editors-in-chief might primarily be responsible for higher-level tasks around the journal, and possibly be less involved in the direct communication process with authors and peer reviewers. Therefore, there is a need to explore whether the involvement of editorial staff in other positions would have produced convergent or divergent findings.

CONCLUSION

This study provides context for, and details about, the roles and tasks of peer reviewers in biomedical journals and helps to explain attitudes and opinions expressed in existing surveys of editors, reviewers and authors on the peer-review process. Our research provides a greater understanding of the current status quo of the review process and why particular issues arise around roles and tasks of peer reviewers, and offers insight into how these issues can be addressed.

Further research is needed on actual performance of peer reviewers looking into the content of peer-reviewer reports on a large scale to inform meaningful training interventions and to improve existing journal policies and guidelines.

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Chapter 3: Journal editors' perspectives on the communication practices in biomedical journals: a qualitative study

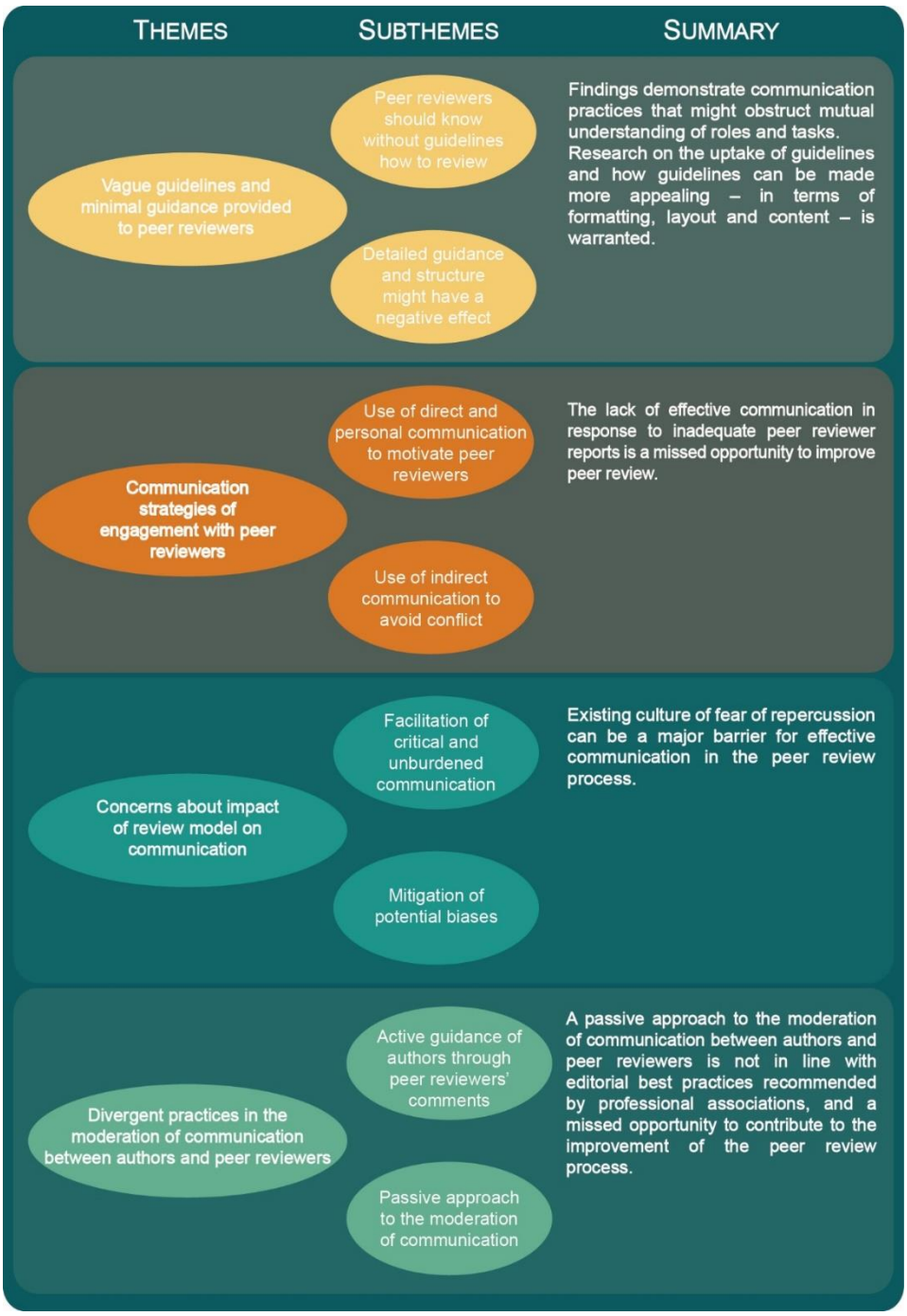
I collected the data for this research concurrently/simultaneously with the previously described qualitative research. The methodology and limitations are the same and are not repeated here. A brief summary of the rationale for conducting this qualitative study and of the findings is provided below.

The peer review process involves collaboration between authors, journal editors and peer reviewers that aims to achieve the dissemination of high-quality research. Good communication practices between these key actors are vital to achieve this aim. While there are a number of studies that focus on bias and directly or indirectly report on misunderstandings and miscommunication, to the best of my knowledge, there are no studies that specifically look into communication practices within the peer review process in biomedical journals. Therefore, the third objective of my research was to provide clarity on the communication practices that might underpin or influence the peer review process. I was specifically interested in the interaction between the key actors and hoped to capture experiences, understandings, perceptions and thoughts. These aspects are largely intangible, subjective dimensions, hence they cannot be unpacked using predefined categories and without in-depth interaction with the study subjects. Therefore, I considered a qualitative approach using interviews with journal editors best suited to answer this research objective. Here the decision was taken to focus on the journal editors' perspective because they are involved in all aspects related to communication in peer review and oversee the communication between authors and peer reviewers, as well as communicate directly with both. Given the methodological overlap, and anticipated challenges in having to recruit journal editors twice to participate in my research, I decided to collect the data for both research objectives concurrently and combined into one interview.

The analysis of the interview data generated four themes. The first theme 'Vague guidelines and minimal guidance provided to peer reviewers' revolved around two subthemes that described the way journal editors rationalised providing peer reviewers with vague guidelines and minimal guidance around their expectations. In the first subtheme 'Peer reviewers should know without guidelines how to review' I found that the prevailing attitude is that guidelines do not play an essential role in conveying journal editors' expectations to peer reviewers, that peer reviewers should know how to review a manuscript without needing guidelines and that it

is generally assumed that peer reviewers do not read guidelines. In the second subtheme 'Detailed guidance and structure might have a negative effect', journal editors expressed the fear that (excessively) structured reviewer forms might have a negative impact on the review report quality due to prescriptive probing rather than eliciting unprompted responses. Such 'over-bureaucratization' might impact reviewers' willingness to participate in the review process.

Figure 3. Summary of themes



In the second theme 'Communication strategies of engagement with peer reviewers' I found two opposing communication strategies that journal editors employed simultaneously to handle peer reviewers. The first communication strategy evolved around the ‘Use of direct and personal communication to motivate peer reviewers to continuously participate in the review process’. Journal editors were aware of the positive effects of direct communication and use it strategically for retention and reward purposes. Despite this awareness, the second communication strategy: ‘Use of indirect communication to avoid potential conflict that could discourage peer reviewers from participating in the review process’ demonstrated that they preferred not to engage with peer reviewers who deliver inadequate reviewer reports. This conveniently avoids potential conflict that they believed might arise through the provision of feedback.

In the third theme 'Concern about impact of review model on communication' I found that the majority of journal editors were against opening peer reviewer identities to authors, arguing that it would potentially make reviewer report quality worse due to potential bias that might arise from the removal of anonymity and due to the fear of repercussions for expressing criticism.

In the last theme 'Divergent practices in the moderation of communication between authors and peer reviewers', I found that on one hand there are journal editors who take an active role and guide authors through peer reviewers comments. On the other hand, there are journal editors who take a passive role and just forward the comments to authors without any guidance. The latter approach is not in line with that recommended by professional associations, indicating that some journal editors might not be following editorial best practice.

Journal editors' perspectives on the communication practices in biomedical journals: a qualitative study

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Abstract

Objective To generate an understanding of the communication practices that might influence the peer review process in biomedical journals.

Method Recruitment was based on purposive maximum variation sampling. We conducted semi-structured interviews. Data were analysed using thematic analysis method.

Participants 56 journal editors from general medicine (n=13) and specialty (n=43) biomedical journals. Most were editor-in-chiefs (n=39), male (n=40) and worked part-time (n=50).

Results Our analysis generated four themes: (1) Providing minimal guidance to peer reviewers – two subthemes described the way journal editors rationalised their behaviour: a) Peer reviewers should know without guidelines how to review and b) Detailed guidance and structure might have a negative effect. (2) Communication strategies of engagement with peer reviewers – two opposing strategies that journal editors employed to handle peer reviewers: a) Use of direct and personal communication to motivate peer reviewers and b) Use of indirect communication to avoid conflict. (3) Concerns about impact of review model on communication – maintenance of anonymity as a means of facilitating critical and unburdened communication, and minimizing biases. (4) Different practices in the moderation of communication between authors and peer reviewers – a) Some journal editors actively interjected themselves into the communication chain to guide authors through peer reviewer comments b) Other editors remained at a distance, leaving it to the authors to work through peer reviewer comments.

Conclusions These journal editors' descriptions reveal several communication practices such as indirect communicatation and no guidance to authors on reviewer comments that might have a significant impact on the peer review process. Potential editorial strategies to manage misscommunication are discussed. Further research on these proposed strategies and on communication practices from the point of view of authors and peer reviewers is warranted.

Strengths and limitations

- The use of in-depth qualitative interviews has provided rich data and new insights into previously hidden aspects regarding the communication practices within the peer review process
- We followed rigorous methodological techniques throughout the six phases of thematic analysis to ensure trustworthiness in the analysis
- While study participants were diverse in terms of characteristics related to the journals, we were unable to include more junior editorial staff
- There may have been social desirability bias during the interviews that affected how participants described the communication practices in their journals
- Individuals who declined to participate in the study may have had different experiences of the peer review process in their journals compared with those who agreed to participate

Introduction

The peer review process in biomedical journals involves collaboration between authors, journal editors and peer reviewers that aims to achieve the dissemination of high-quality research. Good communication practices between these actors are vital to achieve this aim. However, evidence suggests that there are numerous flaws within the peer review process, with communication failures lying at the heart of the problem. For example, existing research suggests that an essential aspect of collaboration – the mutual understanding of stakeholders' professional roles and tasks within the process – is not appropriately communicated. This is manifested in part through the inconsistent provision of journal guidelines for peer reviewers across biomedical journals (1). Ineffective communication practices are also manifested through the lack of transparency and considerable variation observed in the content of peer reviewers' grading forms used to evaluate original manuscripts (2).

Miscommunication typically leads to misunderstandings, which in turn might have a negative impact on different aspects of the peer review process. For example, a study that aimed to identify tasks that journal editors expect from peer reviewers who evaluate a manuscript reporting on a randomised controlled trial found a substantial disconnect between the expectations of journal editors and peer reviewers. The tasks rated as important by peer reviewers were different from the tasks clearly requested by journal editors in their recommendations (3). This can have negative impact on the quality of peer reviewer reports as

expectations on both sides remain unmet, and a delay in the publication process might arise because new peer reviewers might have to be found. Such situations can be considered to be wasteful of resources, straining the already over-burdened system (4).

Yet another study demonstrated unmet expectations caused by lack of communication that in turn influenced the willingness and motivation of peer reviewers to participate in the process. According to at least one survey, peer reviewers would like to receive feedback from journal editors about their reports and view other peer reviewers' comments, which are often not provided (5).

The studies mentioned above directly or indirectly report on misunderstandings and miscommunication in this field. However, to the best of our knowledge, thus far there have not been any studies that specifically explore communication practices within the editorial peer-review process in biomedical journals. In order to address this gap, we set out to generate an in-depth understanding of the peer-review process with the aim of capturing social aspects that underpin or influence the process. Given that we are specifically interested in the interaction between the key actors and wanted to capture salient social and subjective dimensions of the communication, we considered a qualitative research approach to be best suited for our study aim. We therefore set out to interview journal editors. Our decision to focus on the journal editors' perspective stems from the fact that they are central figures who oversee the communication between, as well as communicate directly with, both authors and peer reviewers. Furthermore, they interact with editorial team members, publishers and readers of their journals and are therefore involved in all aspects related to communication in peer review.

As indicated in the previously published study protocol (6), this study had two complementary objectives: firstly, to identify journal editors' expectations and understanding regarding the roles and tasks of peer reviewers; and secondly, to explore their perspectives and experiences of their interactions with peer reviewers and authors. The volume of rich data generated by the interviews was such that it would have been difficult to meaningfully condense the research findings into a single paper. This led to our decision to publish the findings in two distinct, yet complementary, research papers. While in the first study, we focused on editors' understanding of roles and tasks (7), in this present study we specifically examined how these are communicated to peer reviewers and how other interactions with peer reviewers and authors work in practice.

Methods

Study design

We adopted a qualitative study design and conducted semi-structured interviews with biomedical journal editors. A detailed description of the study design and methodology is available elsewhere (6), as well as in a related study using this dataset (7). A brief description of the key methodological components follows below.

Patient and Public Involvement

Patients and the public were not involved in the design, conduct, reporting, or dissemination of our research.

Sampling, recruitment and data collection

We used purposive maximum variation sampling (8). Interviewees were recruited from multiple sources, including professional contacts, networks and directly from publishers. Eligible study participants consisted of journal editors of biomedical journals including all specialties, referring to individuals who were at the time of the interview involved in the communication process between authors and peer reviewers and/or who were in a position to decide about the fate of manuscripts. Interviewees were approached via email from multiple sources, including professional contacts; attendees of the Eighth International Congress on Peer Review and Scientific Publication, and from the BioMed Central and British Medical Journal publishing groups.

Prospective interviewees were provided with a study consent form and an information sheet. Interviewees were asked to sign a written consent form. Before starting the interview, study objectives were reiterated and additional information provided where necessary.

Since sample size is irreversibly linked to saturation, which in turn can only be operationalized during data collection (9), our approach to data collection and analysis was iterative. Thus, recruitment continued until saturation – conceptualized as the point at which no new codes and themes were identified from the data – was achieved. All interviews were conducted by the lead author (KG) either face-to-face (n=2) or by telephone (n=2) between October 2017 and February 2018 using a topic guide (Additional file 1) and lasted 25–60 minutes.

While at the time of the interviews KG was a PhD student, she has previously experienced the peer review process in biomedical journals as an author and peer reviewer. She had training in conducting qualitative interviews prior to data collection. She was supervised by DH, who has

extensive experience of the peer review process in biomedical journals as an author, peer reviewer and journal editor.

Analysis

Interviews were transcribed verbatim and fieldnotes were written up after every interview. All documents were then imported into NVivo V.12 and subjected to thematic analysis as described by Braun and Clarke (10) and outlined in the protocol (6). In summary, a preliminary codebook was generated independently by two researchers (KG and DH) from a subset of six interviews (11) using both, deductive codes from topics in the interview guide and inductive content-driven codes. The remaining 50 interviews were coded by the lead researcher (KG), supervised by DH through regular meetings. In line with the iterative process of data collection and analysis, interviews were analysed in the order in which they were conducted. To assess saturation, the lead researcher documented the process of code development, updating the codebook after analysing each transcript. Saturation was achieved after 56 interviews. To establish trustworthiness in this research, the step-by-step approach proposed by Nowell et al., which provides a detailed description of how to conduct a trustworthy thematic analysis, was followed (12). This approach used criteria for trustworthiness in qualitative research proposed by Lincoln and Guba (13) and shows how these can be achieved throughout the six phases of thematic analysis. The methodological techniques that we undertook to ensure a trustworthy analysis throughout our study are presented in Additional file 2.

Results

A total of 56 biomedical journal editors were interviewed (Table 1). Of these, the majority were male (n=40), Editor-in-Chiefs (n=39), and worked part-time (n=50) at specialty journals (n=43) that employed a single-blind review process (n=38). All key characteristics of our study participants are summarized in Table 1.

Table 1 Sample characteristics

Demographic characteristics	
Sex	Female (n=16), Male (n=40)
Position	Junior Editor (n= 1), Senior/Associate Editor (n=11), Co-Editor-in- Chief (n=4), Editor-in-Chief (n=39), Editorial Director (n=1)
Commitment	Part-time (n=50), Full-time (n=6)
Geographic location	Asia (n=2), Africa (n=1), North America (n=19), South America (n=3), Europe (n=28), Oceania (n=3)
Journal characteristics	
Journal specialty	General medicine and Mega journals* (n=13), Specialty (n=43)
Indexing status**	Yes (n=53), No (n=3)
COPE Membership***	Member (n=27), Not a member (n=29)
Peer review model	Single-blind (n= 38), Double-blind (n=7), Triple-blind (n=1), Open peer review (n=9), Post-publication (n=1)
Open access, Subscription, Mixed	Open access (n=35), Subscription (n=4), Mixed (n=17)
Publishers	Academic (n=9), Commercial (n=34), Mixed model***** (n=13)

* A peer-reviewed academic open access journal designed to be much larger than a traditional journal by exercising low selectivity among accepted articles.

** Refers to indexing status on MEDLINE, Scopus and Web of Science

*** COPE – Refers to the Committee on Publication Ethics

**** Refers to journals that are either published by universities and colleges, or by independent research institutes

***** Refers to journals that are either co-owned by medical societies and commercial publishers, or owned entirely by medical societies but operated through a commercial publisher

We identified four themes from the analysis of the interview data: (1) Providing minimal guidance to peer reviewers (2) Communication strategies of engagement with peer reviewers (3) Concerns about impact of review model on communication (4) Different practices in the moderation of communication between authors and peer reviewers

An overview of the themes and subthemes is presented in Figure 1 (Additional file 3).

Providing minimal guidance to peer reviewers

The theme "Providing minimal guidance to peer reviewers" described the way journal editors rationalised providing peer reviewers with vague guidelines and minimal guidance around their expectations. Two subthemes described the way journal editors rationalised their behaviour: a) Peer reviewers should know without guidelines how to review and b) Detailed guidance and structure might have a negative effect.

Peer reviewers should know without guidelines how to review

As a general practice across most biomedical journals, journal editors' expectations in terms of the roles and tasks of peer reviewers are communicated through the publisher's submission system. An automated email invitation typically leads peer reviewers to the online submission system for the journal, where they are presented with a 'reviewer form' interface that may include guidelines for peer reviewers to follow. Only a few journal editors, notably those who work for non-commercial publishers, reported consciously engaging with the guidelines that are provided to peer reviewers by customizing and updating them regularly. On the other hand, journal editors working with commercial publishing groups reported that publishers often "harmonise instructions and guidelines to authors and peer reviewers across their entire range of journals" which usually results in the provision of "standard guidelines that are meant to generally fit all types of research articles". Thus, editors described the guidance provided by publishers to peer reviewers as "rather vague", "rough" and "unspecific" in terms of concrete expectations from peer reviewers. However, this lack of specificity and detail was not considered to be an issue of concern because journal editors predominantly regarded peer reviewer guidelines as being superfluous, indicating that peer reviewers - particularly experienced ones - are unlikely to engage with them:

> "*People just don't read the instructions carefully enough. If they are experienced reviewers, they are definitely not going to read the instructions.*" (Editor-in-chief, specialty journal)

Interviewees generally felt that written guidelines have little or no practical impact on peer reviewers' understanding of their role within the process and the quality of their performance, since such understanding is mostly dependent on the peer reviewer's experience as an author and concurrent peer-reviewing skills acquired over time:

> "*My feeling or my experience is that it might not matter that much what we write, because the good ones [peer reviewers] deliver good reviews anyway, and the bad ones deliver bad reviews anyway. Either you understand your role or you don't. That is at least my experience.*" (Editor-in-chief, general medicine journal)

There was also a prevailing assumption that detailed guidelines and specific instructions are only useful for "inexperienced peer reviewers", whereas "experienced peer reviewers" – described as prolific authors whose manuscripts have been reviewed, and who have reviewed manuscripts themselves, on numerous occasions – already know, or should know, what to do. Since experienced reviewers are preferred over inexperienced ones, the provision of detailed guidelines was not considered to be essential. Notably, interviewees would often speak interchangeably from both their perspective and experience as journal editors and as peer reviewers in order to justify their views:

> "*They receive some guidance, however most of the time the reviewers who are selected are seasoned investigators themselves, and that is the reason why they are selected to review the manuscript. I have been reviewing papers for 30 years, so…we expect the reviewers to know most of the time what is involved.*" (Editor-in-chief, specialty journal)

No need for detailed guidance and structure

The 'reviewer form' interface often includes boxes to fill in, checklists to complete, and space for a narrative report. The reviewer forms of journals whose journal editors we interviewed varied in their structure and detail according to journal editors' preferences and the degree of customization that was possible. To some extent, such forms prompt peer reviewers to comment on specific issues of interest, and can therefore be considered an indirect form of guidance.

Most journal editors reported having a semi-structured form that consists of some open questions, some closed questions, and request for a narrative report. All journal editors emphasized that they place a higher premium on the 'free text' element that provides the critical insight and reflection that they seek to aid their decision-making role. Thus, the majority of interviewed journal editors expressed a preference for having a few multiple-choice questions/boxes and more space for 'free/narrative text'. Yet again, it was notable that journal editors referred to their own experiences as peer reviewers in order to support their views and justify the layout of the 'reviewer form' for their journal:

> "*The structured boxes, I find them kind of annoying actually when I have to fill them out for other journals. If there is too many boxes, some of these boxes become irrelevant and or I address the comments in another box and I have to put in see prior or see next box or so on, because these submission systems don't allow you sometimes to leave a box blank. So it can be annoying to the reviewer. There needs to be a happy medium between structure and free flow.*" (Editor-in-chief, general medicine)

Journal editors were generally open-minded and flexible with regards to the content and style of the report they expect to receive, leaving it up to peer reviewers to decide how to structure their reports. Most editors considered highly structured forms and templates that 'zoom into' the different sections of manuscripts as "not necessarily informative" and "not helpful" to elicit high quality reviewer reports. This is because excessive granularity may discourage some aspects of reviewers' "narrative" or "subjective opinion" - arising from their experience and expertise around the topics discussed - that editors are after. Journal editors also thought that a highly structured form could impede comments on issues that lie outside of the form's list of items. Instead, journal editors prefer to let peer reviewers comment freely without prompt. Therefore, the majority of interviewed journal editors do not routinely share structured guidance with peer reviewers:

> "*We are very open and unstructured…when I reviewed for some other journals it is incredibly highly structured but not necessarily informative. I have noticed that you can have very structured peer review forms and that "makes sure" all bases are covered, but actually it is a little bit of a tick box exercise, and in our journal we simply ask reviewers to make their expert comments on all aspects of the paper that they feel they can comment on. We don't have any of that sort of tight structure, we don't ask for separate views on for instance different sections of the paper, we don't ask for separate comments about methodology. Some editors require quite excessive levels of detail on their peer review form…. we very much take the view that we want a narrative review.*" (Editor-in-chief, specialty journal)

Excessive structure and guidance was perceived to be prescriptive, with connotations of a 'compulsory exercise'. Instead editors felt the need to give peer reviewers a degree of autonomy and "a feeling of freedom and creativity" to keep them motivated. This was achieved by 'non-

communication' (a form of indirect communication), through not giving a structure to peer reviewers.

> *"They can be anyway they want them to be. When I write a review I write it in paragraphs or I might say let me talk about the intro, let me talk about the discussion, let me talk about the results all the reviews are different. But I don't think there is any problem with a free form review, not at all. I don't want to dictate to a reviewer who is not paid to do this. This is purely voluntary so I don't want to make it an onerous task."* (Co-editor-in-chief, specialty journal)

Most journal editors were also in favour of keeping the reviewer forms simple to reduce the risk of excessive 'bureaucratization' of the process and avoid making it a "burdensome" and "not enjoyable" experience, which in turn could affect the willingness of peer reviewers to perform the review:

> *"I think the risk of using templates is that... it turns the review into more of a chore, and I don't mean that it is actually correct, but just as a perception I think it might turn reviewers off."* (Editor-in-Chief, specialty journal)

Communication strategies of engagement with peer reviewers

With the exception of editors from journals with high impact factor, most interviewees highlighted a general shortage of willing peer reviewers so that they frequently find themselves having to act strategically to maintain their reviewing system. As part of this theme, our analysis revealed two distinct and opposite communication strategies that editors employed to handle peer reviewers: a) Use of direct and personal communication to motivate peer reviewers to (continuously) participate in the review process; and b) Use of indirect communication to avoid potential conflict that could discourage peer reviewers from participating in the review process.

Use of direct and personal communication to motivate peer reviewers

The majority of journal editors reported increasing difficulties with recruitment of peer reviewers and expressed frustration with the high decline rate, often having to contact "numerous potential peer reviewers before finding someone who would agree to do the peer review". Journal editors were particularly disheartened by peer reviewers who do not provide any kind of reply to invitations – "not even decline the invitation", an allegedly fairly regular occurrence. Several recruitment strategies are employed to overcome this challenge, most

commonly the establishment of direct and personalized communication as opposed to the standard "faceless" email sent through the submission system. Journal editors reported that making an effort towards a personal interaction, ideally leading to the development of a personal relationship with the reviewer, was key to establishing a "sense of responsibility" for the reviewing task that leads to a desirable outcome:

> *"I think one of the important points in recruiting reviewers is to contact them ... the first contact is important. When you send them an e-mail or call them, it makes it easy [and] they feel a responsibility to cooperate with your journal or to help you with your work... and fulfil the job within the time frame mentioned.*" (Editor-in-Chief, specialty journal)

Direct communication was also used by some journal editors to pre-emptively increase the likelihood of a receiving a high-quality review report. For example, some journal editors reported customizing their communication to peer reviewers in order to draw on their expertise and call specific aspects of the manuscript to their attention. Although such personalization was described as being time-consuming and therefore not feasible for every submission, it is considered worthwhile as it leads to high quality reports:

> "*I try to ask specific questions. I always say: "Any comment on this paper will be appreciated, but in particular…For example: Do you find that the western blots are valid? Do they really make the point that they say they are making?" If I have a very specific question I will ask it and I think that, that improves the quality of the review.*" (Editor-in-Chief, specialty journal)

Direct communication was also purposefully used as a retention strategy to ensure a sustainable relationship with peer reviewers who delivered high quality reports. Journal editors reported sending personalized positive feedback to express their gratitude. This in turn has a positive effect on the motivation and engagement of peer reviewers:

> *"I give positive feedback but I don't give negative feedback. I just have to choose my battles…for me peer reviewers are precious resource and I think that is true with any journal but it is particularly true at our journal, for some of the reasons I mentioned earlier in our conversation there is just a much smaller pool of people*

who can review the papers that we receive. And so, I want to make them feel good when they have done a good job." (Editor-in-Chief, specialty journal)

Use of indirect communication to avoid conflict

Indirect communication was used more generally as a way of maintaining a working relationship with peer reviewers, irrespective of the review report quality. This was explicitly manifested in the way editors dealt with inadequate reviewer reports. Although inadequacy in peer reviewer reports was perceived as highly frustrating due to the delay and additional work burden generated, journal editors consistently reported a preference for indirect communication in such instances because peer reviewers were seen as "precious resource" that "need to be treated with care". Thus, direct criticism/ feedback on poor performance that was believed to result in a conflict, with the concomitant risk of establishing a negative relationship and losing potential reviewers altogether, is avoided. Instead, journal editors preferred to give reviewers the benefit of the doubt in the hope of receiving a better peer review in the future:

"...the trouble is you never ever want to put off a peer reviewer any more than you want to put off an author because you don't know that when you next go back to them they may give you something sensible. And you definitely don't want to have it so that they will automatically decline because they have taken against you." (Editor-in-Chief, specialty journal)

Therefore, journal editors preferred to 'invest time' in and establish positive relationships with 'good' peer reviewers, while generally ignoring peer reviewers who deliver inadequate reports. The most prominent strategy of dealing with poor-quality reports was to "discard" and "ignore" them, and quickly move on to "seeking another reviewer report". In some cases, non-communication (arguably a form of indirect communication) was employed to convey or express the journal editors' displeasure. For example, journal editors reported "not even to send a thank you note" and behaving in a 'passive-aggressive' manner by recording poor performance into their submission system for future reference, or excluding peer reviewers from existing reward schemes where possible:

"I don't give individual feedback. However, the submission system actually is asking us to rate the review. I can rate it as very useful, not so useful, below average, which I do because they get continuing professional development points and continuing medical education points from doing the reviews...if the review was

really bad, if it was really non-informative, then they won't get their points." (Editor-in-Chief, specialty journal)

At the same time, journal editors' understanding of the primary goals and priorities of the peer review process did not include improving peer reviewers' performance or educating them to write better peer reviews. Instead, their priorities are to quickly reach an editorial decision on a manuscript, thereby ensuring a fast turnaround, and to help authors to improve the manuscript:

> *"Why we don't give feedback? We don't want to educate the reviewers…You are not trying to educate the peer reviewers, you would like to feel that the stuff that you send back to the authors is helping to educate your authors."* (Editor-in-Chief, specialty journal)

Despite the lack of direct feedback on reviewer performance for educational purposes, it was standard procedure across journals to send peer reviewers a copy of the decision letter sent to authors (including all reviewer reports) "so that they can see what the other reviewer thought of the paper and I think that is very useful feedback". Notably, journal editors often "hoped" that peer reviewers would read the decision letter and compare their own reports with that of other reviewers. This was considered to be an effective form of indirect feedback facilitated by journal editors. Concurrently, it is also a convenient way of indirectly offering reviewers an opportunity to learn from fellow reviewers:

> *"We also tried to train our reviewers in an indirect way that is when a decision was completed and when we send the decision letter to the author we usually carbon copy the decision along with the comments of all the reviewers to all the reviewers so that every reviewer can see and compare their own comments with the comments of other reviewers… and that would be a form of training for them."* (Editor-in-Chief, specialty journal)

However, there was a degree of 'uncertainty' regarding the effectiveness of sharing the decision letters with peer reviewers. This form of indirect communication puts the onus of improving and learning upon the "interested reviewer", while obviating the need for journal editors to provide individual feedback to reviewers:

> *"But then I don't tell bad things to reviewers; usually I tend to more often just say good things to good reviewers and then hope that some of the mediocre reviewers will just get better when they see the decision letter and how much more detailed and like expansive the comments were from one or two other reviewers."* (Editor-in-Chief, specialty journal)

Lastly, another perceived benefit of automatically copying reviewers in the decision letter sent to authors as an educational strategy is that journal editors thereby avoid explicitly voicing their own opinion regarding the adequacy (or lack thereof) of reviewer reports:

> *"If we do it in that way, then later the reviewers can have a look at the other reviewer's opinion and they can learn from the other reviewer without us strongly stating that this is our opinion."* (Senior/Associate Editor, specialty journal)

Concerns about impact of review model on communication

This theme is centred around the preservation of anonymity as a way of facilitating angst-free communication and preventing potential biases. Most journal editors outlined why they are unwilling to commit to opening reviewer identities in their journals. Included under this theme were two interconnected categories: a) *facilitation of critical and unburdened communication* and b) *mitigation of potential biases.*

Facilitation of critical and unburdened communication

Traditionally, many biomedical journals have employed a single-blind review model where authors are kept unaware of their peer reviewers' identity. This was also the case for the majority of journals our interviewees worked for. Journal editors were not keen to change this set-up for several reasons. Their support for maintaining peer reviewer anonymity primarily stems from the fact that peer reviewers and authors are often either potential "competitors for grants"; "colleagues and/or collaborators"; or even both simultaneously. Given this situation, journal editors commented that anonymity allows peer reviewers to be "more frank", "more open" and "more critical", and thus leads to "better quality reports" than in situations where reviewers' identities are potentially known by authors. Journal editors gave examples from their own experiences and behaviours as peer reviewers within an open peer review process to illustrate how they tempered their true opinions to avoid causing offence that might have future

negative repercussions. One editor's comment provides a good illustration of how the reviewer's communication strategy is potentially adjusted in an open review model:

> "*I did a peer review just recently…I think that article should have been rejected. I didn't dare suggest rejection because it was all open peer review and these were colleagues from the region, who knew me and I knew them you know and it was like 'Oh-oh. What am I going to say?' So yes, I tried to sort of be very I don't know, be as educated as possible and say maybe it is not you know, maybe it doesn't fit the article section.*" (Editor-in-Chief, general medicine journal)

Journal editors' opinions were strengthened by their experience of peer reviewers' low uptake of the option to sign their reviews. They explained that remaining anonymous is a way for peer reviewers to ensure "self-protection" and "avoid potential conflict". A number of editors also hypothesized that a lack of anonymity might negatively affect peer reviewers' review acceptance rate and curtail their ability to find peer reviewers, thus exacerbating existing recruitment difficulties:

> "*In a specific area like mine, you know the area is not that big, and - we have discussed this among the associate editors as well - we have never had any wish to have an open system regarding disclosure of the names of the reviewers. It would have been more difficult to find reviewers, I am quite sure.*" (Editor-in-Chief, specialty journal)

Mitigation of potential biases

Editors of journals that employed the single-blind or open peer review models shared the perception that there is little to be gained by implementing a double-blind review model because "it would be easy for everyone to figure out the identities" of reviewers, particularly in the case of small and highly specialized fields.

In contrast, while journal editors who employed a double-blind review model were aware that peer reviewers and authors might still suspect each other's identities, they felt that implementing this model remained worthwhile to prevent biases based on authorship from affecting the quality of the peer reviewer report. For example, they referred to the potential for peer reviewers to alter their communication practices due to "prestige bias" – where peer

reviewers' judgement and objectivity is influenced by the authors' affiliation - leading to "lenient", poor quality reports. Journal editors felt that anonymity helped to mitigate this type of bias:

> "*In my field we have the problem…let's just say there are some prestigious groups that crank out a lot of papers, of variable quality. Sometimes reviewers would see that the papers were from these famous people and they would write really short superficial reviews that were praising this work when it didn't deserve to be praised…So we just changed to blinded review and so that really solved the problem. There was a really noticeable change in fact sometimes, because I make a point of obviously sending all the decision letters to the reviewers and some people expressed interesting comments like oh my gosh I had no idea it was from this group. And some of them even went so far as to say I am glad it was blinded review…we found that whatever the case may be in the rest of the journal world for us it was better to have blinded review.*" (Editor-in-Chief, specialty journal)

In contrast, journal editors who employ an open identity practice by default felt that it increases accountability of all parties involved, opening up the 'black box' of editorial decisions:

> "*I think all peer review should be open and transparent. I just think it is a better way of doing things. It is more honest to the author in that the reviewer is given their name. It is honest to readers of the papers in that for example if, if two reviewers both feel the paper should be rejected, and say so quite forthrightly within their reviews then as an editor you are not going to publish that paper with reviews that are in effect available online saying the paper should have been rejected.*" (Editor-in-Chief, specialty journal)

Different practices in the moderation of communication between authors and peer reviewers

Generally, journal editors moderate all communication exchanges between authors and peer reviewers during the entire peer review process. We found different practices in the way journal editors facilitated this exchange, particularly when handling peer reviewer comments' prior to forwarding them to authors. Most commonly, journal editors regarded themselves as "curator of peer reviewer comments". However, the operationalisation of this role varied considerably.

Active guidance of authors through peer reviewers' comments

Some journal editors considered "guiding authors through peer reviewer comments" to be one of their key tasks. This would typically happen in consensus with other editorial members. After checking the peer reviewer reports and deciding on how to proceed with the manuscript, they then send back the peer reviewers' comments to authors with specific guidance on how to address them together with any additional editorial comments. This practice was considered to act as a 'safety net' to screen out incorrect suggestions and provide any supplementary guidance:

> "*The role of the journal editor has to be to look at what comments from the reviewers are really important to improve the [manuscript] that authors should compulsorily follow. [But] others are not so important or maybe I might indeed think that there are wrong recommendations, so I have to advise the author that this is either an optional advice or even an advice that they don't have to follow. We can say to the authors 'please address explicitly the points number 1, number 3 and number 5' and in doing this we are saying to the authors 'don't worry about the points 2 and 4'. So it is not so a big problem if the reviewer is not completely right from our point of view.*" (Senior/Associate Editor, specialty journal)

Passive approach to the moderation of communication

In contrast, other journal editors practiced an alternative, less hands-on method where peer reviewers' comments are sent to authors without any editorial guidance, letting authors decide how to deal with them, including with any contradictory comments. They would then judge the comments and author replies together, and make a final editorial decision. While there was some recognition that providing guidance to authors could be valuable, time constraints often prevented editors from doing so:

> "*Guiding authors through peer reviewer comments is something which would be certainly valuable but I have too many manuscripts to do that. It would be too much work. It is just not feasible and sometimes there are conflicting views so it is of the responsibility of the authors when they send back the revision to say "I couldn't please both reviewers, and the reason why I chose to do this revision." So I judge on that after but not before I send (it to authors). But, ideally it should be done beforehand but it is, honestly too much you know when you have so many manuscripts.*" (Editor-in-Chief, specialty journal)

Discussion

This study is one of the first attempts to understand communication practices within the peer review process in biomedical journals. Our findings illustrate how several communication practices that are employed in response to specific circumstances/challenges may also concurrently influence the peer review process itself. In addition, while it is apparent that journal editors' unique threefold experience as authors, reviewers and editors inevitably shapes their attitudes and perceptions towards peer reviewing, this is likely to be both a strength and a weakness. As was evident in their responses, journal editors may unintentionally project their own experience as peer reviewers, often not evidence based, onto the entire peer review system, potentially limiting their ability to step outside of it and critically appraise their own narrative. This can lead to attitudes and behaviours antithetical to evidence, which is ironically often a threshold to publication required by journal editors.

Many factors affect the communication between journal editors and peer reviewers. However, at the core of this interaction, certain basic principles apply. Some, such as communication of the roles and tasks that journal editors expect peer reviewers to take on and perform, might well serve as key starting points for the process. However, our study findings from the first theme indicate that journal editors do not find this transfer of information important, at least in the biomedical field. Existing literature that explores peer reviewer guideline content and provision practices across journals showed that these are often generic, non-specific and not readily available (1). Our study adds to this knowledge, suggesting that this vagueness is explicitly underpinned by journal editors' prevailing attitude that guidelines do not play an essential role in conveying their expectations (in terms of roles and tasks) to peer reviewers. This attitude is in line with findings that highlighted journal editors' apparent lack of appreciation for formal peer reviewer training (7). In both cases, the justification was the same: peer reviewers should know how to review a manuscript without needing guidelines and training. Such an approach to the communication of roles and tasks is likely to be an obstacle to mutual understanding, and may ultimately impact the quality of reports received. The underlying fundamental assumption is that (extensive) authorship would inevitably lead to good reviewing ability. However, thus far, there is no evidence to support this assumption (14) and further research is needed to assess whether it is actually true or peer reviewing scientific manuscripts is a skill that can be honed through specific training. Providing guidelines to peer reviewers could be a key aspect of such training, especially because peer reviewers come from all over the world, and it is unrealistic

to believe that all of them are on the same page concerning what peer reviewing actually means. A survey of peer reviewers has shown that the most common type of peer review 'training' comes in the form of guideline provision, most commonly journal's instructions for reviewers (15). In the absence of formally established requirements, commonly agreed standards, and widespread training programme delivery, we believe detailed guidelines to peer reviewers could be a useful starting point for editors. Given the variations observed in terms of expectations by journal editors these would provide a common starting point and an essential reference point during the review process. Concurrently, it would be important to promote their dissemination and uptake, particularly in light of our study participants' prevailing attitudes that peer reviewers generally do not read or use guidelines at all. While it must be kept in mind that journal editors might be projecting their own behaviour when reviewing onto other peer reviewers, it is nevertheless an important point, possibly indicating that guidelines need to be presented in a better, more appealing way. Our study data also revealed that there is a diversity of peer review forms in terms of structure. Most journal editors preferred less structured forms and argued that it is better to let peer reviewers comment in an unprompted manner to elicit responses that match their expertise, rather than probing for feedback on areas that they might not feel entirely confident about, but still feel obliged to fill in the relevant box. Furthermore, journal editors expressed a fear of potential bureaucratization and "stifling of creativity" of the process through the introduction of a rigid structure that in turn could further reduce the willingness of peer reviewers to participate in the process.

Thus, given these findings it is evident that further research around how guidelines can be made more appealing – in terms of formatting, layout and content - is warranted. We are not aware of existing empirical evidence on peer reviewers' preferences regarding the structure of peer reviewer forms and guidance. Research on how the uptake of guidelines and guidance among peer reviewers can be improved is also warranted. A strong evaluative component is crucial for such research to promote meaningful improvement in peer reviewer practices. In the biomedical field, it is a well-established fact that physicians across all disciplines are resistant to adherence to clinical guidelines and there is research looking into the contextual factors around physicians and personal motivators for uptake, as well as the guidelines themselves, to understand enabling and disabling factors for uptake and implementation (16). Thus, research on peer review guidelines and implementation should make use of methods and knowledge gained from this field and translate it where possible accordingly.

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Our results from the second theme showed that journal editors are well aware of the positive effects of direct communication and strategically use it for retention and reward purposes. This approach is in line with evidence suggesting that the establishment of personal relationships and the opportunity to network with journal editors is ranked highly among peer reviewers as a motive to participate in the peer review process (15). However, this study also revealed that despite consciously being aware that personal communication can be effective, it was not specifically used to improve the quality of peer reviewer reports: journal editors would not provide direct feedback to peer reviewers who deliver inadequate peer reviewer reports. Thus far, except for receiving an email on the final editorial decision of the reviewed manuscript and a copy of the other reviewers' reports, peer reviewers do not often receive direct meaningful feedback regarding the quality of their work. Evidence suggests peer reviewers would like to receive feedback from a journal on their peer review report, and this would make them more likely to accept an invitation to peer review (15).

Additional research to assess whether this could be a missed opportunity is warranted: investing time to send peer reviewers personalised and constructive criticism might reap dividends, whereas the current preference for indirect, impersonal communication simply perpetuates the status quo.

However, there are several barriers that might prevent the implementation of an approach that gives due importance to feedback in peer review. Firstly, the accounts of journal editors revealed a prevalent lack of time - the vast majority of editors in biomedical journals work part-time for a purely symbolic remuneration whilst juggling many other additional professional roles. Therefore, journal editors preferred to 'invest time' in educating authors (who in turn might become future peer reviewers for their journal), while generally ignoring peer reviewers who deliver inadequate reports. While there is evidence that peer reviewers decline review requests due to a lack of time (17), we are not aware of studies assessing the impact of lack of time on journal editors' work. However, given that the shortage of peer reviewers is a serious and widespread issue (17), this reluctance to educate peer reviewers is likely to be a missed opportunity. Peer reviewers review 'for free' without remuneration. A 'contractual' approach - where reviewers can expect to receive editorial comments on their reviews in lieu of formal training or instead of a fee - should be seriously considered, perhaps under a stronger inclusion of editorial board members to support journal editors with this task. In addition to potentially enhancing the quality of peer review reports, such an approach would also increase overall review capacity.

Secondly, journal editors are part of the wider scholarly system; they are often researchers who compete for grants and authors who submit their manuscripts to journals. It is possible that they might fear the consequences of providing feedback. This could be perceived as unsolicited criticism of peer reviewers' work, potentially leading to conflict and far-reaching professional consequences ranging from being disadvantaged when applying to grants to unwillingness of peer reviewers to re-engage with the journal.

A third barrier is the general lack of evidence around the domain of 'quality' in peer review (18), leaving journal editors without the tools required to methodologically assess the quality of peer reviewer reports.

Lastly, it is important to keep in mind that journal editors are not omniscient by default. For example, a study on the completeness of reporting of randomised trials published in biomedical publications highlighted that a proportion of editors did not correctly identify RCTs, suggesting that there is need for journal editors to enhance their knowledge around identification of a randomised trial and the appropriate reporting guideline (extensions) required (19). Such examples raise questions around journal editors' training and qualifications, an area that requires further research.

Our analysis of the third theme showed that editors have diverse views on the existing peer review models and their potential influence on communication practices in their journal. The majority of our study participants employed a peer review model that does not display review identities by default.

They felt that maintaining anonymity would facilitate better communication practices among peer reviewers leading to high quality reports while protecting peer reviewers from potential conflicts. This attitude reaffirms the existence of bias in the peer review process (20) and is in line with existing research showing that survey respondents were against opening reviewer identities to authors, believing it would make review report quality worse (21,22). This attitude was strengthened by the low uptake of peer reviewers willing to avail themselves of the option to display their identity, which was also reflected in literature (14). The pros and cons of blind review vs open peer review have been widely discussed, with a diversity of views and evidence suggesting that there is no one-size-fits-all solution. However, given that academia is affected by hyper-competition (23) that works on self-regulatory basis (i.e. funding boards consists of researchers that evaluate other researchers work), it could be argued that there is a deep ingrained culture of fear of repercussion – something that became evident throughout the

interviews. This is a major barrier for effective communication practice and can have an impact on the quality of the review process.

The last theme revealed starkly divergent practices in the way journal editors performed their own role. In our study, this notion was exemplified by the moderation of communication between authors and peer reviewers. While some journal editors actively interjected themselves into the communication chain to guide authors through peer reviewer comments others prefer to remain uninvolved – forming their own opinion and decision after viewing the exchange between authors and peer reviewers. A passive approach to the moderation of communication between authors and peer reviewers is a missed opportunity to contribute to the improvement of the peer review process and is not in line with editorial best practices recommended by professional associations. The World Association of Medical Editors (WAME) stipulates that journal editors should make it clear to authors, which revisions are essential and which are optional, and provide active guidance in the case of contradictory comments (24). Some evidence shows that a system with greater editorial involvement can improve the effectiveness of peer review (25). Evidence also suggest that at times peer reviewers are not able to pick up all methodological errors (26), thus an active journal editor can fill in the gaps where possible. Ultimately, it is the journal editor who has overall responsibility for the manuscripts they are assigned to, therefore we believe that it is important for the journal editor to take an evidence-based approach to editorial practices and active ownership of the review process.

Limitations

Our recruitment approach and predominant contact with editors-in-chief during the recruitment phase gave rise to a relative homogeneity of our study sample. This could have led to selection bias, which is a key limitation of this study. The limited representation of other editorial staff members typically involved in the peer review process (such as junior editors) may limit the generalizability of our results. Therefore, there is a need to explore whether the involvement of editorial staff in other positions would have produced different and/or more nuanced findings.

Conclusion

In conclusion, our study showed that there are a number of issues related to communication practices that might have a significant impact on the peer review process and its outcomes. In the absence of effective communication among the key stakeholders, poor transfer of critical information may ultimately lead to reviewer dissatisfaction and dissemination of low quality

research. Less visible communication failures due to embedded organisational practices and unprofessional behaviours remain a challenge. Therefore, it is important to keep the broader context in mind when attempting to enact changes the system at the organisational and individual level. Further research into communication practices from the point of view of authors and peer reviewers will broaden our understanding of existing editorial practices and evolving communication strategies for managing miscommunication.

Footnotes

Contributors: All authors have made substantive intellectual contributions to the development of this manuscript. KG and DH jointly contributed to study conception and design. While KG led data collection, analysis and writing of the manuscript DH led the supervision of all these steps. IB and DM have contributed to the writing of the manuscript and approved the final manuscript.

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Patient consent: Not applicable.

Ethics approval: This project has been evaluated and approved by the University of Split, Medical School Ethics Committee. Ethical approval (Reference number 2181-198-03-04-17-0029) was granted in May 2017. Prospective interviewees were provided with a study consent form and a study information sheet. Interviewees were asked to sign a written consent form prior to being interviewed. Copies of the invitation letter, information sheet, and consent form are available from the leading author (KG).

Data sharing statement: The data generated and/or analysed in the study are not publicly available due to participant anonymity, but may be available from the corresponding author on reasonable request that includes a study protocol, ethical approval and data use agreement.

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Discussion

Summary of findings

This thesis filled existing gaps of research on the content and communication practices of the peer review process in biomedical journals. More specifically, the roles and tasks of peer reviewers are not clearly defined, and therefore the expected contents of peer reviewer reports are not clearly outlined. Furthermore, there is evidence that communication between key stakeholders is not optimal.

In my first project, I performed a scoping review of the literature to determine the roles and tasks of peer reviewers in biomedical journals. I showed that peer reviewers are expected to perform a large number of roles and tasks. I identified 76 unique statements relevant to roles and grouped them into 13 themes: *Proficient experts in their field, Dutiful/altruistic towards scientific community, Familiar with journal, Unbiased and ethical professionals, Self-critical professionals, Reliable professionals, Skilled critics, Respectful communicators, Gatekeepers, Educators, Advocates for author/editor/reader and advisors to editors.* Roles that do not fall within the remit of peer reviewers were also identified.

I also identified 73 unique statements relevant to tasks and grouped them under six themes: Organisation and approach to reviewing, Make general comments, Assess and address content for each section of the manuscript, Address ethical aspects, Assess manuscript presentation and Provide recommendations.

Among those numerous roles and tasks I found that some of them are vague, contradictory and overlap with the respective position of the journal editor. Thus, the scoping review provided evidence that there is lack of clarity and appropriate communication of peer reviewers' roles and tasks and illustrated that overall the descriptions of the numerous roles and tasks are unhelpful to facilitate the understanding of what is needed. It is the first time that a comprehensive list of roles and tasks for peer reviewers in the biomedical field was derived from a wide range of sources and reported in a published article.

In responding to my second study objective, I gained deeper insight into journal editors' understanding of the roles and tasks of peer reviewers. Their understanding of peer reviewers' role as proficient experts in the field was determined by extensive authorship, while formal

training was not considered to be essential. Findings also showed that journal editors were divided on whether peer reviewers should be seen as doing their duty towards the scientific community or as volunteers who deserve recognition. Consistent with findings from the scoping review, there was a general agreement among study participants on the need for peer reviewers to be unbiased, ethical, reliable professionals and skilled critics. In particular, journal editors primarily regarded peer reviewers as their advisors and themselves as ultimate decision makers, yet the majority gave considerable importance to the reviewers' recommendations. Furthermore, the findings showed that considerable agreement existed concerning technical tasks, however there was an apparent difference in journal editors' expectations of the level of depth and detail depending on the resources of the journal.

In my last project, I explored journal editors' experience of the communication process in their journals. This qualitative work showed four communication practices that influence the peer review process. Journal editors rationalised providing peer reviewers with vague guidelines and minimal guidance around their expectations in two ways. Firstly, the prevailing attitude is that guidelines do not play an essential role in conveying journal editors' expectations to peer reviewers, that peer reviewers should know how to review a manuscript without needing guidelines and that peer reviewers generally do not read guidelines. Secondly, journal editors expressed the fear that (overly) structured reviewer forms might have a negative impact on the review report quality due to prescriptive probing rather than unprompted responses and can impact the willingness to participate in the review process due to over bureaucratization of the process.

Furthermore, I found two opposing communication strategies that journal editors employed to handle peer reviewers. The first strategy evolved around the use of direct and personal communication to motivate peer reviewers to (continuously) participate in the review process. Journal editors were aware of the positive effects of direct communication and use it strategically for retention and reward purposes. On the contrary, they use indirect communication with peer reviewers who deliver inadequate reviewer reports to avoid potential conflict that they believed might arise by the provision of feedback.

Additionally, journal editors were concerned about the potential impact of review model on communication and most of them were against opening peer reviewer identities to authors arguing that it would potentially make reviewer report quality worse due to potential bias that

might arise from the removal of anonymity and due to the fear of repercussions for expressing criticism.

Lastly, journal editors employed two divergent practices in the moderation of communication between authors and peer reviewers. While some take an active role and guide authors through peer reviewers comments, there are others who take a passive role and just forward the comments to authors without any guidance.

Implications

This research showed that peer reviewers are expected to perform a large number of roles and tasks, some of which are vague, contradictory, and overlap with the roles and tasks of journal editors, and that current communication does not facilitate understanding of expectations among and between stakeholders. In the absence of formally established requirements or commonly agreed standards, together with variations in expectations by journal editors and the international nature of scientific publications, my findings may help to raise awareness among journal editors that an attitude of 'implicitness' (i.e. that peer reviewers shouldn't need guidelines because, as authors, they should already know what is expected of them) is neither fitting nor helpful. It might also obstruct mutual understanding of roles and tasks between the key actors, which in turn may affect the quality of peer reviewer reports. My findings further suggest that there is a need for journal editors to critically review and evaluate the content of their instructions to peer reviewers and explore how their uptake can be improved. Ideally, this evaluation should be set up as a scientific study, for example as a randomized control trial, to create solid empirical evidence on the practice of managing peer review in a scientific journal which can then be used by other journals. This is in line with repeated calls for more research into peer review [54,101].

My findings also demonstrated that most journal editors are of the opinion that authorship experience is key to producing high-quality reviews, while formal training in peer reviewing is not. In the light of existing surveys suggesting a profound need for this kind of training [102], together with the surge of large-scale, international courses such as those organized by Publons, this attitude is likely to be unwarranted, untimely, and not sustainable in the long run. Peer reviewing manuscripts is a skill that can and should be developed through specific training. In developing this skill authorship experience is probably necessary, but not a sufficient condition.

Therefore, one of the wider implications arising from my study is that the scientific community needs to recognize peer reviewing as a separate skill from writing a scientific manuscript, and that the establishment of formal training for peer reviewers is essential to hone this skill. However, this would only make sense if there is cross-journal agreement regarding the essential key elements of a high quality reviewer report and universal recognition of the competencies that are necessary to deliver it [103]. Furthermore, in the absence of sturdy evidence linking authorship experience and academic qualifications to high-quality reviews, as well as existing difficulties in finding willing peer reviewers, journal editors should consider moving away from focusing their invitations to review solely on senior researchers. Instead, they should invite junior researcher to review manuscripts on a more regular basis.

In addition, this study demonstrated that the majority of journal editors gave considerable importance to reviewers' 'recommendation' function. While being fully aware that the absence of commonly agreed-upon definitions for manuscript recommendation options and the common occurrence of disagreement among peer reviewers are problematic, there seems to be little awareness that this emphasis might inadvertently convey to peer reviewers the false impression that they are decision makers. Such an impression is misleading, and may influence the focus of the peer reviewer report accordingly instead of focusing on the improving function that most journal editors desire. Given the potential for misunderstandings, my findings support calls for removing reviewers' 'recommendation function' [104]. This might help to eliminate a problematic aspect of the existing malleable boundaries of authority and responsibility for scientific gatekeeping, realigning the role of peer reviewers as 'advisors' while placing the journal editor in the sole decision-maker position. Again, such an intervention should be set up as a scientific study to create evidence for or against this step.

Another key implication arising from my research is the need to engage with peer reviewers that deliver inadequate peer reviewer reports by sending them personalised and constructive criticism. The current common practice - as outlined by my study participants – involves simply circulating peer reviewer reports in the hope that poorly-performing peer reviewers will learn from their colleagues' efforts. As such, it is intangible and most likely does not help to achieve a real long-lasting learning effect or foster critical reflection on one's own performance as a peer reviewer. Although implementing this suggestion would inevitably mean a major

investment for journal editors, in the long run it might reap substantial dividends, whereas current practice simply perpetuates the status quo. Here again, the generation of evidence and agreement around the domain of quality would give journal editors the tools required to methodologically assess the quality of peer reviewer reports. At the same time this study outlined three main potential barriers to implementation of this suggestion, namely: 1) Lack of time among journal editors; 2) Fear of repercussions including loss of potential peer reviewers; and 3) Disagreement that the education of peer reviewers should be a responsibility of journal editors. These barriers are not easily overcome and require substantial systemic changes. It might indeed be unrealistic to expect journal editors who mostly work part-time [29] to provide individual feedback. Therefore, substantial financial investment by publishers is needed to create incentives for journal editors to commit more time to editorial work. Incentives for editorial board members to support journal editors with this task should also be considered. In order to address the second barrier, the system needs to be turned inside out. For example, feedback provision could be a new standard procedure that is presented to peer reviewers as a service in recognition of their substantial time investment, rather than as criticism.

Lastly, my findings suggest that some journal editors employ a passive approach to the moderation of communication between authors and peer reviewers. This is not only a missed opportunity to contribute to the improvement of the peer review process, but also not in line with editorial best practices recommended by professional associations such as WAME [28]. Lack of time was, according to my study participants, the main reason for engaging in such a passive approach. This finding highlights that this is a major and recurrent problem with a potentially significant impact on the peer review process, and adds fuel to the call to create (financial) incentives and provide better support for journal editors to lead their journals in line with best practices. Concurrently, this finding also raises the need to conduct large-scale research on the editorial practices by journal editors. While lack of time is undeniably a major factor, it might well be that journal editors are not aware of existing best practices since many journal editors of biomedical journals operate largely without formal training [50]. Unlike other professional associations (e.g. medical associations), there is no mandatory universal certification or membership procedure that journal editors need to fulfil. Thus, the broader implications for my study are in line with the plea made by Moher and Altman for research funders and publishers to invest money into journalology investigations, certification and continuing training for journal editors as well as peer reviewers in the long run [103].

Strengths and limitations of this research

Strengths

This research has a number of strengths. First, an *a priori* study protocols [72,73] that extensively outline the rationale, methodology and analyses for my research (Appendix 1 and 2) were published in advance for all papers. The publication of protocols helps to ensure transparency in the research process and informs other researchers about ongoing research activities.

I made use of complementary methods, and triangulated data arising from the scoping review and qualitative research, with substantial convergence of findings demonstrated across the three research papers.

Through the scoping review, I systematically identified the roles and tasks of peer reviewers in biomedical journals and produced a comprehensive list derived from a wide range of sources. It complements existing work on journal editors [50,64] and while it is focused on the biomedical field, the findings could apply more broadly to other scientific fields.

The qualitative projects responded to a long-recognised need for (more) qualitative research into the peer-review process in the biomedical field [105]. The interviews enabled journal editors to speak freely and at length about their personal experiences. Most were frank and forward in sharing their own practices (including potentially controversial ones) and expressing critical, uninhibited views on the workings of the peer review process in their journal and in general. Another strength of the qualitative research employed for this thesis is the diversity of study participants in terms of journal characteristics, such as the broad range of specialty fields and journal sizes reached.

Lastly, I believe that my study sample has adequately mirrored the current 'state' of biomedical journals. For example, there is an existing gender imbalance in biomedical journals in terms of editorial positions: women hold fewer editorial board positions [38] and the vast majority of editors-in-chief are male. This is also the case for my study participants. Furthermore, most biomedical journal editors work part-time [29], as did 50 out of 56 of my study participants. Lastly, most biomedical journals still operate a single-blind peer review process [22] which was also the case for the journals included in my study.

Limitations

At the same time, while conducting my research, I encountered several conceptual and methodological challenges, resulting in several limitations that merit critical discussion.

First, despite the systematic search conducted across multiple databases, it is possible that some aspects of peer reviewers' roles and tasks described in the literature might have been missed. The search strategy was designed to be as broad and as inclusive as possible, and consequently resulted in a large number of irrelevant hits. For example, the term 'peer review' is commonly also used in the biomedical field to refer to the ongoing professional practice evaluation of clinical performance in hospitals. It is also used as an educational strategy in the course of education across all health-related professions. My search returned a total of 23,176 records and included a substantial number of studies on the aforementioned topics that were irrelevant to my research question. For pragmatic reasons, this large set of records was initially only screened by myself to exclude studies that seemed completely irrelevant, resulting in 2763 citations deemed suitable for double-screening. Some relevant literature might have been missed during the initial screening process.

Second, given the large number of statements on roles and tasks obtained, inevitably there were a number of redundant and overlapping items. Considerable effort was made to preserve the wording used by authors as much as possible and to capture all nuances, however some streamlining was necessary to ensure that the final list of roles and tasks was both manageable and useful. It is possible that this resulted in occasional misinterpretation of authors' intended statements and potential loss of subtle differences between the items.

Third, no language restrictions were set for the database searches. Data were extracted from articles written in English, German, Spanish and Portuguese. However, the database search may not have included some journals that publish in other languages. Furthermore, due to feasibility issues, the grey literature search was restricted to English and hence potentially excluded relevant resources in other languages.

Lastly, in the a priori protocol of the scoping review, I described the steps for conducting a comprehensive review of biomedical journal guidelines. However, over the course of the work it became clear that this proposition was overly ambitious and probably merited its own manuscript. I ultimately deemed it not to be feasible to complete within a reasonable timeframe, particularly in light of the large number of records that needed to be screened. This deviation from the protocol was noted in the manuscript.

The second and third research projects share the study methodology and therefore also share its limitations. The recruitment approach employed gave rise to several limitations in both studies. Purposive maximum variation sampling [88] was used to obtain as much diversity in the demographic and journal characteristics of study participants as possible. Interviewees were recruited from three sources: 1) Professional network within the Methods in Research on Research project; 2) Two publishers (BioMed Central and British Medical Journal publishing group); and 3) Attendees of the Eighth International Congress on Peer Review and Scientific Publication identified from the participant list. This recruitment approach led to an initial predominant contact with editors-in-chief. Although potential interviewees were asked either to participate themselves or to recommend suitable journal colleagues who could be contacted in their stead, two thirds of participants ended up being editors-in-chief within their respective journal, leading to relative homogeneity of the study sample in terms of the interviewees' position in journal editorial boards. This limited representation of other editorial staff members typically involved in the peer-review process may limit the generalisability of the results.

Future work

My research thus far has focused on published literature and on the point of view of journal editors. However, to get a more comprehensive overview and understanding of the expected roles and tasks of peer reviewers and communication practices, it is necessary to explore peer reviewers' and authors' perspectives as well. While there have been calls to explore the quality of journals' manuscript peer review process by analysing the written communication between authors, referees, and journal editors, I was unable to identify studies that examined both peer reviewer reports and authors' responses at the same time. It appears that while there are a few studies that investigate some of the areas ('content areas') peer reviewer focus upon, thus far a systematic characterization of such content areas has not been carried out. Such an analysis would provide an integrative overview of the peer review process, one that looks at the entire web of communication between authors, editors and peer reviewers. In this section I propose a study that will address a gap in the knowledge base by examining the content of peer reviewer reports and their corresponding responses by authors across both accepted and rejected manuscripts.

The overall aim of this future study would be to explore the interactions between authors, peer reviewers and journal editors. More specifically, my research findings suggest that it would be

important to map out the components and characteristics of peer reviewer reports on manuscripts of original research, and to analyse authors' responses to these reviewers' comments. Specific objectives could include:

- To characterize content areas that peer reviewers focus upon within peer reviewer reports
- To classify types of tasks requested by peer reviewers
- To explore how authors negotiate peer reviewers' requests to make their manuscript more acceptable for publication

Content analysis - a method for systematically describing documents and written communication - would be an appropriate method to explore the content of peer reviewers' reports and the subsequent responses by authors [106]. The process of content analysis can be divided into three phases: preparation, organization, and reporting [107].

A convenience sample of data associated with original biomedical research articles, such as peer reviewers' reports and authors' subsequent responses, shall be obtained from a biomedical journal. If possible, in order to get a comprehensive dataset that reflects the true situation around peer review, a sampling strategy that considers both accepted and rejected manuscripts should be adopted.

The starting point of the analysis is the identification of an eligible individual manuscript, which will be considered to be the primary unit of analysis. Each manuscript may have multiple peer reviewer reports and responses by authors associated with it. These would be the focus of this future study. Within these data, individual sentences can be extracted, coded and analysed.

Both inductive and deductive approaches would be adopted in order to: map/classify the content of peer reviewer reports; identify types of tasks requested by peer reviewers and develop a coding framework; and to identify negotiation strategies employed by authors.

I expect the study results to consist primarily of descriptive statistics and exploration of themes for content areas that peer reviewers focus upon within peer reviewer reports; types of tasks requested by peer reviewers; negotiation strategies employed by authors and editorial decisions on the ultimate fate of the manuscript.

Conclusion

My research confirmed that the expected roles and tasks of peer reviewers and thereby the content of peer reviewer reports is not clearly outlined and communicated. I identified a large number of roles and tasks and highlighted problematic areas related to vague descriptions, contradictory statements and areas that overlap with the supposed duties of journal editors. My research unpacked and explained these incongruities. I have also illustrated several communication practices that might have a negative impact on the peer review process.

The finding of my research provide clear evidence that there is a need to define quality criteria for peer reviewer reports and for journal editors to critically review their communicative practices.

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Appendices

Appendix 1 – Study protocol for paper 1

Open Access Protocol

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A scoping review protocol on the roles and tasks of peer reviewers in the manuscript review process in biomedical journals

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ABSTRACT

Introduction The primary functions of peer reviewers are poorly defined. Thus far no body of literature has systematically identified the roles and tasks of peer reviewers of biomedical journals. A clear establishment of these can lead to improvements in the peer review process. The purpose of this scoping review is to determine what is known on the roles and tasks of peer reviewers.

Methods We will use the methodological framework first proposed by Arksey and O'Malley and subsequently adapted by Levac *et al* and the Joanna Briggs Institute. The scoping review will include all study designs, as well as editorials, commentaries and grey literature. The following eight electronic databases will be searched (from inception to May 2017): Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, EMBASE, MEDLINE, PsycINFO, Scopus and Web of Science. Two reviewers will use inclusion and exclusion criteria based on the 'Population–Concept–Context' framework to independently screen titles and abstracts of articles considered for inclusion. Full-text screening of relevant eligible articles will also be carried out by two reviewers. The search strategy for grey literature will include searching in websites of existing networks, biomedical journal publishers and organisations that offer resources for peer reviewers. In addition we will review journal guidelines to peer reviewers on how to perform the manuscript review. Journals will be selected using the 2016 journal impact factor. We will identify and assess the top five, middle five and lowest-ranking five journals across all medical specialties.

Ethics and dissemination This scoping review will undertake a secondary analysis of data already collected and does not require ethical approval. The results will be disseminated through journals and conferences targeting stakeholders involved in peer review in biomedical research.

Strengths and limitations of this study

- ► The large volume of literature informing this scoping review ensures that a broad overview of the roles and tasks of peer reviewers in the manuscript peer review process within biomedical journals will be obtained
- ► Another strength of this study is the inclusion of grey literature, including the review of journal guidelines.
- ► As this is a scoping review, the quality of the evidence and risk of bias will not be evaluated.

BACKGROUND

The publication of peer-reviewed articles in scientific journals has long been the cornerstone of science,[1] and the primary means by which new research is documented and the outcomes disseminated.[2] Manuscripts that are submitted for publication in scientific journals typically undergo a critical appraisal process by researchers from a similar field who are in the wider sense peers and colleagues — known as peer review — as part of a broader editorial process led by journal editors.[3] However, the importance of peer reviewing within this process extends beyond purely academic concerns. Academic publishing lies at the interface between biomedical research and practice, having the potential to influence clinical decisions.[4 5] Clinical decisions should be guided by the best evidence available, yet these can be misleading if they are based on incomplete or inaccurate information. Any process that influences the accuracy, quality, assessment and dissemination of clinical evidence may therefore have a direct impact on patient care.[3] The editorial process within biomedical journals can thus be considered to be a 'gatekeeper' for scientific publications, consisting of the following steps:

1. Editors consider the overall 'fit' of the research article to the journal, as well as suitability and relevance for the journal and its readership.[6]

2. Selection of reviewers by the editors: within the traditional biomedical sphere, peer reviewers are typically invited by journal editors to review manuscripts on the basis of their apparent expertise, which is often gauged in terms of their article output in their respective research area.
3. Editors communicate with both reviewers and authors and coordinate their interaction during peer review.

Editors are responsible for taking an independent decision regarding the fate of the manuscript (ie, whether it is accepted for publication or not).[7] However, it has been suggested that journal editors are not entirely independent in their assessment of an article's suitability for publication once it has undergone peer review. Research indicates that editors give considerable weight to reviewers' recommendations on whether to reject or accept a manuscript.[8] This may in part be due to the fact that core competencies for scientific editors in biomedical research have not yet been formally established,[9] and most scientific editors of biomedical journals do not receive formal training.[10] This is also the case for the majority of reviewers. Despite a significant proportion of reviewers perceiving that they need guidance and formal training on how to conduct a peer review,[11] most are not trained in how to write a reviewers' report. Instead, reviewing is often a skill learnt through feedback received on their own submitted manuscripts.[12] Furthermore, since it is rare for reviewers to receive feedback on their own reviewer reports, it is difficult for them to know whether their reviews are of good quality.[13]

Although journals, authors and reviewers widely support peer review as the primary tool for evaluating research outputs in biomedical research,[11 14 15] there is concurrently a broad consensus across scientific disciplines that the peer review process may be flawed.[12 16 17] A growing body of literature has identified several potential problems, including misjudgement by editors, and biased, inconsistent or inadequate reviewing by reviewers.[17]

Over the years, there have been various attempts to improve the quality of peer reviewer reports in biomedical science. A recent systematic review evaluating the impact of interventions aimed at improving the quality of peer review of randomised controlled trials (RCTs) for biomedical publications concluded that there is a need to clarify the roles and tasks of peer reviewers as a step forward in quality improvement of peer reviewing.[18] Within the biomedical field, the apparent roles and tasks of peer reviewers are closely related to the structural properties of the editorial process itself. For example, some — but not all — journals require peer reviewers to assess novelty and/or clinical relevance of articles in addition to assessing scientific rigour. Journals also differ with regard to their expectations of how a reviewer report should be written. Some journals encourage reviewers to follow a specific structure in their reporting, whereas other journals prefer free text. Journals also differ in their request for peer reviewer recommendations regarding whether an article should be accepted for publication in the journal or not.

These differences may influence quality of peer review reporting, and thus quality of the peer review process across journals. An RCT aimed at determining the effects of training peer reviewers found only a slight positive impact on the quality of peer review. After receiving training, the quality of the peer reviewers' reports as measured by the 'Review Quality Instrument' — which assesses the extent to which a reviewer has commented on five aspects of a manuscript (importance of the research question, originality of the paper, strengths and weaknesses of the method, presentation, interpretation of results) and on two aspects of the review (constructiveness and substantiation of comments) — was deemed to have improved overall. However, peer reviewers in the study failed to detect all major errors that were introduced to the articles under review.[19] At the same time, a major criticism of this study was that reviewers do not necessarily think that their task is to find all major errors in an article.[20] This dissonance was also reflected in a recent study that showed that the most important tasks in peer review, as perceived by peer reviewers evaluating RCTs, were not congruent with the tasks most often requested by journal editors in their guidelines to reviewers.[21]

These differences clearly illustrate the need to clarify the roles and tasks of peer reviewers. Thus far, this has only been somewhat explored, to a limited extent, for RCTs[21] but not for other study designs.

The primary objective of this research is to determine the specific roles and tasks of peer reviewers as depicted in biomedical research. The wider purpose of this research is to inform and facilitate the future development of a set of core tasks that should be carried out by peer reviewers. This will contribute to improvements in the quality of peer reviewer reports, and ultimately of the biomedical scientific literature in general.

METHODS

A scoping review was considered to be the most suitable approach to responding to the broad aim of this study. In contrast to systematic literature reviews that aim to answer specific questions, scoping reviews have been described as a process of producing a broad overview of the field.[22–24] In addition to published biomedical journal articles, grey literature will also be searched because it is likely that most of the information being sought (ie, descriptions of the roles of peer reviewers) would be found in calls for reviewers on journal websites, and guidance documents which would not generally be captured in a traditional review of published research. This approach has been previously adopted by authors of a study that aimed to identify competencies of scientific editors of biomedical journals.[9] We used the Preferred Reporting Items for Systematic Reviews and Meta-analysis for Protocols (PRISMA-P) to draft this protocol.[25]

This scoping review will use the methodological framework proposed by Arksey and O'Malley,[22] as well as the amendments made to this framework by Levac *et al*[26] and by the Joanna Briggs Institute.[27] The framework consists of six consecutive stages: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, (5) collating, summarising and reporting results, and (6) consultation. Each stage is discussed in further detail below.

STAGE 1: IDENTIFYING THE RESEARCH QUESTION

Arksey and O'Malley suggest an iterative process for developing one or more research questions. In the first stage two research questions have been identified based on gaps in the literature:

1. What are the expected roles of peer reviewers in the editorial peer review process in biomedical journals?
2. What tasks are peer reviewers are expected to perform for biomedical journals?

Given that some overlap between the terms 'roles' and 'tasks' is expected, we defined 'roles' as referring to the overarching nature of peer reviewers' function, whereas 'tasks' refer more specifically to actions that fulfil these roles.

These questions might be refined, or new ones added, as the authors gain increasing familiarity with the literature.

STAGE 2: IDENTIFYING RELEVANT STUDIES

A comprehensive search strategy will be developed in order to identify relevant literature, underpinned by key inclusion criteria (see box). These are based on 'Population–Concept–Context (PCC)' framework recommended by the Joanna Briggs Institute for scoping reviews,[27] which has roots in the PICO (population, intervention, comparator and outcome) framework commonly used to focus clinical questions and develop systematic literature search strategies.[28]

Exclusion criteria

Studies referring to peer review that is not related to manuscript peer reviewing in biomedical journals (eg, grant peer review, professional performance review, peer review of teaching and so on) will be excluded.

Box Inclusion criteria

P—Population = journal editors, publishers, peer reviewers, (corresponding) authors in biomedical journals and organisations that offer (educational) resources and training to peer reviewers in the biomedical field

C—Concept = articles with specific focus and/or statements mentioning roles, tasks and competencies pertaining to the role of peer reviewers in the journal editorial process

C—Context = the review will include all study designs, as well as book chapters, editorials and commentaries from the biomedical field; there will be no date and language restrictions

Search strategy

The electronic literature search strategy will follow the three-step process recommended by the Joanna Briggs Institute.[27] The first step consisted of an initial preliminary search of at least two online databases relevant to the topic. This was undertaken for MEDLINE (via Ovid) using the 'peer review, research' medical subject headings and 'peer review' keyword in the Cochrane Library, resulting in 2,017 studies in the Cochrane Library and 13,717 in MEDLINE. In the second step, we will closely review potentially relevant text words in the titles and abstracts of the most pertinent papers in order to compile a list of terms that can be used to inform our search strategy. Index terms used to describe the articles will also be included. This list will be combined with search strategies from existing scoping and systematic reviews on peer review[9 21 29] to develop database-specific search strategies.

The Peer Review of Electronic Search Strategies 2015 Guideline statement will be used to guide the electronic literature search strategies.[30] These will be further refined in collaboration with a health sciences librarian. Subsequently, the following databases will be searched: Cochrane Library, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, EMBASE (via Ovid), PsycINFO (via Ovid), MEDLINE (via Ovid), Scopus and Web of Science. The search strategy for MEDLINE can be found in online supplementary appendix 1.

There will be no time or language restrictions. The authors involved in this protocol are in command of the following languages: Catalan, Croatian, English, French, German, Italian, Russian and Spanish. Relevant articles identified in any other language will be translated.

In the third and last step, reference lists of included studies, as well as websites of journals which display a strong interest in peer review, as evidenced by numerous publications on the topic (such as the Journal of the American Medical Association (*JAMA*), *Nature* and *Science*), will be hand-searched using keywords related to peer review, as outlined in the MEDLINE strategy to identify any additional literature.

The search strategy for grey literature will include searching in websites of existing networks (ie, EQUATOR Network, New Frontiers of Peer Review), biomedical journal publishers (ie, BMJ Publishing Group, Elsevier, Springer Nature, Taylor & Frances, Wiley) and organisations that offer resources for reviewers (including educational courses, eg, those provided by Cochrane[31] and Publons[32]). Relevant blogs, newsletters (ie, The METRICS Research Digest[33]), surveys and reports of authors/reviewer workshops will also be considered.

In addition we will review journal guidelines to peer reviewers on how to perform the manuscript review.

The guidelines will be searched for statements around the roles and tasks of peer reviewers.

Journals will be selected using 2016 journal impact factor (Thomson Reuters Journal Citation Reports-Science Citation Index Expanded). We will identify and

assess the top five, middle five and lowest-ranking five journals across the medical specialties recognised in the Directive 2005/36/EC of the European Parliament and of the Council of 7 September 2005 (on the recognition of professional qualifications).

It is expected that some journals may directly communicate their instructions to peer reviewers via email or through their submission systems, rather than through publicly available instructions. In order to obtain the content of such instructions for examination, we will contact the editor-in-chief and/or managing editor of the identified journals to request details of any 'direct to reviewer' guidance.

STAGE 3: STUDY SELECTION

Following the execution of the search strategy, the identified records (titles and abstracts) will be collated in a reference manager for de-duplication. The final unique set of records will be imported into a systematic review paper manager that facilitates independent screening and logs disagreements between reviewers.

The study selection process will be implemented over two stages. The first stage will involve the screening of titles and abstracts by two reviewers (KG and DC) to determine each article's eligibility for full-text screening based on a priori inclusion criteria. The second stage of the selection process will consist of retrieving the full text of all potentially eligible articles, which will also be independently screened. Disagreements between reviewers regarding eligibility will be resolved by a third member of the research team (DH). Data will also be extracted independently by KG and DC.

We expect that some of the grey literature might subsequently be published elsewhere in the indexed literature. This will be accounted for by cross-checking authors' names across grey literature and index literature results in order to identify potential duplicates.

An adapted version of the PRISMA flow diagram will be used to report final numbers in the resulting study publication once the review is completed. Reasons for exclusion will be recorded at the full-text review stage.

STAGE 4: CHARTING THE DATA

A draft charting form (see table 1) has been developed at the protocol stage to aid the collection and sorting of key pieces of information from the selected articles. It will be pilot-tested and refined during the full-text screening to capture detailed information on each study. The information from research-based and non-research-based publications will be collected in separate extraction forms. Additional categories that may emerge during data extraction will be added accordingly.

Another form will be developed for the extraction of information from the journal guidelines to peer reviewers. In addition to the general and specific descriptions of expectations and competencies of peer reviewers, variations according to journals and their peer review models (such as single-blind peer review, double-blind peer review, open peer review, postpublication peer review) and whether peer reviewers have to provide specific recommendations (ie, no revision, minor revision, major revision, reject) will be noted.

Table 1 Draft data charting form

Study characteristics	Extracted data
General information	First author's last name Journal Publication year Study design Publication type: journal article, editorial, conference abstract, grey literature, report
Definition of peer review	Underlying definition and conceptualisation of the peer review process
General and specific descriptions of expectations and competencies of peer reviewers	Abilities Knowledge Roles Tasks Training Skills

STAGE 5: COLLATING, SUMMARISING AND REPORTING THE RESULTS

In order to create a useful summary of the data, we will combine all expectations and competency-related statements retrieved from all sources.

The general and specific descriptions of expectations and competencies of peer reviewers extracted from the different sources will be combined and de-duplicated, producing a list of unique statements. These will subsequently be organised into emerging categories. While the primary goal is to extract roles and tasks of peer reviewers, additional items related to particular abilities, knowledge, training and skills will also be extracted.

A checklist for reporting scoping reviews—the 'Preferred Reporting Items for Systematic Reviews and Meta-Analysis: extension for Scoping Reviews (PRISMA-ScR)'—is currently under development.[34] If published by the time the scoping review is complete, the PRISMA-ScR will be used.

STAGE 6: CONSULTATION

This final stage refers to consultation with stakeholders in the field of peer review to inform and validate findings from the scoping review. This has also been shown to be a knowledge translation activity and an important step in scoping reviews.[35]

Journal editors will be consulted to explore their views and perspectives on the roles and tasks of peer reviewers.

Results will be presented in detail in separate research papers.

DISSEMINATION

To the best of our knowledge this scoping review is the first attempt to systematically identify the roles (overarching nature of the work) and tasks (specific actions carried out to fulfil these roles) of peer reviewers involved in the manuscript review process in biomedical journals.

As a standalone research piece, it will primarily be helpful to determine and highlight the different perspectives around the roles and tasks of peer reviewers, and will be relevant to a variety of audiences including editors, peer reviewers and authors. It will also inform the consequent consultation with stakeholders, with the aim of developing a taxonomy of peer reviewers' roles and tasks leading to the development of a set of core competencies for peer reviewers of biomedical journals. The study findings could further be used by journal editors to review their instructions to peer reviewers and develop/update training courses for peer reviewers.

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Contributors All authors have made substantive intellectual contributions to the development of this protocol. KG, DH, EC, IB and DM jointly conceived the idea for the project. DC, EC, IB, DM and DH contributed to the study design and development of research questions. KG conceptualised the review approach and led the writing of the manuscript. DH led the supervision of the manuscript preparation. All authors provided detailed comments on earlier drafts and approved this manuscript.

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Open access Protocol

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Editors' perspectives on the peer-review process in biomedical journals: protocol for a qualitative study

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ABSTRACT

Introduction Despite dealing with scientific output and potentially having an impact on the quality of research published, the manuscript peer-review process itself has at times been criticised for being 'unscientific'. Research indicates that there are social and subjective dimensions of the peer-review process that contribute to this perception, including how key stakeholders—namely authors, editors and peer reviewers—communicate. In particular, it has been suggested that the expected roles and tasks of stakeholders need to be more clearly defined and communicated if the manuscript review process is to be improved. Disentangling current communication practices, and outlining the specific roles and tasks of the main actors, might be a first step towards establishing the design of interventions that counterbalance social influences on the peer-review process. The purpose of this article is to present a methodological design for a qualitative study exploring the communication practices within the manuscript review process of biomedical journals from the journal editors' point of view.

Methods and analysis Semi-structured interviews will be carried out with editors of biomedical journals between October 2017 and February 2018. A heterogeneous sample of participants representing a wide range of biomedical journals will be sought through purposive maximum variation sampling, drawing from a professional network of contacts, publishers, conference participants and snowballing. Interviews will be thematically analysed following the method outlined by Braun and Clarke. The qualitative data analysis software NVivo V.11 will be used to aid data management and analysis.

Ethics and dissemination This research project was evaluated and approved by the University of Split, Medical School Ethics Committee (2181-198-03-04-17-0029) in May 2017. Findings will be disseminated through a publication in a peer-reviewed journal and presentations during conferences.

Strengths and limitations of this study

- ► Qualitative analysis of interview data from a wide range of editors of biomedical journals will allow an in-depth understanding of the communication practices prevailing within biomedical journals.
- ► Quality assurance will be employed throughout data collection and analysis to ensure traceability and verification.
- ► Journal editors of a selection of biomedical journals will be interviewed; therefore, research findings cannot directly be extrapolated to all biomedical journals and other scientific fields.

INTRODUCTION

Most journals in the biomedical field implement a prepublication process which primarily involves the interaction of three key stakeholders around an academic research manuscript: journal editors, peer reviewers and authors. This process, typically referred to as 'peer review', is strongly embedded in the field of biomedical publishing and in its broadest sense refers to the evaluation of manuscripts submitted for publication by researchers from the same or related areas of expertise. Thus far, there is no universal definition of 'peer review', and its specific objectives are not clearly defined.[1] Concurrently, the roles, tasks and core competencies expected of peer reviewers and editors have not been formally established and both groups operate largely without formal training.[2 3] A study that aimed to identify all tasks that journal editors expect of peer reviewers who evaluate a manuscript reporting a randomised controlled trial (RCT) found that the most important tasks in peer review, as perceived by peer reviewers evaluating RCTs, were not congruent with the tasks most often requested by journal editors in their guidelines to reviewers.[4] These differences illustrate the need to clarify the roles and tasks of peer reviewers.

The peer-review process has at times been criticised for being 'unscientific'.[5 6] Despite dealing with scientific output that potentially leads to changes in clinical practice, the process itself is not without potential biases—including prestige or association bias, gender bias, confirmation bias, conservatism, bias against interdisciplinary

research, publication bias, language bias and conflict of interest.[7 8]

In light of this criticism, there have been several attempts to improve the peer-review process and the quality of peer-reviewer reports in the biomedical field.[9] A recent systematic review evaluating the impact of interventions to improve the quality of peer review for biomedical publications[10] identified 25 strategies that have been implemented, including training interventions; use of checklists (such as Consolidated Standards of Reporting Trials[11]); addition of specific experts (ie, statistical peer reviewers); the introduction of open peer review (ie, peer reviewers informed that their identity would be revealed) or blinded peer review (ie, peer reviewers blinded to author names and affiliation) and interventions to increase the speed of the peer-review process. The authors of the systematic review refrain from providing recommendations regarding the wider implementation of the identified interventions due to concerns about their methodological quality, small sample size and applicability. Other researchers have argued that most of the approaches outlined above fail to compensate for potential biases and point out that any success so far has been limited.[12]

Researchers have argued that limited success of interventions might be due to the underlying nature of peer review, which has been described as an intellectual process that encompasses objective and subjective elements.[13] Editors and peer reviewers bring a diverse mix of skills, preferences and intellectual idiosyncrasies to the task.[14] At times, these may result in subjective judgements of manuscript quality. Peer review has also been described as an 'inherently human phenomenon' that is underpinned by social dimensions.[15 16] A qualitative study of the social and subjective dimensions of manuscript peer review in biomedical publishing concluded that biomedical manuscript review '*is a highly social and subjective process driven by communal as well as scientific goals, and influenced by reviewers' and editors' sense of their own authority, power and moral responsibility, as well as by unavoidable prejudice and intuition*'.[17]

Our broader research framework aims to generate an understanding of the communication practices within the editorial and manuscript peer-review process in biomedical research. Disentangling current communication practices for a range of biomedical journals, and outlining the specific roles and tasks of the main actors might be a first step towards establishing the design of interventions that counterbalance social influences on the peer-review process. In this study, we aim to identify and characterise the roles and tasks of the different actors in the process of peer review from the perspective of journal editors.

Our specific objectives are:

1. To examine biomedical editors' experiences of their interactions with peer reviewers and authors.
2. To characterise journal editors' perspectives, expectations, understandings and perceptions regarding the roles and tasks of peer reviewers.

METHODS AND ANALYSIS

Qualitative approach and research paradigm

Given its underlying social and subjective dimensions,[17 18] the need for more qualitative research into the peer-review process within the biomedical field has been recognised for some time.[1] However, to date, most such research has been overwhelmingly quantitative in nature.[19]

Drawing on a pragmatist epistemological position that the aim of inquiry cannot be independent from human experience,[20] we considered a qualitative approach to be best suited to answer our research question. The expectations, understandings, perceptions and thoughts of journal editors are largely intangible aspects that cannot be unpacked using predefined categories or viewed independently from the purposes of the peer-review process itself.

The use of qualitative interviews will enable participants to speak freely and at length about such aspects, thus providing rich data embedded in personal experiences and practices.

Data will be analysed using thematic analysis (TA) as described by Braun and Clarke primarily because of the methods flexibility and epistemological assumptions that are compatible with a pragmatist approach.[21]

Study participants will be offered the possibility of conducting the interview either face to face or by phone/conferencing system, according to personal preference and availability. This will also enable the interviewing of people in geographically distant locations.

Study sample and recruitment

We will use maximum variation purposive sampling to recruit a heterogeneous study sample of biomedical journal editors, allowing us to select editors with different characteristics that we anticipate may influence their perspectives. This sampling method enables conceptual exploration using the characteristics of individuals and journals as the basis of selection in order to reflect the diversity and breadth of the sample population, rather than achieving population representativeness.[22]

Participants will be recruited through different sources. The study recruitment pathway is shown in table 1.

Initially, interviewees will be drawn from a professional network of contacts (members of the Methods in Research on Research (MiRoR) project[23]) who are journal editors.

Table 1 Study recruitment pathways

Source of participants	Sampling
Existing professional networks	Purposive/snowballing
Two research publishers	Purposive/snowballing
International Congress on Peer Review and Scientific Publication	Purposive/snowballing

Table 2 Sample characteristics

Criteria	Characteristics
Demographic characteristics	► Gender ► Editorial experience ► Commitment (full-time, part-time) ► Editors geographical location
Journal characteristics	► Journal specialty (eg, Clinical, Public Health) ► Impact factor (journals with or without impact factor) ► Peer-review practices (closed peer review, open peer review, postpublication peer review) ► Publisher (medical publishing companies, independent publisher/university) ► Open access, paywall ► Size (editorial team)

Four editors will be interviewed for piloting purposes and requested to recommend additional journal editors whom the lead researcher (KG) can interview.

The research publishers BMC (part of Springer Nature) and BMJ are partners of the MiRoR project and this partnership will be used to recruit interviewees. Editors in chief operating within the BMJ Publishing Group will be contacted by the lead researcher via email, provided with study details and asked to either participate themselves or recommend suitable journal editors who can be contacted instead. One follow-up email will be sent after 2weeks to non-respondents.

Due to a different standard operating procedure, a different recruitment strategy will be employed at BMC. The publishers' communication manager will communicate with all editors via internal mail, introduce the lead researcher and the research and encourage them to respond if interested in participating.

Concurrently, the conference participation lists from the Eighth International Congress on Peer Review and Scientific Publication[24] will be reviewed and potential interviewees will be contacted via email by the lead researcher. One follow-up email will be sent to non-respondents after two weeks.

Following the maximum variation sampling strategy, journal editors who agree to be interviewed will be categorised using the characteristics presented in table 2, some of which have been shown to influence the peer-review process (e.g, gender).[25]

This step will help to determine the characteristics that are under-represented and inform the sampling strategy for identification of further participants in such a way as to maximise the diversity of interviewees.

Lastly, the journal editor identification process will be supplemented through snowball sampling.[26] At the end of each interview, interviewees will be asked to recommend other editors whose experiences might be relevant to the study and who would potentially be interested in contributing to this study. These steps are expected to lead to recommendations that optimise sample variation.

Saturation

Saturation is a core guiding principle to determine sample sizes in qualitative research, yet few qualitative studies report in detail on the parameters that influenced saturation in their studies.[27] In this study, we will adopt the seven parameters outlined by Hennink et al that influence saturation[28] to establish our sample size determinants and demonstrate the grounds on which saturation will be assessed and achieved, thereby justifying the final sample size. The parameters of saturation and sample size for our study are outlined in table 3. According to Hennink et al, the sample size is determined by the combined influence of all parameters rather than any single parameter alone. In our case, some parameters indicate a smaller sample for saturation and others suggest a larger sample, suggesting the need for an intermediate sample size.

The first parameter is the *purpose* of the study, which in this case is to capture themes from the data using the TA method. The second parameter is *population*. For the purposes of our study, we want do grasp as wide variety

Table 3 Parameters of saturation and determinants of sample size for our study

Parameters	Sample size determinant for each parameter	Determinant definition
Purpose	Capture themes	The thematic analysis method will be used to identify themes and patterns of meanings across the dataset in relation to the research question
Population	Heterogeneous	Journal editors with different characteristics (ie, demographic characteristics, journal discipline and characteristics)
Sampling strategy	Iterative sampling	Iterative sampling using established networks; enlarged through snowballing
Data quality	Thick data	Experiences and opinions will be captured with the aim to provide deep and rich insights
Type of codes	Conceptual codes	Explicit and subtle
Codebook	Emerging codebook	Emerging codebook existing of inductive and diductive codes updated after every interview
Saturation goal and focus	Data saturation	Referring to saturation as the point where no new codes are identified from the data

of biomedical editors as possible and will thus obtain a heterogeneous sample. This parameter will be satisfied by interviewing journal editors with different characteristics (ie, demographic characteristics, journal specialty and journal characteristics). Our *data collection strategy* will be iterative, involving continual data collection until a sample covering wide variety of experiences and viewpoints has been achieved. We aim to collect *thick data* in order to provide deep and rich insights and capture explicit and concrete codes as well as conceptual codes that capture subtle issues. Our codebook will be *emerging* including a broad range of codes, including explicit, subtle and conceptual codes.

Lastly, the *saturation goal and focus* of our study is to achieve data saturation, that is, the point where no new issues or themes are identified from the data.[28]

Although the process of reaching saturation cannot be meaningfully quantified in advance and involves an iterative approach until saturation is obtained, we used a recently developed quantitative method to offer an initial estimate of expected number of participants in our study. Following the approach suggested by Fugard and Potts[29] of estimating sample size required to achieve code saturation for studies that use TA, we calculated that we would need a sample size of at least 38 participants to detect, with 90% power, two instances of a theme with 10% prevalence. Online supplementary appendix 1 shows the details of the calculation. This is in line with our previously hypothesised number of participants. Therefore, while our core approach to data collection strategy will be iterative, involving continual data collection until saturation is reached, we anticipate around 40 participants to be sufficient to provide us with meaningful information to answer our research questions, in line with similar studies.[17]

Inclusion criteria and recruitment process

Study participants will consist of journal editors of biomedical journals, referring to individuals who are currently involved in the communication process between authors and peer reviewers and/or who are in a position to decide about the fate of manuscripts. They might also, but not necessarily, contribute to the determination of journal content and policy.

Journal editors will be contacted between October 2017 and February 2018. They will be sent an invitation email and information sheet by the lead author (KG), followed by a phone call to determine if they are interested in participating in the study.

Interview guide

A preliminary topic guide for the semistructured interviews (see table 4) has been developed, informed by the outcomes of a previously conducted scoping review of the literature.[30] The topic guide was piloted on four editors to assess usefulness and meaningfulness of the questions, the ease of administration, language and length, and to refine the topic guide. It is likely that the topic guide will be refined further after conducting more interviews.

Data collection and recording

All interviews will be conducted by the lead researcher (KG) either face to face or by phone or online call (eg, Skype or conferencing system), according to the circumstances and preferences of the interviewees.

With the permission of the participants, interviews will be audio recorded and notes will be taken.

Interviewees will be asked if they could be contacted again if further clarification is needed.

Based on the pilot interviews, it is anticipated that interviews will take around 30 min to complete.

Data analysis

Data will be analysed using Braun and Clarke's six phase TA described as 'a method for identifying, analysing and reporting patterns (themes) within data'.[21] This analytical framework assumes that truth can be accessed through language, but that accounts and experiences are socially mediated.[31]

It is not bound to any pre-existing theoretical framework, therefore, it offers relative theoretical independence and compatibility with various approaches which is compatible with pragmatist position that we subscribe to.[32] TA has also been described as a more accessible form of analysis compared with other approaches that requires less detailed theoretical and technical knowledge, and is therefore particularly suitable for the lead researcher (KG) of this study who is at an early stage of her qualitative research experience.[21] The leadresearcher (KG) will conduct all interviews, which will be transcribed verbatim.

Data analysis will take place concurrently with data collection in an iterative cycle. This serves two purposes: first, it will help to further refine the topic guide and allow the interviewer (KG) to reflect with the senior investigator (DH) on her own interviewing technique and style for subsequent interviews. Second, it will help the researchers to determine when saturation occurs.

The six phases of TA analysis consist of: familiarising with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, producing the report.

The first phase will start by familiarising with the data—rereading each transcript at least twice and noting down initial ideas.

In the second phase, initial codes will be generated from a subset of interviews using both, deductive codes from topics in the interview guide and inductive content-driven codes. The codes will be developed line by line from the interview content, focusing on the identification of both semantic (ie, reflecting the explicit content) and latent (ie, reflect the implicit content) features.[21] In order to ensure consistency and credibility, a code manual/codebook will be developed by both researchers (KG and DH). These codes will be then applied to subsequent interviews with sensitivity to the possibility of new

Table 4 Topic guide for semistructured interviews

Key area of investigation	Topics	Questions and prompts
Background information	► Explore personal background ► Level of experience ► Own roles and tasks as an editor	► Tell me about your journal and the job you have. ► How long have you been in this position? Prompt: percentage of time devoted to editorial duties (eg, part time, full time) ► What are your current responsibilities? ► Did you hold any other editorial position before your current position? If yes, what were your responsibilities then?
Journal set-up	► Explore journal set-up	► Tell me about your journal—how does it work? Prompt: availability of editorial support staff ► How does the peer-review process work in your journal? ► What do you do within the process?
Opinion on peer-reviewers role and tasks	► Roles and tasks of peer reviewers ► Expectations	► What do you expect from peer reviewers in terms of their roles and tasks? ► How do you let your reviewers know what you expect from them? Prompt: on whatever has not been mentioned ► Attitudes and beliefs (about role and tasks) ► Organisational expectations (about role and tasks) ► Can you tell me about a specific situation when you were not satisfied with a review or with a peer reviewer? ► What did you do in that a situation? Prompt: looks for factors other than being late with a review,or not doing a review once they have accepted it ► Can you tell me about a situation when you were exceptionally satisfied with a review or with a peer reviewer? ► Were there situations (in regard to the roles and task of reviewers) when you disagreed with the other editors you work with? What about? What happened? ► What about other journals, do roles and tasks differ among journals in your field? Prompt: If yes (ie, differences exist), then: ► How does this affect the process? ► How does it affect your communication? ► How do you negotiate those differences? Does it matter?
Communication between editors, peer reviewers and authors	► Communication between the three parties ► Potential conflicts ► Power	► Can you describe your experience of the communication process between editors, authors and peer reviews? ► How do you communicate with authors and peer reviewers? ► Can you give me some specific examples of situations where this communication is challenging? Prompt: ► What are potential conflicts? ► When do disagreements arise? ► What happens if there is disagreement between peer reviewers?
Conclusion	► Snowballing ► Documents ► Final comments	► Is there anybody else whom you think I should speak to? ► Any articles/documents I can access/should look at? ► Any final comments? Is there anything else that you think is important to mention?

emerging codes that will be added to the code manual and applied to the entire dataset in an iterative manner. The qualitative data analysis software NVivo V.11 will be used to aid data management and analysis (ie, indexing of coding and transcripts).

In the third phase, the codes will be clustered into potential themes to give an indication of their prevalence for the assessment of (code or meaning) saturation, and into a preliminary thematic map displaying the main themes.

The fourth phase will consist of reviewing themes and will be divided into two stages: the reviewing and refining of the data at the level of the coded data extracts, and subsequently at the level of the entire data set. These two

stages will lead to the generation of a thematic map of the analysis.

The aim of the next phase will be to definitively define the scope and content of each relevant theme and precisely name them. This will involve debriefing between the study team. Debriefing with an outside expert (on peer review in biomedical journals) as suggested by King[33] will be conducted to ensure that themes are sufficiently clear to someone outside of the immediate research team.

After the establishment of the final themes, the last phase will consist of writing up the study findings as a journal article. Direct quotes will be used to illustrate specific points of interpretation and the extraction of themes. All themes and subthemes will be presented in the result section and discussed in the light of existing literature.

Securing study quality

The most widely used criteria for evaluating qualitative analysis are those developed by Lincoln and Guba,[34] who introduced the concept of 'trustworthiness' to parallel the conventional quantitative assessment criteria of validity and reliability. Trustworthiness is determined by applying the concepts of credibility, transferability, dependability and conformability to qualitative research. Credibility corresponds to the concept of validity, whereby researchers seek to ensure that a study measures what it is actually intended to measure. Transferability corresponds to external validity, or the extent to which the research can be transferred to other contexts. Dependability corresponds with reliability, or whether the research process is methodologically consistent and correct, whether the research questions are clear and logically connected to the research purpose and design, and whether findings are consistent and repeatable. Confirmability is concerned with establishing that the researcher's interpretations and findings are clearly derived from the data, requiring the researcher to demonstrate how conclusions and interpretations have been reached.[35]

In order to establish trustworthiness in this research, the step-by-step approach proposed by Nowell *et al*—which provides a detailed description of how to conduct a trustworthy TA—will be followed.[36] These authors use the criteria by Lincoln and Guba and show how these can be achieved throughout the six phases of TA.

We will use reporting guidelines for reporting qualitative research to provide detailed reporting of methods used.[37]

Patient and public involvement

There will be no patient or public involvement in this research project.

DISCUSSION

This research has multiple potential uses. As a standalone research piece, it will generate context-based information from journal editors' perspectives that will help to provide insight into the communication patterns within biomedical journals, including differences and similarities across biomedical journals. It is also embedded within a larger project that will inform the analysis of peer-reviewer reports.

The study findings can further be used to inform biomedical journal policies and develop training courses for peer reviewers and journal editors.

Ethics and dissemination

Interviewees will receive an information sheet about the research and a consent form before the interview. The information letter includes details on the maintenance of anonymity and confidentiality throughout the research process. Prior to the interview, information from the information sheet and consent form will be reiterated verbally, and interviewees will be asked to consent to participation and recording of their interviews. Participants will be able to choose not to be directly quoted in any publications resulting from the study.

Findings will be disseminated through a publication in a peer-reviewed journal and presentations at academic conferences and other meetings.

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Contributors All authors have made substantive intellectual contributions to the development of this protocol. KG conceptualised the study approach and led the writing of the manuscript. DH led the supervision of the manuscript preparation. DH was involved in developing the study questions and design and provided detailed comments on earlier drafts.

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Disclaimer The funders had no role in the study design, data collection and analysis, decision to publish or preparation of the manuscripts.

Competing interests At the time of the submission of this protocol KG conducted a secondment at the BMJ.

Patient consent Not required.

Ethics approval This project has been evaluated and approved by the University of Split, Medical School Ethics Committee (2181-198-03-04-17-0029) in May 2017.

Provenance and peer review Not commissioned; externally peer reviewed.

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Appendix 3 – Ethical approval for study 2 and 3

MEDICINSKI FAKULTET
SVEUČILIŠTA U SPLITU

Klasa: 003-08/17-03/0001
Ur. br.: 2181-198-03-04-17-0029

Etičko povjerenstvo

Split, 26. svibnja 2017.

MIŠLJENJE

Etičkog povjerenstva povodom prijave istraživanja:

Kvalitativno istraživanje komunikacijske prakse tijekom procesa recenzije u biomedicinskim časopisima (eng. A qualitative study on the communication practices within the manuscript review process in biomedical journal)

I. Zaprimljen je zahtjev Ketevan Glonti za odobrenje znanstvenog istraživanja pod nazivom: **Kvalitativno istraživanje komunikacijske prakse tijekom procesa recenzije u biomedicinskim časopisima** (eng. A qualitative study on the communication practices within the manuscript review process in biomedical journal) – provedba znanstvenog istraživanja na ljudima. Predviđeno je da ovo istraživanje započne u lipnju 2017. i da traje do listopada 2017., a provodit će se u sljedećim ustanovama: Sveučilište u Splitu, British Medical Journal, BioMed Central, Université Paris Decartes, Universitat Politecnica de Catalunya, University of Amsterdam, University of Oxford, Stanford University, Ottawa Hospital Resarch Centre (moguće je da se tijekom prikupljanja podataka lista proširi obzirom da će se sudionike uzorkovati tzv. Snowballing tehnikom). Glavni cilj ovog istraživanja je razviti detaljni okvir za razumijevanje uloga i zadataka recenzenata iz perspektive urednika međunarodnih biomedicinskih znanstvenih časopisa.

II. Etičko povjerenstvo Medicinskog fakulteta Sveučilišta u Splitu je, prilikom raspravljanja o ovom predmetu, uzelo u obzir izjavu prijavitelja da rizika za ispitanike nema. Također je uzeta u obzir izjava da će identitet ispitanika (zdravog ili pacijenta) uvijek ostati anoniman.

III. Sukladno odredbi članka 16. Etičkog kodeksa Medicinskog fakulteta u Splitu Povjerenstvo je zauzelo stajalište kako je predmetno istraživanje **u skladu s odredbama Etičkog kodeksa** koje reguliraju istraživanja na ljudima u znanstvenom, istraživačkom i stručnom radu i etičkim načelima Helsinške deklaracije.

IV. *Mišljenje je doneseno jednoglasno.*

Predsjednica Povjerenstva:

prof. dr. sc. Dušanka Martinović Kaliterna

Dostaviti:
- *Ketevan Glonti x2*
- *arhiv Etičkog povjerenstva Medicinskog fakulteta*
- *arhiv Fakulteta*

Appendix 4 – Study consent form and a study information sheet

A qualitative study on the communication practices within the manuscript review process in biomedical journals

Principal investigator: Ketevan Glonti

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http://miror-ejd.eu/

Consent by participant

1. "I have read the information sheet concerning this study and I understand what will be required

of me and what will happen to me if I take part in it."

2. "My questions concerning this study have been answered by the interviewer."

3. "I understand that at any time I may withdraw from this study without giving a reason."

4. "I consent to take part in the study and agree to be interviewed for this study"

5. " **I do / do not** agree to be quoted anonymously in any publications arising from this study."
(please encircle/highlight as appropriate)

6. " **I do / do not** agree for the interview to be tape-recorded."
(please encircle/highlight as appropriate)

7. " **I do / do not** agree for anonymised interview transcripts to be accessable to other researchers with additional ethical approval."
(**please encircle/highlight as appropriate)**

Name of participant (printed)_____

Signature _____ Date _____

Please sign and return this form to the interviewer, indicating your consent to take part in the interview. Alternatively you may email the signed form to kglonti@unist.hr or keti.glonti@gmail.com

INFORMATION SHEET

A qualitative study on the communication practices within the manuscript review process in biomedical journals

What is this study about?

The aim of this study is to generate a detailed understanding of the communication practices within the editorial and manuscript peer review process in biomedical research, from the perspective of editors.

Your participation

You are invited to participate in a semi-structured interview lasting approximately 20-30 minutes. Throughout the interview some written notes will be taken, and with your kind permission, the session will be tape-recorded (audio only). I do not expect the interview questions to pose any inconvenience or discomfort. Withdrawal is possible at any time without having to give a reason.

How confidentiality will be ensured

All information collected about you and your organisation during the course of the interview will be kept strictly confidential. Transcripts of the interviews will be made available only to myself and the immediate research team and will be kept in a secured file. You will be assigned a unique Study Identification Number (SID), which at the completion of the study will be de-linked from personal identifiers. Results will be written up as a journal publication and possibly presented at conferences.

Interview transcripts might be quoted in publications using a code with no reference to your name, age, gender or organisation. You also have the option of not being quoted at all. Results will be presented in relation to groups of individuals. If any individual data are presented, the data will be totally anonymous, without any means of identifying the individuals involved.

Who is organising and funding the research?

The research is being carried out by University of Split, which has granted ethical approval for this study, reference number 2181-198-03-04-17-0029.

This project was supported by the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 676207.

Further information

If you accept to be interviewed, please read, sign and return the attached consent form to myself at the time of the interview.

Should you have any questions, complaints or reservations about your participation in this study you may contact me on +44 7523383404 or via email at kglonti@unist.hr or keti.glonti@gmail.com. If you prefer, you may also contact my supervisor Prof. Darko Hren (at dhren@ffst.hr), or the ethic committee directly (at lana.barac@mefst.hr). Any complaints or enquiries will be treated in the strictest confidence and investigated fully.

Thank you for considering participating in our study.

Yours sincerely,

Ketevan Glonti

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http://miror-ejd.eu/

Appendix 5 – Additional papers

Social Science & Medicine 235 (2019) 112388

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

"I don't see gender": Conceptualizing a gendered system of academic publishing

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Feminist science studies

ABSTRACT

Academic experts share their ideas, as well as contribute to advancing health science by participating in publishing as an author, reviewer and editor. The academy shapes and *is shaped by* knowledge produced within it. As such, the production of scientific knowledge can be described as part of a socially constructed system. Like all socially constructed systems, scientific knowledge production is influenced by gender. This study investigated one layer of this system through an analysis of journal editors' understanding of if and how gender influences editorial practices in peer reviewed health science journals. The study involved two stages: 1) exploratory in-depth qualitative interviews with editors at health science journals; and 2) a nominal group technique (NGT) with experts working on gender in research, academia and the journal peer review process. Our findings indicate that some editors had not considered the impact of gender on their editorial work. Many described how they actively strive to be 'gender blind,' as this was seen as a means to be objective. This view fails to recognize how broader social structures operate to produce systemic inequities. None of the editors or publishers in this study were collecting gender or other social indicators as part of the article submission process. These findings suggest that there is room for editors and publishers to play a more active role in addressing structural inequities in academic publishing to ensure a diversity of knowledge and ideas are reflected.

1. Introduction

Academia is considered to be the pinnacle of knowledge production. The ability to take empirical data and imbue it with the authority accorded to academe bestows power upon those who conduct science and academic research (Latour, 1987). Academic institutions and modes of inquiry were created by and for powerful men (Ahmed, 2015; Franklin, 2015). Historically, women were formally excluded from universities, laboratories and publishing societies and thus the power to create and reproduce this knowledge has resided primarily with men (Harding, 1991).

Today, women's exclusion from academia is less explicit yet publishing – and the critical gatekeeping role it plays in the recognition of academic knowledge – is still an arena of male privilege. Women publish fewer articles (Elsevier, 2017; Filardo et al., 2016; Helmer et al., 2017), particularly in high-impact journals (Bendels et al., 2018; Shen et al., 2018). Women are less likely to be called upon as peer reviewers (Helmer et al., 2017; Mullan, 2018; Murray et al., 2018; Steinberg et al., 2018; Williams et al., 2018) and hold fewer editorial board positions (Amering et al., 2011; Amrein et al., 2011; Ioannidou and Rosania, 2015). Having fewer women in gatekeeper roles has implications for their representation in the generation of knowledge through published literature (Nielsen et al., 2017). Given that academic publishing is the mode of knowledge dissemination that is most highly valued and rewarded with promotion and advancement within the scholarly ecosystem, it must be examined and understood from a gender perspective.

In this paper, we apply an explicit gender lens to academic publishing in medical and health science journals, to understand if and how

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academic editors in the health sciences recognize or consider gender in their editorial role. We ground our understanding in feminist theory, which conceptualizes gender as an organizing social structure that governs societal attitudes, beliefs, behaviours and expectations which results in different lived experiences for people of different genders (Ridgeway and Correll, 2004). The absence of ongoing and widespread critical inquiry across disciplinary boundaries makes it difficult to identify individual, organizational and societal level 'blind-spots' – we do not often realize that we ascribe to specific gendered systems. As such, our attitudes and beliefs about gender are reproduced through daily interactions, within organizations and across systems (Franklin, 2015).

2. The evolution of academic publishing

Academic publishing is an exchange between authors, peer reviewers and editors (Smith, 2006). A researcher can and may act in any of these roles. As an editor, a researcher works as a curator and initial evaluator of content submitted to a scientific journal. An editor typically first gains experience as an author and then as a peer reviewer before advancing into the more senior position of editor.

Peer review has evolved to become central to the scientific enterprise. It is the mechanism through which articles are evaluated for publishing, as well as in other contexts such as research funding, conference submissions and hiring committees (Smith, 2006). The practice of editorial peer review in biomedical and scientific journals began in the mid-20th century and evolved in different forms across journals (Burnham, 1990). The approach, however, dates back to the all-male learned societies of 17th century Europe (Berg, 2001; Harding, 1991). In journal peer review, experts in a particular discipline are invited to review the written work of other colleagues in the same field (Lee et al., 2013). Subjecting an article to peer review lends credibility to a piece of research and facilitates the communication of research findings to the broader academic community, as well as policy-makers and practitioners (Ali and Watson, 2016; Smith, 2006). Peer-reviewed journal articles document new knowledge and, in some cases, scientific discovery (Ali and Watson, 2016). In this way, journals play a vital role in the advancement of knowledge, policy and practice (Ali and Watson, 2016).

3. Gender and the academic cycle of knowledge production

The research presented in this paper contributes to the current debates by exploring gender considerations in editorial practices. Drawing on our review of the literature, we conceptualize the academic model of knowledge production and dissemination as a cycle (Fig. 1). Each stage of the cycle is influenced by gender, and other social characteristics such as ability, class, ethnicity, nationality, race and sexuality (Combahee River Collective, 1995; Crenshaw, 1991).

The cycle begins with securing funding to conduct scientific research, often as a result of holding a position as a junior researcher, staff or tenure-track faculty at an academic institution. Acquiring research funding is gendered. Scientific review panels award a higher number of grants and a more substantial grant funding to male applicants (Head et al., 2013; Kaatz et al., 2016; Magua et al., 2017; Tamblyn et al., 2018; R. van der Lee and Ellemers, 2015). Women applicants experience biased assessments based on pervasive gendered assumptions about quality and merit (Witteman et al., 2019).

Author contributions have also demonstrated a gendered division of labour within research teams: women are more likely to perform the 'physical' labour and men the 'conceptual' labour (Macaluso et al., 2016). Across all fields in the JSTOR database, including demography and pollution and occupational health, women are less likely to be associated with the more prestigious roles of first or last author (West et al., 2013) which often correspond to the Principal Investigator or senior researcher. Women academics are often described as 'less

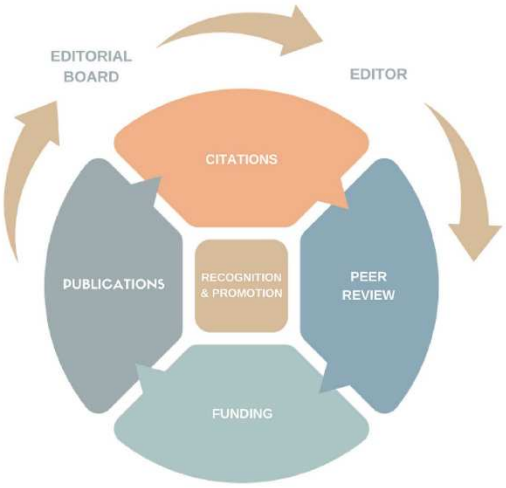

Fig. 1. The cycles of power and privilege in academic journal publishing.

productive,' and this observation has been conceptualized as a 'productivity puzzle' (Albert et al., 2016; Dehdarirad et al., 2015; Larivière et al., 2011; Mauleón et al., 2013; Reza Davarpanah and Moradi Moghadam, 2012). While these studies document a puzzle, they offer few explanations, due to the limited amount of data within large-scale bibliometric databases, such as Web of Science. Other studies posit that biases are at work in the discrepancy between roles of men and women; for example, a large bibliometric study of the Frontiers journals found that women represent 37% of authors, 28% of reviewers and 26% of editors across disciplines (Helmer et al., 2017). The authors conclude that increasing the numbers of women authors is not enough to counteract the effect of subtle (or explicit) gender bias that disadvantages women within the peer review process, and throughout their careers (Helmer et al., 2017). Both women and men were found to be less likely to recommend women for peer review (Fox et al., 2017). When reviewed with a feminist framework, the 'puzzle' can be 'solved' by considering systemic gendered structural forces within and across the academy (Elsevier, 2017; Filardo et al., 2016; Helmer et al., 2017).

There is conflicting evidence regarding gender and citations. Studies show that women are less likely to be cited (Larivière et al., 2013), including in fields such as health sciences and international relations (Beaudry and Larivière, 2016; Maliniak et al., 2013). Others argue that over time women will receive more citations (Ceci and Williams, 2011); recent evidence shows that men are more likely to cite themselves and research by other men (King et al., 2017). Securing citations is a mechanism for greater visibility and is associated with recognition and financial reward, including promotion.

Despite literature documenting the underrepresentation of women in certain positions in many scientific journals, qualitative work on the topic remains scarce. In particular, the social practices of editorial work and journal peer review, specifically regarding gender and bias reducing interventions, have not been adequately studied. Further study of the topic is needed to explore existing gender dynamics and mechanisms for greater recognition of women's contribution to health sciences. In this study, we build on the understanding of peer review as a social process to investigate how editors understand the influence of gender on journal peer review. Specific research questions asked were: How do academic journal editors approach gender in the peer review process (if at all)? What are their views about the topic? What is the role of journals in addressing women's equal participation in peer review?

4. Methods

4.1. Positionality

All the researchers in this study are women working at academic institutions in high-income countries. The two senior researchers have experience in lead editorial roles, and one has an established area of research in gender and healthcare. We began this research with an inductive approach, situated in what we would later come to understand as a liberal egalitarian feminist framework — asking questions about the representation of women in health science publishing. We undertook an exploratory empirical process, including interviews with editors from academic health science journals and a consensus workshop to prioritize critical issues and solutions. We initially framed our questions around gender representation and gender bias. As we continued with interviews, the concepts required thinking beyond a liberal egalitarian framework. How did we make sense of someone's claim not to notice gender, for example? Our research questions and analysis, thus, evolved to become more clearly situated within feminist theories, including feminist science studies.

4.2. In-depth interviews

We chose a qualitative approach — in-depth interviews — in light of the exploratory nature of the research and the open-ended questions outlined in this study (Robson, 2002). To ensure a diverse sample, we included journal editors according to the following criteria: gender, editor's geographic location, the type of peer review process (open, single-blind, double-blind) practices in their journal, journal specialty and publisher. We identified respondents were through purposive and snowball sampling (Tongco, 2007). The interviews explored the editors' understanding of their practice as an editor and how gender influences the peer review process, awareness of gender equality in their work and any actions they may have considered or taken to address potential gender bias in the publication process.

We recruited participants via email sent by an academic publisher that was involved in the conceptualization of the research topic and who facilitated access to networks of publishers. We put out further calls on social media (Twitter). We conducted a total of 15 in-depth interviews in July 2017 (see Tables 1 and 2). The sample represented the experiences of editors at nine journals, across four different publishers. We conducted four interviews in person and another 11 via Skype. We recorded and transcribed all interviews verbatim. The ethics committee at the London School of Hygiene & Tropical Medicine approved the study, which we conducted between July 2017 and April 2018. We obtained written and verbal informed consent from all participants.

4.3. Nominal-group technique

Building on the findings of the in-depth interviews, we convened a consensus-building workshop using NGT to prioritize issues and actions to address gender imbalances in scientific journal peer review. We chose NGT because of its strengths in generating ideas where there is limited evidence on a given topic and as a structured approach to reconciling diverse views (Nair et al., 2011). The NGT also served as a forum to validate findings from the in-depth interviews.

We recruited NGT participants using purposive and snowball sampling, starting with emails to participants identified during the in-depth interviews as actively working on gender within journal peer review. We generated an initial list of participants, based on the sample of editors interviewed during the first phase of the research. We also purposively recruited participants with experience working in low and middle-income countries, as this was as an issue of concern in health sciences during the in-depth interviews. We posted a call for participants on the Mendeley group "Gender bias in academic publishing" run by Elsevier. We contacted potential participants via email with an invitation to participate in the workshop.

Our recruitment target was eight to 12 participants, anticipating saturation at this point (McMillan et al., 2016). We invited 34 participants via email. Potential participants who could not attend were asked to forward the invitation to others or recommend colleagues with relevant expertise. Seventeen participants attended the NGT at the London School of Hygiene & Tropical Medicine in November 2017 (16 in-person and one via GoToMeeting) (see Table 3). The participants were from a range of organizations with experience at journals, publishers and funding institutions (see Lundine et al., 2018 for a full list of participants). All were from health sciences fields, with experience in publishing and organizational gender equity work in policy or programming. Two participants had also participated in the in-depth interviews, as they are recognized leaders in relevant fields.

The NGT followed four steps, silent generation, round robin, clarification, and ranking (McMillan et al., 2016). The question posed to the group was: what can journals do to promote women's equal participation in peer review (as authors, peer reviewers and editors)? We recorded and transcribed key discussions during the NGT. All five authors participated in the NGT, four as facilitators and one as a participant.

4.4. Data analysis

We employed a thematic analysis of the interview data using the six steps suggested by Braun and Clarke (Braun and Clarke, 2006). For familiarization, we reviewed the transcripts against the recordings. We read and re-read paper copies of each transcript. Second, we developed initial codes by hand. This allowed us to re-examine the codes in context and identify new codes. The first author developed a charting

Table 1
Summary of in-depth interview participant characteristics.

Criteria	Category	Number of participants
Gender	Women	9
	Men	6
Position	Editor-in-Chief	3
	Senior editor	12
Geographic region	Europe	7
	North America	5
	Australia	3

Table 2
Summary of journal characteristics.

Criteria	Category	Number of participants
Type of peer review process	Open peer review	10
	Single-blind	4
	Double-blind	1

Table 3
Summary of NGT participants.

Criteria	Category	Number of participants
Gender	Women	14
	Men	3
Primary employer	Academic Institution	5
	Funder	1
	Journal	4
	Non-governmental organization	3
	Publisher	4
Geographic region	Africa	1
	Asia	1
	Europe	15
	North America	1

framework in Excel (2016) and copied quotes against each code. We then reviewed the codes within each interview to ensure consistency. We grouped codes into broader categories of data (e.g. 'gender-blind'). We compared codes and quotes across interviews and grouped them into subthemes. We reviewed themes and reorganized data that did not fit the original theme. The first author reviewed, discussed and revised themes together with the last author, who has experience as an editor. We discussed the preliminary findings among all authors, which led to revisions. We identified common themes and areas of divergence from the in-depth interviews which we presented and discussed at the NGT. We then further revised and prioritized based on the findings from the two methods and helped to generate a set of concrete ideas of how journals can address women's equal participation in peer review. We present the findings thematically below.

5. Results

5.1. The editor is 'gender blind' and thus considered objective

5.1.1. Gender 'blind' manuscript review and associate editor assignment

One of the primary tasks carried out by the editors was to assess manuscripts submitted to the journal. The quality of the manuscript was reported to be the focus of the assessment. In keeping with the principle of objectivity, quality was referred to regarding the methodological rigour. In contrast, editors described exercising professional freedom and applying subjective judgement when interpreting the other elements of quality, such as English-language writing ability, "fit" within the mandate of the journal, "useful and correct analysis" or scientific merit of the submission. One editor spoke about quality as an individual, subjective decision and said:

> "... the influence that I have as a section editor, you know, kind of independently in terms of what I accept and reject. I mean, it's not like there's a clear line for what the level of quality is, that means that they ... what's the word, yeah, means it's a useful and correct analysis, it's a very messy line that's open to interpretation, so the only influence is how I interpret that line." (Participant 6, Man)

In this task, most participants thought that gender was immaterial. When asked what role gender plays in editorial work, one male participant responded "none." When asked why he answered:

> "Okay, I'll revise that. There's a small role because there's a stream of scholarship related to women's health and similar issues, and we have one or two associate editors that are interested in those topics, and those editors happen to be female. So, to some extent, research on women's health issues is going to go to one or two female associate editors. Aside from that, I don't see gender. Sort of a dumb joke. It's not relevant because it's not relevant" (Participant 8, Man)

Q: *What do you mean by that?* (Interviewer).

Honestly, I tell you to look at the authorship, when I see a publication, I'll tell you what I do. I look at the authorship to see if it's anybody that I recognize. Usually, the answer to that is no .... (Participant 8, Man).

Despite discussing several ways in which the editor obtains social cues – country and institutional affiliation(s) of the author(s) – the editor maintained that the assessment of the manuscript was not "flexible." The statement may reflect the view, explained further by other editors, that the editor is believed to be an unbiased scientist who can pass objective judgement on the quality of scientific research. In this line of argument, concepts of quality are not influenced by gender.

> "As I say, I don't find that (gender) is at all useful in giving me any clues about the likely quality of the work and the trustworthiness of the work that's coming through." (Participant 2, Man)

In this way, "gender-blind" or "blind to gender" conceptualization was used by several editors. Editors strived to be 'blind,' seen as a metaphor for being objective, and deliver an assessment based strictly on the objective measures of quality of the manuscript.

5.1.2. Gendered names but genderless authors

Editors discussed names as the only gendered information that editors receive about authors. Many editors reported noting the name and reviewing the author(s) information to check for conflicts of interest and make an initial observation about the reputation of the author's institution. While editors acknowledged that these practices might introduce other forms of partiality, they believed – in direct contradiction to the idea that names are gendered – that the names did not send any signals about gender that would influence their opinion of the document:

> "... it's far more difficult to isolate the gender of an author in public health simply because we have multi-author papers almost as standard, so the typical public health research paper has many authors. And it's again difficult in that context to then think about a paper being written by a male or a female. So just from that angle, I don't think it has a lot of roles to play." (Participant 15, Man)

Thus, manuscripts with multiple authors complicate how editors consider the gender of an author and lead to a situation where the editor tries to disregard gender.

Another way editors referred to being 'blind' to gender or viewing authors as gender neutral was about names from certain parts of the world. In some cases, editors expressed frustration with being unfamiliar with naming conventions.

> "So, in the review process, I mean, I am really completely blind to this question, because a lot of people who submit articles to us are from outside of the continental US, and I can't tell from their names whether they're male or female. I mean, I get probably 600 Chinese articles a year, and for most of them, I can't tell at all. I mean, I don't speak Mandarin, so I have no clue." (Participant 10, Man)

Several participants noted that they had no control over the gender composition of authors submitting to the journal.

> "Authors obviously we can't do anything about, we just ... papers come in, we just evaluate them, and we don't really look at who they've come from. I mean we, you know, some names you recognize, some you don't but definitely don't worry is it from a man or a woman." (Participant 9, Woman)

The editor, in this case, cared about gender representation but did not think it was possible to address the structural issues in journals to increase the number of women authors. This was primarily seen to be due to "upstream" forces such as women taking time out of work to have children or some disciplines attracting more women than men (or vice versa). Most participants viewed gender as a topic that should be addressed by academic institutions and mentioned workplace policies and initiatives that they were familiar with, such as gender committees or tracking gender balance in academic appointments.

5.1.3. Gendered research content

Several editors mentioned that gender can be important when moving the manuscript on to the next phase of the peer review process. If the topic of the manuscript deals with a women's health issue (postmenopausal osteoporosis was an example), some editors preferred to send the document on to a woman editor or peer reviewer, who may have both professional expertise and a more nuanced personal understanding of the topic through lived experience. For some, identifying as a woman was equated with having expert knowledge of gender issues or women's health – which are not necessarily related. Others who used 'gender-blind' did not assume women had content expertise and thus did not consider gender when choosing reviewers or editors.

Beyond the manuscript content, for some editors, the peer review process was not considered gendered.

"Yes, I usually don't look at the gender of the peer reviewer" (Participant 5, Man)

"But, it's an interesting question, because I just have to tell you, I'm completely blinded to that question. It just never occurs to me that I should pick a female versus a male associate editor" (Participant 10, Man)

"Yeah, I definitely would say I don't really consider gender in my decisions to assign papers to associate editors or to assign or pick peer reviewers at all, that I'm aware of." (Participant 4, Man)

It was interesting to note the contradictory views that some editors held about the gender issues relevant to the peer review process. Of the 15 editors, five women were aware of gender issues with the publishing process and were actively working to manage any gender inequalities or biases in the peer review process.

One of the strategies implemented by editors was positive discrimination, which was aimed to increase the number of women editors on the Board and to increase women's representation amongst peer reviewers.

"The next one is peer review, what's really interesting is we asked authors, they were allowed to recommend some peer reviewers for their paper and they just recommend men. It's 80%, and sometimes it's all men. … that's where I will exercise positive discrimination, so if I'm looking at five suggested people and I don't know them, or I do know them and whatever, I will go for the women first." (Participant 9, Woman)

Other participants were emphatic that they do not (and should not) consider gender when selecting peer reviewers or editors; considerations when selecting reviewers were "*competence*," "*workload*," content-knowledge, "*geography*" and the ability to provide "*thoughtful, incisive, critical kind of reports*."

5.2. Editorial acknowledgement of other social characteristics of authors

Editors admitted holding predetermined views about particular social characteristics of both authors and peer reviewers. Overall, there were concerns regarding the representation of authors from parts of the world underrepresented or under-resourced in academic research and publishing. In some cases, strategies were in place to redress the inequities. Editors expressed concern over geographic inequities in publishing, with gender being less commonly perceived as a source of inequity. Some editors actively worked to recognize and try to counteract disparities based on nationality.

"… [E]veryone looks out for papers, for example, where you might have ten authors from a high-income country, but the paper's exclusively on Sierra Leone, so we ask the question why. Why is that the case? It has to be a pretty good reason, really." (Participant 12, Woman)

In addition to nationality, most editors believed that the institution or reputation of a research group influenced their decision about whether or not to send a paper on for peer review. Further, reviewers from prestigous institutions were selected based on the presumption that they would likely provide a high-quality review.

5.3. Distancing from inequities

Most participants believed that inequities exist in academia and peer review, just not in their own work as an editor. One editor wondered about bias in high impact journals and several others about the bias that could be perpetuated by peer reviewers or other editors, thereby placing potential blame of partiality on other journals and reviewers, not themselves, their journal's policies or processes.

"I suppose some biases could occur at the reviewer level. It's possible you could get reviewers that may have some biases that you may not be aware of, which could affect their peer review or recommendation to publish or not." (Participant 4, Woman)

Editors mentioned the potential for gender bias in other journals where editors use personal networks to find peer reviewers. A common concern was about bias related to individual disciplines, such as economics and computer science or within certain health specialties, such as psychiatry.

Belief in the existence of gender inequities was also based on anecdotes that editors had experienced first-hand or had been recounted to them by family members or colleagues; stories related to either the academic workplace or to the peer review process. In this way, others were portrayed as perpetrators, and the participants as the audience or 'victims' of gender bias; nevertheless, editors acknowledged that gendered inequities and prejudice exists. Others were aware of the literature on the topic or had read the literature themselves.

Of those who believed gender inequities or bias in academia or peer review exists, few could point to gender inequities or bias in their own role as editor. Most editors were reluctant to admit that they might hold biased views based on gender. This may be because gender bias is not socially acceptable, even if unconscious. Editors exhibited the belief that their commitment to impartiality and broad awareness of gender issues could overcome any potential individual unconscious gender bias. Others working on gender issues, at feminist journals or coming from feminist viewpoints, did not think they were as susceptible to gender bias. One editor put it this way:

"… most people doing this kind of work, it's about the public good and concerned about public health, probably believe that their biases are fairly limited and that they can overcome them intellectually, but I don't think that's necessarily the case, so I think having people become more aware of [gender bias], that could be useful as well." (Participant 6, Man)

Editors from open review journals believed that the journal was more likely to attract a diversity of authors, and thus minimize possible gender bias or inequities. Editors remarked that open peer review journals value transparency and diversity in content, examples such as implementing peer review and being an avenue for replication studies were given as examples of these values.

5.4. Editorial acknowledgement of gender identities

Most editors did not believe they were susceptible to individual-level gender bias but did recognize gendered behaviour that played out in the publishing process. Interestingly, the view regarding the impact of gender on the performance of the peer reviewers was diverse and often relied on personal opinions, indirect observation and hearsay. Some believed women give more thorough and thoughtful peer reviews. Others mentioned that women are harsher or provide more critical feedback in their peer review comments. Another perception of women peer reviewers was that they were more likely to decline a request to act as peer reviewers or editors. Women were believed to have a more significant commitment to quality and a need to balance family and other obligations with their academic career. In one instance, an editor-in-chief discussed difficulty recruiting women as editors.

"Women are devoted … "How many hours is it going to take?" … so the most ask you lots of questions. "How many hours a week?" "What's the commitment?" "How can I, you know, balance this with my parent role?" Etcetera, etcetera … And often it ends up in a no. Um, I held this reservation. Whereas I speak to a man, you almost hear yes immediately." (Participant 14, Man)

The challenges in recruitment were based on observations by the editor, not on empirical testing or data collection. On the other hand,

Table 4
Top ten recommendations developed during NGT, presented in rank order.

Rank Order Round 1	Rank Order Round 2	Recommendation
1	1	Track, analyze and publish gender statistics for authors, editors and peer reviewers
2	3	Create an Athena SWAN-type programme for journals that is binding
3	2	Set quotas for female reviewers, editors and authors
4	8	Raise the profile of female authors (through naming them, inviting them to conferences, commissioning content, profiling in the journal, invite to author commentary)
5	9	Change processes to remove bias/barriers in the peer review system (e.g. analyze language)
6	4	Providing training and mentoring for editors-in-chief and editors on addressing gender bias
7	5	Include gender as a field in the article submission system
8	7	Give preference to women when recruiting (so state "female senior editor")
9	6	Define and publicize the journal's actual objectives regarding equal participation in publishing
10	–	Provide more funding for research that can expose gender bias in peer review
	10	For handling editors, make it a performance objective to invite equal numbers of men and women to peer review

one editor believed that she works more often with women peer reviewers and that women are more likely than men to say yes to a peer review. She thought that this was due to two factors: firstly, that her discipline had more women working in it and secondly, that men were less likely to take on volunteer roles. It may be the case that she had more professional contacts who are women and therefore found it easier to secure women peer reviewers. For the most part, editors were not collecting empirical data to test their observations or designing interventions to address any imbalances.

5.5. Visibility of men in peer review

Editors did not express any significant concern over the gender composition in manuscripts; however, some noted that there might be more contributions from researchers, senior scientists or principal investigators who are men.

> "I would say that at least more senior PIs in most academic institutions are more men …" (Participant 5, Man)

The above statement suggests an awareness of gender inequalities in senior authorship and the need for the problem to be addressed. The same participant describes this further as a problem within academic institutions, as related to promotions:

> "I actually know my managing editor is a woman, and I think in public health, like a lot of practitioners, if not most of them, are women, so nothing … I mean, that wouldn't necessarily … I'm not saying the whole field is gender-blind, but at least, in my practice, it doesn't seem to present itself. I think from a publishing standpoint, that's more applicable to promotions and things like that, women aren't getting equal promotions. When it comes to publishing productivity and things like that, but I don't necessarily see it in the workflow of a journal." (Participant 5, Man)

Some editors had beliefs about stereotypically male behaviour: 1) men were more likely to put themselves forward for positions; 2) men were less worried about the quality of their work and will commit to the opportunity regardless of if they can deliver, and 3) men had more time to commit to work outside the home.

Some participants believed that men are more visible in peer review and academia in general. For this reason, participation in peer review was emphasized by some participants as more favourable to scientists who are men.

> "This could be due to the fact that men are more often invited to review because that's where they are more visible, they are more at conferences, they are more first authors. When we are talking about the reviewers, that's the pictures that we are getting, is more male than female, just because we are more exposed to male researchers." (Participant 13, Woman)

Some editors were concerned that despite a commitment to gender equality, the visibility of men, as well as the influence of male-dominated social networks in their fields made it difficult for women to receive consideration for editorial positions.

5.6. Nominal group technique

After presenting these findings, the question posed to the NGT was: *what can journals do to promote women's equal participation in peer review (as authors, peer reviewers and editors)?* There were a variety of opinions on the best approach within journal peer review. Some of the NGT participants – those with experience in open peer review suggested the transparent process may discourage discriminatory practices, as was identified during in-depth interviews with editors from open review journals. Others, however, were more likely to favour the use of 'blinding.' One NGT participant remarked, "*I think that double-blind and fully open are different solutions to the same problem*," recognizing that both have been proposed to counter social biases. There was also debate over what was perceived as the deficit model, focused on "fixing" women versus making changes to the journal publishing system. One participant remarked, "*that's a bit of a deficit, that's saying the women are in some way lacking, and what do we need to provide to them.*" There was recognition amongst the group that:

> "… whether it's focused on supporting women, or whether it's focused on removing barriers in the system. I think having advancement in both is important in any programme you do." (NGT participant, Woman)

Table 4 includes the top ten recommendations as developed and ranked according to potential impact by participants, indicating changes between the two rounds or ranking. Recommendations span the range of individual, journal, publisher and system-level changes. We have reported findings as ranked by participants, which is essential to stay true to their priorities (Delbecq et al., 1975). Some of the recommendations appear to be overlapping; however, the participants felt that specifying self-identification would raise the profile of this issue.

The critical importance of collecting, aggregating and publishing gender statistics for authors, editors and peer reviewers was upheld. These data are currently unavailable and hamper efforts to address gender disparities. Setting quotas became more important, as well as practical steps such as providing training and mentoring for editors on addressing gender bias and capturing authors' self-reported gender via the article submission system.

6. Discussion

This study advances knowledge of the social nature of peer review, bringing a gender lens to the process. It provides evidence of that belief in personal objectivity (Heim et al., 2018; Lipworth et al., 2011) may lead editors to strive for 'gender blindness' or 'gender neutrality' in their

editorial roles and responsibilities, stripping other scientists of their gendered identities. Together with time constraints and the decentralized nature of peer review (Kaatz et al., 2014), such beliefs present challenges to system-wide changes. The evidence presented here makes evident that there is room for editors and publishers to question their current understandings about their role in curating a diversity of knowledge and ideas, as well as recognizing the connection of scientific knowledge to embodied individuals. Science editors' associations, such as the International Committee of Medical Journal Editors or the European Association of Science Editors, have demonstrated commitment to sex and gender analysis in research content (Heidari et al., 2016), however, similar guidelines for gender and diversity in the editorial workforce have yet to be developed. The research and publishing community would benefit from a greater acknowledgement of systemic barriers to research and publishing, including institutionalized and structural sexism, racism, classism, ableism, imperialism and heteronormativity (Combahee River Collective, 1995).

6.1. Theorizing editorial practice: blindness as a metaphor

Critiques of 'blindness' employed as a metaphor (and disability or disablement metaphors in general) have been raised by critical disability scholars (Schillmeier, 2010; Schor, 1999). Critical race scholars have also raised concerns about 'racial blindness' as both an argument to defend against accusations of racism and ignorance of the impacts of racist stereotyping (Ahmed, 2012; Bilge, 2013). Drawing on this work, we examine two metaphors of blindness in journal peer review: blindness as objectivity and blindness as ignorance. Editors mostly believed that the peer review process is gender 'blind' by their definition. Editors aspired towards a 'gender blind' assessment of a manuscript as a manifestation of good practice, highlighting the widely accepted, arguably aspirational belief that editors and reviewers should strive to be impartial and objective in their assessment and handling of an academic manuscript (Kaatz et al., 2014; Lee et al., 2013). This use of 'blindness' as a metaphor for objectivity is employed in popular literature, where "seeing is an impediment in the quest for true vision" (Schor, 1999). This echoes Donna Haraway's critique of positivistic science, which employs the "god trick of seeing everything from nowhere" (Haraway, 1988); that is, many scientists believe that by using established scientific approaches they can uncover universal and unbiased truths about the world. We question whether impartiality and objectivity are possible.

The idea of the existence of "true vision" or objectivity in science has been challenged (and overturned) by feminist scholars who show how science is always shaped by the social, economic, political and historical context (Ahmed, 2015; Haraway, 1988; Subramaniam, 2009). Within feminist standpoint theory, objectivity is understood to be strengthened through an explicit description of a scientist's social and historical location, thus becoming "strong objectivity" (S. Harding, 1992). Research findings are interpreted – and editorial decisions are made – within the context of an editor's professional training, rooted in theoretical and methodological choices informed by one's historical position and lived experience.

'Gender blindness' in the peer review system acts to secure greater opportunity and visibility for men (Helmer et al., 2017). When understood as such, 'blindness' could, therefore, be considered a metaphor for ignorance. 'Gender blind' policies are those that have not considered gender or where analysis has been done and not acted upon (World Health Organization, 2011). 'Gender-blind' systems or processes "maintain the status quo and will not help transform the unequal structure of gender relations" (World Health Organization, 2011). To self-identify as 'gender-blind' is to remain unaware of the role of power and positionality, and perhaps more problematically, to inadvertently perpetuate systems of structural gender inequities.

All editors had access to names, institutions, potentially nationality and thus critical elements of the identity of authors and peer reviewers. Addressing misconceptions about the concept of 'gender blindness' and objectivity within the peer review system may be a starting point for discussion with editors. The NGT participants discussed capturing data within the process as a necessary but insufficient step to address imbalances within the broader system (Lundine et al., 2018). Authors, editors and reviewers could, for example, be asked to self-report characteristics, such as gender, race and nationality, that would allow editors to track progress towards diversity targets deliberately. They also suggest pushing this further, requiring editors to undertake further education in mechanisms to recognize and counter prejudice and discrimination.

6.2. Addressing social biases and structural inequities

The editors interviewed distanced themselves from gender inequality and bias but believed that others might hold prejudiced views. "The ability to see cognitive bias in others but not in oneself" has been referred to as "blind-spot bias," which some have theorized could potentially impact scientific peer review (Kaatz et al., 2014). "Blind-spot bias" has been demonstrated empirically in other contexts (Ehrlinger et al., 2005; Pronin et al., 2002), highlighting that "people tend to introspect to determine whether their own judgments are tainted by bias but to consult abstract theories to determine whether others' judgments are biased" (Ehrlinger et al., 2005). While editors were willing to admit to having other social biases, such as North-South, English-language and institutional biases, gender bias was not readily acknowledged as a problem. This was perhaps in part because the first author, who conducted the interviews, may have been considered a 'safe' person to discuss other prejudices with, as a white woman from a high-income country, working at a well-known university, for whom English is a first language.

The existence of gender bias within the assessment of peer review manuscripts has been debated (Ceci and Williams, 2011), and there is still a lack of consensus on the effectiveness of 'blinding' for countering gender and other social biases (Budden et al., 2008; Engqvist and Frommen, 2008). There is also some movement toward open peer review, which editors perceived to be a solution to counter biases. Given that interactions and decisions are made public, open peer review provides increased transparency, which can, in theory, deter people from discriminatory practices (Heim et al., 2018). The possibility that open peer review reduces gender and other social biases has yet to be explored. Without explicit attention to institutional and structural barriers to publishing, open peer review, in and of itself, will likely not lead to greater diversity in publishing. As more journals adopt open models (Heim et al., 2018; Matthews, 2017), this is an area where further investigation is warranted. There is limited evidence of interventions to improve peer review in general, including a dearth of evaluations of the impact of open peer review on gender and other types of discrimination (Bruce et al., 2016).

This study refocuses attention on the social nature of journal peer review, and the impact editors and publishers have on a journal's direction. It highlights the need to bring an intersectional lens to peer review processes. Where our initial liberal egalitarian feminist framework led us to question gendered inequality, our analysis of objectivity and bias was constructed using feminist standpoint theory. Such an approach also draws questions about other forms of inequality – race, class, sexuality, nationality, ability - into the frame (Combahee River Collective, 1995; Crenshaw, 1991); questions that our initial framework did not address. Nonetheless, we consider that our findings could be useful for this broader understanding of social inequities. Instead of a focus on representation, we must understand how ideas about objectivity function, which necessitates making sense of the ways power structures intersect.

One approach that journals and publishers may consider is being more explicit about the values of a journal. Recommendations from the NGT were to define what research equity means to each journal

explicitly, set quotas, collect data and track changes. We echo the recommendations by previous authors (Lipworth et al., 2011), and add that if changes are implemented at the level of the publisher, this will go further to "open the black box" of journal peer review. Future research should evaluate potential interventions to make the peer review process more inclusive, recognizing that biases in journal publishing are potentially the manifestation of inequities in broader structural systems. Surprisingly little empirical evidence exists in this space (Tricco et al., 2017).

The study is limited in its focus on gender, gender as a binary (we recognize that gender is not binary) and on individual editors; however, we seek to inform further inquiry within academic institutions and journal structures to address inequities in peer review publishing and academia more broadly. We have also learned that we cannot apply a feminist framework without engaging with the work of Black feminists, who introduced the critically important recognition of how multiple intersecting structural forces shape our sciences and indeed our lives (Combahee River Collective, 1995; Crenshaw, 1991). The study of peer review is particularly important to understand the evolution of scientific thought as well as women, men and gender diverse people's career trajectories in scientific research. Societal and structural barriers to participation in journal peer review could partially explain the lack of women, in particular, women of colour from the 'global south,' recognized in leadership roles within health science leadership.

Declarations

JL is a member of the Gender Policy Committee of the European Association of Science Editors. The authors declare no further conflicts of interest.

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ORIGINAL ARTICLE

Online survey about the STROBE statement highlighted diverging views about its content, purpose, and value

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Abstract

Background and objective: The endorsement rates of The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) Statement are low and little is known about authors' opinions about this reporting guideline. We conducted an online survey with observational study authors on attitude toward and experiences with the STROBE Statement with the aim of understanding how to effectively implement STROBE.

Methods: A thematic analysis on the responses to an open-ended question was conducted using inductive coding. Two coders classified responses independently into themes using a codebook. The inter-rater agreement ranged from 87.7 to 99.9%.

Results: 15% (n = 150) of survey participants (n = 1,015) shared perceptions and insights on STROBE. We established four themes: 1) perceptions of the checklist, 2) academic confidence, 3) use in education and training, and 4) journal endorsement and use in peer review. Views were diverse and revealed multiple misunderstandings about the checklist's purpose and content, and lack of incentives for its use.

Conclusions: Better communication efforts are needed when disseminating STROBE and other reporting guidelines. These should focus on content, education for early career researchers, and encouragement of critical self-reflection on one's own work. In addition, results emphasized the need for better incentive and enforcement mechanisms.

Keywords: Observational studies; Epidemiologic research design; Guidelines as topic; Information dissemination/methods; STROBE Reporting guidelines

1. Background

Reporting guidelines (RGs) were created to help reduce research waste and promote reproducibility by providing a minimum set of items to be reported when describing the results of a study. Incomplete reporting contributes to a "reproducibility crisis" where scientific progress is impeded because of an inability to replicate results and to accurately interpret findings [1,2]. Furthermore, reporting clear and complete information is an ethical responsibility as it informs clinical practice [3]. In addition, incomplete reporting causes studies to be excluded from systematic reviews and meta-analyses, resulting in research waste. With the rise in systematic reviews [4], more attention has been given to the necessity of complete reporting and therefore reporting guidelines [5–7].

The RG movement began in the mid-1990s and first focused on randomized control trials and systematic reviews, resulting in the Consolidated Standards of Reporting Trials (CONSORT) [8] and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [9] Statements. The focus then turned to observational studies which represent most of health research and are often "the most necessary and difficult" studies to conduct in epidemiology [10–14]. Observational studies can provide a large number of participants at an affordable cost, allowing for subgroup comparisons and longer follow-up periods to

Ethics approval and consent to participate: Ethical approval was granted by the University of Split (2181-198-03-04-18-0010).

Availability of data and material: The deidentified standalone qualitative responses will be made available on the Open Science Framework [35].

Conflict of interest: M.K.S. works with the STROBE Statement as a part of her doctoral studies. D.H. provides support and mentoring as a part of the Methods in Research on Research (MiRoR) project. K.G. is a doctoral student on the MiRoR project.

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What is new?

Key findings

- 150 authors of observational studies completed our online survey and shared their attitudes toward and experiences with the STROBE reporting guideline.
- Many participants noted that they use STROBE as a teaching tool for early career researchers and find its structure and content useful. However, for mid- to late-career researchers, there was an overwhelming response of self-assuredness that STROBE was not as useful given their level of expertise.

What this adds to what was known?

- This is the first survey done evaluating authors attitudes towards the STROBE Statement.
- Respondents reported mixed feelings about STROBE and expressed concerns about the perceived benefits of using it given additional time requirements of use.
- Authors also thought that there is a need for better incentive and enforcement mechanisms from journals. When journals request completed checklists, it should be ensured that it is used during editorial or peer review.

What is the implication and what should change now?

- We need to better communicate flexibility to authors who are investing extra time, often perceived to be at the sacrifice of one's ego, to complete reporting checklists.

determine long-term risks and benefits. However, they are prone to biases and confounding, making careful design and analysis invaluable [15].

In 2007, the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) Statement was developed to help address these problems. It has since been endorsed by the International Committee of Medical Journal Editors and a number of journals [16–18]. However, endorsement rates remain low [19–23] and, while some studies have been conducted on editors' perceptions [24,25], little is known about what authors think of reporting guidelines and how they perceive journal requests for completed checklists. To our knowledge, only one small-scale study, investigated author's perspectives on an RG, the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) Statement [25].

To address this research gap, we conducted an online survey asking observational study authors about their experiences with and attitudes toward the STROBE Statement.

2. Methods

2.1. Data collection

Details of study methods were previously published [26]. Briefly, data were drawn from a cross-sectional online survey on STROBE that was completed by authors of observational studies. The survey was distributed from March 5 to August 31, 2018 via social media, and emails to 257 biomedical journal editors and over 14,000 authors. Participants (n = 1,015) comprised three groups including those who 1) had used the STROBE checklist before (group 3, n = 635), 2) had heard of STROBE, but had not used it (group 2, n = 195), and 3) were new to the concept of STROBE, and were asked to give their initial thoughts on it after a brief introduction (group 1, n = 185).

The survey included questions about demographics, timing and frequency of use, awareness referral mechanisms, motivators, facilitators, and barriers to use. It concluded with an open-ended question: "Do you have any other comments? Please feel free to expand on anything related to STROBE or this survey. For example, your experiences with STROBE, thoughts about its usefulness, content, format, the extensions, etc."

Nearly 20% (n = 203) of those who completed the survey responded to this open-ended question. After eliminating nonsubstantive responses (e.g., "N/A"), 150 participants gave detailed feedback. Owing to the number and richness of responses, we are discussing these separately in this article as it has implications for understanding how to effectively implement STROBE and other reporting guidelines.

2.2. Analysis

Open-ended responses were imported from SurveyMonkey into R and then into NVivo 12 [27]. Using inductive coding, one coder (M.K.S.) proposed the initial schema which the other coder (D.H.) used to code the first 100 responses (of the original 203); agreement was over 90% for all codes. Results were then discussed to identify any potential missing categories or disagreements. No issues were found and no changes were made.

3. Results

Demographic data for the full sample was reported previously [28]. Our full sample had roughly equal distributions for age, gender, and time spent in research across groups and the qualitative respondents generally did as well (Table 1). Of the 150 qualitative respondents, 65% (n = 98) had used STROBE before (group 3), 17% (n = 26) had

Table 1. Sample demographics

	Respondents (n = 150)				Nonrespondents (n = 1,015)			
	Total sample	Never heard of STROBE, never used [group 1]	Heard of STROBE, Never used [group 2]	Heard of STROBE, have used [group 3]	Total sample	Never heard of STROBE, never used [group 1]	Heard of STROBE, Never used [group 2]	Heard of STROBE, have used [group 3]
Variables	*N* (%) 150 (100)	*N* (%) 26 (17)	*N* (%) 26 (17)	*N* (%) 98 (65)	*N* (%) 1,015 (100)	*N* (%) 195 (19)	*N* (%) 185 (18)	*N* (%) 635 (62)
Time spent in research								
1–10 y	42 (28)	6 (23)	7 (27)	29 (30)	332 (33)	57 (29)	65 (35)	210 (33)
11–30	48 (32)	4 (15)	7 (27)	37 (38)	362 (36)	107 (55)	95 (51)	372 (59)
31 +	39 (26)	10 (38)	6 (23)	23 (23)	86 (10)	30 (15)	25 (14)	48 (8)
I do not work in research	15 (10)	3 (12)	5 (19)	7 (7)	3 (<1)	1 (0)	0 (0)	2 (<1)
Prefer not to say	6 (4)	3 (12)	1 (4)	2 (2)	3 (<1)	0 (0)	0 (0)	3 (<1)
Age								
18–34	29 (19)	4 (15)	4 (16)	21 (21)	185 (18)	36 (19)	38 (21)	111 (1)
35–54	74 (49)	9 (35)	11 (42)	54 (55)	589 (58)	101 (52)	83 (45)	405 (64)
55 +	46 (31)	13 (50)	11 (42)	22 (23)	235 (23)	58 (30)	64 (35)	113 (18)
Prefer not to say	1 (<1)	0 (0)	0 (0)	1 (1)	6 (<1)	0 (0)	0 (0)	6 (<1)
Gender								
Woman	69 (46)	12 (46)	12 (46)	45 (46)	469 (46)	97 (50)	82 (44)	289 (46)
Man	77 (51)	13 (50)	14 (54)	50 (51)	525 (52)	94 (48)	101 (55)	329 (52)
Trans	0 (0)	0 (0)	0 (0)	0 (0)	3 (<1)	0 (0)	0 (0)	3 (<1)
Prefer not to say	4 (3)	1 (4)	0 (0)	3 (3)	20 (2)	4 (2)	2 (1)	14 (2)
Region								
Africa	3 (2)	2 (8)	0 (0)	1 (1)	22 (2)	5 (3)	2 (1)	15 (2)
Asiatic region	2 (1)	0 (0)	1 (4)	1 (1)	31 (3)	7 (4)	4 (2)	20 (3)
Eastern Europe	4 (2)	1 (4)	0 (0)	3 (3)	33 (3)	12 (6)	5 (3)	16 (3)
Latin America	5 (4)	0 (0)	1 (4)	4 (4)	54 (5)	14 (7)	10 (5)	30 (5)
Middle East	2 (1)	0 (0)	1 (4)	1 (1)	26 (3)	11 (6)	6 (3)	9 (1)
Northern America	57 (38)	13 (50)	6 (23)	38 (39)	283 (28)	58 (30)	57 (31)	168 (27)
Pacific Region	15 (10)	1 (4)	6 (23)	8 (8)	54 (5)	4 (2)	10 (5)	40 (6)
Western Europe	57 (38)	8 (31)	9 (35)	40 (41)	465 (46)	69 (35)	83 (45)	313 (49)
Not reported	5 (4)	1 (4)	2 (8)	2 (2)	47 (5)	15 (8)	8 (4)	24 (4)

heard of STROBE, but had not used it (group 2), and 17% (n = 26) had never heard of STROBE before nor used it (group 1). Representation was roughly equal between groups with 15% of each subgroup responding to the open-ended question.

Thematic coding established four main content areas: 1) mixed perceptions of the checklist, 2) academic confidence and self-assuredness, 3) use in education and training, and 4) journal endorsement and use in peer review. Owing to group imbalances and in the interest of transparency, the participant's subgroup accompanies each quote.

3.1. Mixed perceptions of the checklist

General perceptions of STROBE were mixed, ranging from positive reviews that hailed STROBE for how it "helps in standardizing how research is reported and guides the author/researcher to ensure all the necessary information (that the reader would be looking for) is included" (group 3) to harsh reviews that called it a "procedural straightjacket" (group 3).

Participants also had varied opinions on the additional time investment required to complete STROBE vs expected gain. Respondents referred to the uncertain impact on article publication despite the substantial amount of time required to complete the checklist which implicitly revealed their motivation for using the checklist: "it also adds to the time required to put together a manuscript, and I am not sure how much it improves the chances of a manuscript being published" (group 3). Conversely, the expected quality improvement was considered a key motivational aspect of using STROBE despite the additional working time required, "it does increase the quality of the articles, it is clearly worth the time" (group 3).

STROBE's length and content is a key factor influencing the time needed to complete it. Several authors expressed concerns

that the checklist is too exhaustive and "rigid," (group 3) reporting fears of an "incomplete" checklist giving the impression that their study is "less than 'perfect'…" (group 3).

These uncertainties stress the need for flexibility when using STROBE. Authors may "fear the 'Checklist Manifesto' becoming a rigid bureaucracy, and also becoming contrived" (group 1, ID1). Although Atul Gawande's "Checklist Manifesto" argues for implementing checklists [29], our authors cautioned that "that balance between freedom and structure is important to consider" (group 1, ID1) and that it is "important to recognise that each study/analysis is unique and doesn't always fit with the recommendations" (group 3, ID1).

In recognition of the variety of different types of observational studies, many field- and method-specific extensions to STROBE have been created to provide more nuanced guidance. However, some participants pointed out that these extensions have created needless complexity "… additional confusion in reporting of observational studies" (group 3) and that the "number of extensions has become excessive, especially given that multiple extensions may apply to a single study," (group 3).

3.2. Academic confidence and self-assuredness

Although authors expressed the need for a general flexibility in use and assessments, they also conveyed strong beliefs in their abilities to adhere to the checklist and the standards that it contains. One of the most prevalent themes was the expression of self-assuredness.

> "[I] follow the STROBE guidelines in my reporting reasonably well without actually referring to them or using a checklist" (group 3, ID1) and "[I] already apply the STROBE recommendations despite not having heard of it until today" (group 1).

Many authors claimed to be using or following the checklist when, in fact, as demonstrated by the quotes aforementioned, it became evident that they were not completing it or sometimes had never even seen it before.

Furthermore, several authors conveyed their beliefs that STROBE "is a waste of my time" (group 3) in light of their own training and experience. However, they were "glad that investigators with limited training are expected to use STROBE when they approach publication" (group 3).

Despite the prevailing attitudes of self-confidence, there was also recognition that STROBE can be helpful to experienced researchers for quality assurance: "even for those of us who have been researchers for many years, it is sometimes helpful to check a tool such as STROBE, to ensure that we have included everything" (group 3).

3.3. Use in education and training

Despite experienced researchers generally not seeing a benefit to personally using STROBE, there were strong feelings that it is valuable to early-career researchers (ECRs). Many participants shared that they use STROBE's structure and content as an educational tool for ECRs to instill good practice in writing manuscripts.

> "STROBE is useful for any observational researcher, but exceptionally useful for new researchers… it can help them structure their drafts and develop a strong foundation and habits as they write their first papers. We use it in our epidemiologic analysis course and hope that students continue to use it" (group 3).

Aligned with an early intervention stance to intervene in the initial stages of one's research career, some also suggested that STROBE should be used earlier in the research process itself, like when writing study protocols. Some respondents also thought that intervening earlier would have the most impact on the final quality of reporting: "To fully apply the criteria, I would need to systematically apply the STROBE criteria on the front end design of a project, grant, etc…rather than at the time of writing a project… Encouraging policy that focuses on a front end approach would be helpful" (group 2).

Intervening at the early stages of research and in one's career could theoretically instill greater contemplation and caution in research planning. While in-depth analytical and epidemiological thinking is not embedded within STROBE, responses revealed that authors see an educational purpose in STROBE and expressed the need for optimization: "woefully deficient in encouraging…use of appropriate data analytic approaches. Strobe should, for example, encourage analysts seeking causal effect estimates to highlight their assumptions with a causal diagram" (group 3).

3.4. Journal endorsement and use in peer review

Aside from the personal and educational use of STROBE, many authors expressed beliefs that journals are largely responsible for properly implementing STROBE through mandatory enforcement "I think the main way to increase its use is to make it mandatory before submission," (group 3) and "guidelines should need to be obligatory for every study. Better implementation is needed" (group 3).

However, it seems that a number of authors primarily looked at the administrative burden of using STROBE over its primary purpose, that is, ensuring that the study is completely reported. One participant noted that "there are so many guidelines like STROBE, it can be difficult to put the energy into using STROBE (or any other) one a priori since ultimately, it depends on the journal submitted to and accepted to" (group 3). While others expressed frustration that it is "annoying to upload the STROBE checklist with journal submissions" (group 3) that "the elucidation of exact pages where the criteria were met, which I found arduous and a bit pedantic" (group 3).

Although STROBE may be seen as an administrative burden to some, other reporting guidelines may not share similar harsh reviews as they are more broadly endorsed by journals. This difference in RG acceptance was pointed out by one participant: "I am sorry to say that PRISMA and CONSORT have become mandatory but STROBE isn't?" (group 3).

One possible reason for this difference in acceptance might be the relationship to other implementation efforts. For example, one author noted that the conventional nature of trial or protocol registration might affect the acceptability of RGs: "since observational studies do not require prospective registration unlike RCTs or systematic reviews, I don't think STROBE is used as much as CONSORT or PRISMA even though these reporting guidelines substantially improve study design and reporting" (group 3).

Key to the crux of the issue is again the perceived benefit and establishing a norm for requiring RGs. If an author spends time using a requested checklist, it should be used in the evaluation by peer reviewers and/or editors. However, one author noted a current problem with implementation: "I have never had (nor have I heard of) an editor or reviewer pushing back on a claim that all STROBE criteria were met. Therefore, when a STROBE checklist is required for manuscript submission, it seems to turn into a[n] exercise in additional administrative busywork without really improving the research." (group 3, ID2).

Other survey respondents echoed concerns regarding the peer review process. When authors go through the trouble of completing a checklist, oftentimes there seems to be little benefit from using it as "the information provided does not matter as the reviewers do not know what to do with it" (group 3).

Despite these reported challenges, using STROBE in peer review can also be beneficial as it provides a reference of support when requesting additional information from authors: "As a junior scientist it gives me confidence to request the reporting of a certain piece of information knowing I have the backing of STROBE" (group 3).

4. Discussion

Responses revealed multiple misunderstandings about STROBE's purpose and content, and a lack of incentives for use. Our findings emphasize the need to better communicate the reasons for using STROBE and reporting guidelines in general—explaining their potential impact on reproducibility, clinical decision-making, and future research. It is important to convey the idea that complete and transparent reporting goes beyond perceived article publishability. Awareness and education campaigns are key to addressing skepticism and maladaptive beliefs regarding time requirements, benefits of use, and (over) self-confidence.

Part of these efforts must be focused on communicating the flexible nature of STROBE and the continued need for a strong epidemiological education which STROBE cannot replace. A reporting guideline cannot fix study aspects that were not thought about previously or were performed incorrectly. Related to this, some reported the need to use STROBE at earlier stages of research. This suggestion is aligned with a recent scoping review (2019) on interventions to improve adherence to reporting guidelines [30]. The authors found a general lack of attention given to interventions at the early stages of research and suggested that early-intervention policies (e.g., at the funder or ethical review board level) may be more effective in promoting more carefully designed studies.

Although reporting guidelines were not intended to be used for educational purposes, many authors reported that STROBE is useful for teaching early career researchers. STROBE can be a valuable tool to demonstrate how epidemiological concepts work together in practice and we encourage expansion and elaboration on its content. However, although suggestions for more detailed guidance are valid, there is only so much education that an RG can contain. STROBE is not meant to be a guideline on how to properly conduct research [31], but it appears as though many participants did not see education and reporting as distinct concepts. In-depth continuous education should be provided to researchers as epidemiological understanding and critical thinking cannot be taught through an RG alone.

There are many leverage points in the system to target for increased implementation of STROBE; but ultimately the task is placed on authors as they are the creators and owners of the research. Authors highlighted several areas of concern that must be addressed to better implement reporting guidelines. Above all, the perceived benefit and impact of using STROBE must be communicated and established. Authors need to be reassured that extra time spent will be personally rewarding and impact scientific literature as a whole, as it will help knowledge synthesis efforts. Unlike previous work focused on the TREND guideline [25], which found that authors did not think that their RGs took too long to complete, time and the perceived benefit of use was a recurring issue from our participants. Thus, there is a need for research investigating the impact of endorsement on completeness of reporting and on the submission process (e.g., likelihood of being published, speed of reviews, etc.).

To date, research on STROBE's impact has shown mixed results—either showing no effect on the reporting of confounding [32] or insufficient evidence to determine an impact on overall completeness of reporting [33]. However, recent work by Vilaró et al. demonstrated that having a methodological reviewer dedicated to looking for missing reporting guideline items (not only STROBE) increased the number of article citations by 43% [34]. This could be seen as an incentive for authors but also a proxy for perceived higher quality/impact. We need more research in this area to provide convincing evidence that additional time spent using STROBE can have a positive impact.

Furthermore, when journals request a completed STROBE checklist, it should actually be used by editors and peer reviewers. Otherwise, authors may feel like they did extra work for no benefit. It is theorized that requiring a completed checklist is the most effective form of implementation by journals. However, most endorsement literature does not differentiate between requiring and recommending RGs, so it is unclear whether there are discernible differences on completeness of reporting [33]. Journal editors have also been reluctant to enforcing RGs, expressing concerns that authors will switch to journals with easier submission processes, that their instructions to authors are sufficient, and that implementation would place undue burdens on reviewers [24].

Survey responses solidified often-discussed benefits and issues with reporting guidelines. There is a great potential to increase transparency and reproducibility through complete reporting, provide structure to manuscript writing, and educate early career researchers on the proper conduct of observational research. However, we need to better communicate flexibility to authors who are investing extra time, often perceived to be at the sacrifice of one's ego, to complete reporting checklists. Perhaps the most challenging aspect is the culture change needed to shift away from ingrained personal (over)confidence. Recognizing that these beliefs are quite common is the first step to better acknowledging the importance of humility. Although the ivory tower of academia is still standing, we might be inadvertently missing a few bricks.

CRediT authorship contribution statement

Melissa K. Sharp: Conceptualization, Methodology, Formal analysis, Data curation. **Ketevan Glonti:** Writing - review & editing. **Darko Hren:** Validation, Investigation, Resources, Writing - review & editing, Supervision, Funding acquisition.

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Authors' contributions: M.K.S. conceptualized the study and led the writing of the manuscript. K.G. contributed to the manuscript preparation. D.H. led the supervision of the manuscript preparation. M.K.S. and D.H. performed all analyses. All authors read and approved the final manuscript.

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DIABRISK-SL trial: further consideration of age and impact of imputations

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Abstract

Type 2 diabetes mellitus (T2DM) is a major cause of morbidity and mortality worldwide. Early interventions may help to delay or prevent onset of cardiometabolic endpoints of clinical importance to T2DM patients. Wijesuriya et al. (*BMC Med* 15:146, 2017) published results of a randomised controlled trial in Sri Lanka testing the effect of two lifestyle modification programmes of varying intensity in participants aged 5–40 years with risk factors for T2DM. The intervention measured the impact of the two programmes on the primary composite endpoint consisting of various predictors of cardiometabolic disease. The authors concluded that the more intensive programme significantly reduced the incidence of predictors of cardiometabolic disease. Further, they delivered a large-scale intervention with restricted resources with widespread acceptance as demonstrated by the high uptake rate. However, we believe that further analysis is required to fully understand the potential for benefit, particularly in relation to age, retention and missing data.

Keywords: Randomised controlled trial, Lifestyle modification programme, Type 2 diabetes mellitus

Introduction

There is an increasing incidence of type 2 diabetes mellitus (T2DM) in young urban South-Asians. In a large scale randomised controlled trial delivered in Sri Lanka, Wijesuriya et al. compared a trimonthly lifestyle modification programme with a less-intensive 12-monthly control programme to determine impact predictors of cardiometabolic disease in participants aged 5–40 years with risk factors for T2DM [1].

The study results were presented in two different age groups, participants aged above and below 18 years of age. We outline here a detailed explanation of why we believe that the authors, based on the sample size the research team achieved, should have provided a more detailed analysis of the different age groups. Given the rising levels of childhood obesity it is of utmost importance to understand whether resources should be focused to the different age groups.

Another important consideration given the different intensity of the interventions is the retention of participants in the clinical study and how the authors handled the missing data, so that the results are not compromised [2]. In the paragraph below about retention and missing data, recommendations have been provided about reporting the amount of missing data and the approaches that could have been used as more appropriate based on the underlying assumptions of missingness and whether they are realistic and scientifically justified.

Age differentiation

The intervention implemented by Wijesuriya et al. [1] is generally well described; however, given the wide age range of participants included in the study (6–40 years), further details are required regarding the nature of the intervention delivered to children. It is unclear whether the study provided a nuanced intervention for those aged under 18 years considering different approaches for the various age brackets and their respective developmental stages [3]. Age-specific subgroups within the paediatric population may show differential responses to the same intervention due to their inherent physiological and educational differences; therefore, adequate power to avoid type II errors in age-specific subgroup analyses is key [4]. In their previous paper assessing the

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prevalence of cardiometabolic risk factors in a study population screened for randomised controlled trial participation, the authors provided demographic and anthropometric characteristics according to different age groups [5]; it is unclear why this information was not provided for the recruited study participants.

Furthermore, given that children within the lower age ranges do not have independence over their food choices and activity options, engagement of their primary carers is necessary [6]. Therefore, it would have been meaningful to provide more details on whether carers had been involved in the intervention and how the authors handled situations wherein carers and children reported differently.

Further exploration of age could also provide important information regarding the age-specific effects of the interventions on the outcomes assessed. Nevertheless, consideration of age within the statistical analysis is limited to its categorisation above or below the age of 18 years. Given the rising levels of childhood obesity and its long-term consequences [7], it is important to understand whether the intervention is equally effective across all age groups or whether resources should be targeted to particular age groups.

Retention and missing data

In their study protocol [8], the specified follow-up period is 5 years in order to detect a 25% reduction in the relative risk between the participants in the trimonthly lifestyle modification programme and participants in the less-intensive 12-monthly control programme. However, in their final published article, Wijesuriya et al. [1] report a median follow-up of 3 years, with a range of 1 to 4 years. It would be of interest to know whether the reduction in the follow-up period was influenced by retention of study participants. More details on the group-specific retention rates would also be useful because a differential retention between groups may indicate non-adherence and biased results [9]. Given the different intensity of the interventions being compared in the study, there may be treatment group-specific differences between participant engagement and consequent retention.

Furthermore, the authors used the last observation carried forward (LOCF) method to handle missing data for participants with missing measurements. This method substitutes a single reasonable value for a missing observation assuming no change since the last observed value prior to dropout [10]. This method of imputation relies on the assumption that the probability of missing data occurs completely at random and that the probability of dropout is not related to variables such as disease severity, group assignment or intervention side effects [11]. However, the assumptions of stability and randomness may not be realistic for the study by Wijesuriya et al. [1] as the reasons causing the missing data are not known.

Imputation of a single value for the missing data is not recommended since the underlying assumptions often seem to be unrealistic and are scientifically unjustified [12]. In an anti-obesity drug trial, Jorgensen et al. [13] used different imputation methods for the missing values, including the baseline carried forward approach, where the missing weight measurements were substituted with the baseline weight, the LOCF, and the multiple imputation (MI) method, where the missing data are replaced by imputed values sampled from the predictive distribution based on the observed data. While the MI and LOCF methods in Jorgensen et al. [13] resulted in similar between-group differences for the treatment and placebo groups, this is probably because the LOCF introduces the same bias for both treatment groups. However, analysis using LOCF assumes the imputed value is known, thereby overestimating precision.

MI models impute data several times in order to allow estimation of the full uncertainty of the missing data. This method therefore incorporates not only the variability of the outcome but also the uncertainty about the missing observations. MI uses the available information to make better allowances for patients with missing data. Since the mechanism behind the missingness is unknown, and it is possible that the missing data are not missing at random [14], the MI approach [15] could provide more reliable results in comparison with the LOCF approach used by Wijesuriya et al. [1]. Bias introduced by the MI analyses could be reduced if the variables predictive of missing values are included in the imputation model.

Furthermore, in Wijesuriya et al. [1], it is unclear how many participant measurements were observed and how many were imputed. It is important for the readers to know the extent of imputation required and whether the analysis accounted for differential retention [16]. Thus, the robustness of the conclusions reached and any differences in retention rates between trial arms could be investigated in order to aid interpretation of the findings and support future trial designs.

Nevertheless, deficiencies in the reporting of missing data seem to be commonplace. Only half of the articles in a review by Rezvan et al. [17] reported both the proportion of missing data and complete cases for the variables of interest. Sterne et al. [18] also identified a lack of reporting of the MI approach, with only seven out of 59 articles reporting results from both imputed and complete case analyses. Thus, guidelines have been suggested to improve reporting of missing data analysis methods.

Despite the fact that there is no universal method for handling incomplete data in a clinical trial, there are six principles that should be considered, including the reasons causing the missingness, the primary set of assumptions about the missing data mechanism and clarification of whether the values that are missing are meaningful for analysis [12]. Although it is not possible to determine whether data are missing at random or missing not at random, sensitivity analyses addressing biases caused by data that are missing not at random are recommended to assess the robustness of findings.

Conclusion

The DIABRISK-SL is a large, low-cost educational intervention. Therefore, it is important to take advantage of the sample size and evaluate the available information for different age groups. The analysis of participants under 18 years of age without differentiation into smaller age categories could be considered a missed opportunity to help those of an early age to establish a healthy lifestyle and prevent the incidence of type 2 diabetes mellitus. Provision of additional information regarding attrition and missing data would allow greater reassurance regarding the robustness of the results and conclusions and inform future study designs.

Abbreviations

LOCF: Last observation carried forward; MI: Multiple imputation

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Authors' contributions

The commentary was prepared by EG, KG, SD and CG after careful consideration of the research article for the DIABRISK-SL trial and its protocol. All authors read and approved the final manuscript.

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PRESENTATIONS

PEERE International Conference on Peer Review, Rome, 7th - 9th March 2018
Oral presentation: 'The editors' perspectives on communication practices within the manuscript review process in biomedical journals: a qualitative study'

Eighth International Congress on Peer Review and Scientific Publication, Chicago, 10th - 12th September 2017
Poster presentation: 'A Scoping Review of the Roles and Tasks of Peer Reviewers in the Biomedical Journal Editorial Process'

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