

Management of mastitis/ breast abscess in postpartum women in Coburg's Emergency Department

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UNIVERSITY OF SPLIT



**UNIVERSITY OF SPLIT
SCHOOL OF MEDICINE**

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**MANAGEMENT OF MASTITIS/ BREAST ABSCESS IN POSTPARTUM WOMEN
IN COBURG'S EMERGENCY DEPARTMENT**

Diploma thesis

**Academic year:
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**Mentor:
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Split, July 2023

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To my mentor.

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To my husband.

Thank you for being my tower of strength, for your patience and encouragement on cloudy days, for sharing all the ups and downs and for your unswerving faith. Your love is my greatest possession.

1. LIST OF ABBREVIATIONS

ABM – Academy of Breastfeeding Medicine
CBC – Complete blood count
CRP – C-reactive protein
e.g. – Latin: *exempli gratia*; for example
etc. – etcetera
GP – General practitioner
GDPR – General Data Protection Regulation
JASP – Jeffreys’s Amazing Statistics Program
ICD-10 –International Classification of Diseases-10
IL-6 – Interleukin-6
IRB – Institutional Review Board
mg/l – milligram per liter
N – Number
NSAIDs – Non-steroidal anti-inflammatory drugs
REDCap – Research Electronic Data Capture
WHO – World Health Organization

2. INTRODUCTION

2.1. The importance of breastfeeding

Breastfeeding is the natural way to nourish newborns. It is inexpensive, always available at a perfect temperature and ideally adapted to the individual needs of the baby. Moreover, it offers advantages for the health of children and their mothers. Breastmilk is not only optimal in regard to its nutrients and digestibility but contains antibodies and other immune factors to help the babies' immature immune system. Additional advantages become apparent in the long run: for example, the risk of obesity and diabetes type 2 is reduced in formerly breastfed children. For mothers, the risk of breast and ovarian cancer is significantly reduced (1). However, according to the World Health Organization (WHO) "nearly 2 out of 3 infants are not exclusively breastfed for the recommended 6 months — a rate that has not improved in 2 decades." (2) One of the reasons for this is the difficulties women encounter while breastfeeding, one of which is lactational mastitis.

2.2. Definition of mastitis and breast abscess

According to the World Health Organization's document 'Mastitis: Causes and management', mastitis is defined as "an inflammatory condition of the breast, which may or may not be accompanied by infection. It is usually associated with lactation [...]." Breast abscess is described as "a localized collection of pus within the breast, [which is] a severe complication of mastitis." (3)

Antepartum mastitis is a rare form of lactational mastitis which occurs during pregnancy (4).

2.3. Epidemiology of mastitis and breast abscess

The reported incidence of mastitis in the literature varies due to the lack of larger studies (3). Approximately 15 to 20% of women experience mastitis within six months postpartum, particularly within the first few weeks (5). The highest incidence of lactational mastitis is found in the first three weeks postpartum (6). The incidence of lactational breast abscess ranges from 0.4 to 11 % (7). Mastitis is a frequent reason for stopping breastfeeding early; in fact, in a study conducted in Australia, 18% of women ceased breastfeeding due to mastitis (8).

2.4. Etiology of mastitis

Milk stasis and infection are etiological of lactational mastitis. With milk stasis being the primary cause, researchers reported effective removal of milk as a measure to prevent lactational mastitis. Moreover, the stagnant milk provides the needed medium for bacterial growth (3). Causative organisms are usually bacteria colonizing the skin. The most frequently found organism is *Staphylococcus aureus*, other bacteria include Methicillin-resistant *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Bacterioides* species and *Coagulase-negative staphylococci*.

Other known factors increasing the risk for lactational mastitis are prior history of mastitis, nipple cracks and fissures, maternal stress, lack of sleep, tight-fitting bras, and the use of antifungal nipple cream (6).

Breast abscess is a complication of lactational mastitis that occurs as a progression of bacterial mastitis to an infected fluid collection, with the need of drainage (9), although there are case reports describing the occurrence of lactational abscess without evident preceding mastitis (3).

2.5. Clinical presentation

Prior to the development of lactational mastitis, patients frequently experience symptoms of breast engorgement or a focally blocked duct (6). As illustrated in Figure 1, these conditions are characterized by swelling and edema of the affected breast due to obstruction of venous and lymphatic tissue and consequently the overfilling of milk and tissue fluid (3).

Clinically, women with lactational mastitis present with a locally erythematous, swollen, and painful breast, which is usually accompanied by a feeling of illness as well as systemic symptoms, including high fever and myalgia (3,6,10). Additionally, patients may experience shivering or nausea (6). Typically, the condition only affects one breast (3). In the patient history, breast engorgement or local milk duct obstructions are commonly found (6).

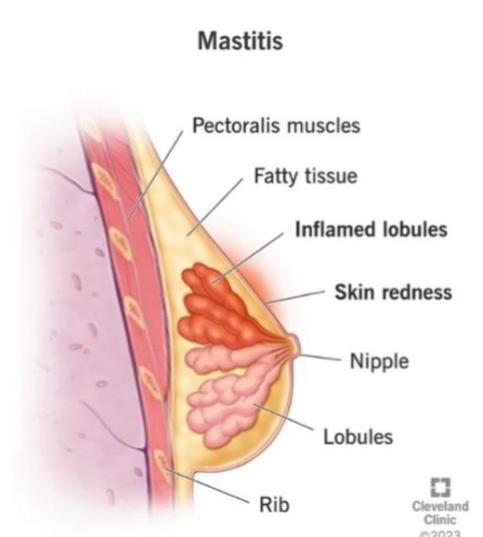


Figure 1. Breast inflammation characterized by local tenderness, swelling and erythema (11)

2.6. Pathophysiology

Lactational mastitis and breast abscess comprise variable conditions. As previously mentioned, milk stasis, especially when colonized by bacteria, are causative for the occurrence of lactational mastitis. Many other factors contribute to its development, with hyperlactation and/ or mammary dysbiosis as well as ductal narrowing being considered causative agents. Narrowed milk ducts and alveoli because of stromal edema and ductal inflammation are contributing factors in the disease development (12).

Apart from hyperlactation, inadequate drainage of milk is said to play a key role. This may occur due to the hyperlactation itself but also due to infrequent feeding, time-restricted feeding, inefficient milk removal (e.g. due to ankyloglossia), rapid weaning, clogged ducts and illness of mother and child. Because of milk stasis – either because of being narrowed by the edematous tissue or clogged – bacteria, that probably entered through sore or cracked nipples, enter the milk ducts, and start to propagate, causing the infection. These organisms may derive from the mother’s natural skin flora or the child’s mouth (6). An alternative explanation, given in the ABM protocol, is mammary dysbiosis, which results from a complex interplay of various factors from host, microbiota, and medication. Physiologic bacteria, normally found in breast milk, form a film lining the milk ducts. This increases in thickness during hyperlactation resulting in narrowing or obstruction of milk ducts, and an imbalance in the population of bacteria in the milk (9).

2.7. Diagnosis

Lactational mastitis is typically a clinical diagnosis which is based on the patient's history and specific symptoms. If symptoms do not disappear, despite taking an appropriate antibiotic, the affected breast should be examined sonographically to rule out breast abscess (6,13). Ultrasound may also guide fine-needle aspiration of any fluid or pus collection to be sent in for microbiology and culture. As inflammation may also be a sign of breast cancer, core biopsy is recommended in case the aspirate is not of liquid matter but rather blood-stained than purulent and in cases of inflammation in the presence of a breast mass. (13). In case of recurrent lactational mastitis or more severe forms, it is recommended to check a culture of breast milk for atypical pathogens, followed by selection of appropriate antibiotics (6,9). Blood cultures may be indicated if there is suspicion of bacteremia or sepsis in severe cases (6).

2.8. Management

The management of mastitis comprises conservative measures including emptying the breast, the use of non-steroidal anti-inflammatory drugs and, if symptoms persist, antibiotic treatment with Dicloxacillin or Cephalexin (9). To assess whether Coburg's management of lactational mastitis and breast abscess is according to best practice, the following guidelines were used for comparison.

The World Health Organization's document 'Mastitis: Causes and Management' which, despite being published in 2000, continues to be frequently cited and referenced.

The latest German S3 guideline 'Therapie entzündlicher Brusterkrankungen in der Stillzeit' (Therapy of inflammatory breast diseases during lactation period) was published in 2013 and is now in the process of being revised to give more updated information.

The Academy of Breastfeeding Medicine (ABM) recently published a new protocol 'The Mastitis Spectrum, Revised 2022' which assists with managing common medical issues that might affect breastfeeding success, such as breast engorgement, lactational mastitis, phlegmon, breast abscess, and galactoceles. (9,12).

2.8.1. Patient history and clinical examination

Prior to initiating the treatment of lactational mastitis, a thorough assessment of the individual situation of the patient should be conducted. Among other things, the frequency and breastfeeding technique as well as presence of cracked nipples, hyperlactation or mechanical blockage of milk flow should be evaluated according to the German guideline (14).

The WHO states, that, in any case, a patient history, and clinical examination, including observation of breastfeeding and, if appropriate, tips on improving of breastfeeding technique, latching of the baby etc. should be performed (3).

No specific recommendation regarding patient history or clinical examination are stated in the paper published by the ABM (9).

2.8.2. Investigations

Ultrasonography

The German guideline only mentions ultrasonography as a therapeutic option for some patients, especially in case of breast abscesses to perform an ultrasound-guided fine-needle aspiration (14).

The WHO and the ABM recognize ultrasonography as an important tool for diagnosing breast abscess, as well as for utilizing it as a therapeutic tool in ultrasound-guided fine-needle aspiration. Therapeutic ultrasound is mentioned as a treatment option in the ABM protocol (3,9).

Laboratory work

The German guideline mentions laboratory work only as a measure to detect increased inflammatory markers, including leucocyte count, CRP, erythrocyte sedimentation rate, IL-6 and procalcitonin (14).

The WHO document does not contain any information regarding laboratory work (3).

The ABM protocol considers laboratory work, such as leucocyte count and CRP of little value in the diagnosis of mastitis and breast abscess as they are non-specific measures (9).

Milk culture

The German S3 guideline mentions milk culture only as an option for the determination of infectious or non-infectious mastitis. Simultaneously it is advised to obtain ‘material’ for pathogen detection in microbiological cultures (14).

The WHO suggests obtaining a milk culture for choosing an appropriate antibiotic (3).

Performance of milk culture is recommended for diagnostic confirmation of recurrent mastitis and the evaluation of an appropriate antibiotic in the ABM protocol.

2.8.3. Conservative management

Breastfeeding advice

All guidelines advise to continue breastfeeding even in case of bacterial lactational mastitis or breast abscess. Only in the German guideline preterm babies are excluded from this recommendation if bacterial mastitis is present (3,9,14).

Effective milk removal

The German guideline suggests to regularly and effectively remove milk to relieve the pressure on mammary glands (14).

The WHO recognizes effective milk removal as the most important part of treatment, as this is the mainstay to prevent worsening or relapsing of the disease (3).

Feeding on demand and expressing small volumes of milk for relieving the pressure is recommended in the ABM protocol. It is emphasized not to empty the breasts completely as this involves the risk of hyperlactation and worsening of symptoms (9).

Breast care

As stated earlier, in the German guideline it is recommended to effectively remove milk to relieve pressure on the mammary glands. Moreover, physical measures like the application of heat prior to breastfeeding and the application of cold compresses after breastfeeding may support milk flow as well as relieve symptoms. Additionally, manual expression of locally blocked areas may be performed (14).

Efficient milk removal and the application of heat to the breast is also advised by the WHO. Moreover, one should ensure an adequate intake of fluids and sufficient rest, preferably in bed (3).

In the protocol of the ABM, it is advised to wear a well-fitting supportive bra and to avoid topical products, such as saline soaks or castor oil, for example. Moreover, one should refrain from deep massages of the lactating breast and concentrate on effective milk removal. To alleviate inflammation, ice and other cold packs are recommended. Additionally, a daily oral intake of 5-10g sunflower or soy lecithin may help to reduce inflammation and emulsify the milk (9).

2.8.4. Systemic management

Prescription of analgesics

All guidelines recommend the prescription of NSAIDS (e.g., Ibuprofen) to relieve pain and symptoms of inflammation. The WHO states paracetamol as an alternative (3,9,14).

Prescription of antibiotics

In the German S3 guideline bacterial mastitis should be treated with antibiotics. First line antibiotics are First- and Second-generation Cephalosporins, alternatively Beta-lactamase inhibitors, or, in case of allergies, Clindamycin. Treatment should start immediately, however, appropriate material for microbiological culture should be obtained to ensure sensitivity of existing bacteria for the chosen drug. The duration of antibiotic use should be 10-14 days to reduce the risk of relapses (14).

The WHO identifies four indications to start antibiotic treatment. Antimicrobial therapy should be started in case of cracked nipples *or* presence of severe symptoms from the start *or* absence of symptom improvement 12-24 hours after improvement of milk removal *or* if cell and bacterial colony counts and culture are available and indicate infection. Recommended antibiotics include Beta-lactamase resistant antibiotics, Cephalexin (250-500 mg 6 hourly) or Flucloxacillin (250 mg 6 hourly). The duration of antibiotic therapy should continue for 10-14 days (3).

The ABM protocol advises the prescription of Dicloxacillin or Flucloxacillin 500 mg four times a day for 10-14 days (9).

2.8.5. Management of breast abscess

The German guideline recommends fine-needle aspiration as first line treatment of breast abscesses and names surgical procedures, like incision and drainage, as second line therapy options (14).

In comparison, the ABM guideline recognizes that many institutions recommend fine-needle aspiration with fluid culture as first line treatment, but – due to the frequent need for multiple aspirations and the associated strain for patients – recommend to directly perform incision and drainage of breast abscesses (9).

The WHO recommends performing thorough fine-needle aspiration to drain the breast abscess whenever possible. They recognize it to be a less stressful procedure, commonly performed in an outpatient setting. Surgical incision and drainage may also be an option (3).

2.8.6. Comparison of recommendations for the management of lactational mastitis

Evaluation of milk cultures for microorganisms is recommended in the paper from the WHO and the ABM, whereas the German guideline only mentions it as an option to differentiate infectious from non-infectious mastitis. Breastfeeding continuation, breast care and analgesics are recommended in all three guidelines. Antibiotic use, if indicated, is also advised in all guidelines although dosages and active substances differ. Whereas the guideline from Germany and the WHO recommend fine needle-aspiration to treat breast abscesses, the ABM protocol suggests surgical incision and drainage.

Table 1 summarizes the differences in recommendations regarding the management of lactational mastitis and breast abscess in the three different guidelines.

Table 1. Comparison of recommendations regarding the management of lactational mastitis and breast abscess in various guidelines

	German Guideline, 2013	WHO, 2000	ABM Guideline, 2022
Milk culture	Option for determination of infectious or non-infectious mastitis	Recommended to secure appropriate prescription of antibiotic	Esp. in recurrent mastitis
Breastfeeding continuation	Recommended	Recommended	Recommended
Breast care	<ul style="list-style-type: none"> • Proper technique and frequency of breastfeeding • Cracked nipples • Hygiene • Manual milk expression in blocked areas • Application of warmth prior to breastfeeding <ul style="list-style-type: none"> • Cooling after breastfeeding 	<ul style="list-style-type: none"> • Proper technique and frequency of breastfeeding • Efficient milk removal • Application of heat <ul style="list-style-type: none"> • Bed rest • Adequate intake of fluids 	<ul style="list-style-type: none"> • Feeding on demand • Cooling with application of ice or cabbage • Lymphatic drainage • Avoid nipple shields • Treatment of nipple blebs
Analgesics	NSAIDs	Ibuprofen Alternatively: Paracetamol	NSAIDs
1st line antibiotic	<ul style="list-style-type: none"> • 1st or 2nd generation Cephalosporins for 10-14 days • Betalactamase-inhibitors • Allergies: Clindamycin 	<ul style="list-style-type: none"> • Beta-lactamase resistant antibiotics • Cephalexin (250-500 mg 6 hourly) • Flucloxacillin (250 mg 6 hourly) • Therapy for 10-14 days 	<ul style="list-style-type: none"> • 500 mg Dicloxacillin or 500 mg Flucloxacillin for 10-14 days
Management of breast abscess	1 st line: Fine needle aspiration 2 nd line: Incision & drainage	Thorough fine needle-aspiration	Incision & drainage

2.9. Prevention and general recommendations

In the latest German S3 guidelines, sore nipples and breast engorgement are listed as risk factors for puerperal mastitis. For the purpose of enhancing breastfeeding, it is of utmost importance to appropriately treat these breastfeeding associated conditions (14).

The ABM recommends preventing and treating conditions within the pathophysiological spectrum of lactational mastitis (e.g., hyperlactation, milk dysbiosis, ductal narrowing and inflammation) by utilizing conservative measures including cooling, use of NSAIDs and breastfeeding on demand (9).

The WHO state lactational mastitis and breast abscess to be preventable diseases and hence recommend educating new mothers on how to establish breastfeeding in order to reduce the risk of milk stasis. Moreover, early signs and risk factors like engorgement and stagnant milk should be treated promptly. For this to be possible a skilled professional is of utmost importance (3).

3. OBJECTIVES

3.1. Main aim of the study

The main aim of the study is to evaluate if postpartum women with lactational mastitis/ breast abscess who attend the Emergency department in Coburg are being managed according to best practice guidelines.

3.2. Specific aims

Specific aims of the study are:

- To evaluate if patients with mastitis who present to the Coburg Emergency Department are treated according to current guidelines and, if not, what differences there are.
- To evaluate what proportion of women with mastitis are prescribed an appropriate antibiotic.
- To evaluate the recommendations regarding continuation of breastfeeding.
- To evaluate how breast abscesses are managed.
- To evaluate what proportion of women with mastitis have had a milk culture done if symptoms did not improve within 48 hours.
- To evaluate the most common symptoms women with mastitis/ abscess presented to the Emergency Department.
- To evaluate at what stage postpartum women with mastitis/ abscess most frequently presented to the Emergency Department.
- To evaluate what proportion of women with mastitis have had a breast ultrasound ordered if symptoms have persisted for more than seven days.

3.3. Hypothesis

Mastitis/ breast abscess in postpartum women is not being managed according to current practice guidelines.

4. SUBJECTS AND METHODS

4.1. Study design and setting

An audit of medical records was performed as part of a retrospective, cross-sectional, descriptive study looking at the management of lactational mastitis in Emergency rooms. The research was part of an international study documenting medical practices in Australia, Brazil, Croatia, Germany, and Turkey.

In Germany, data was collected from patient histories following admission to the Gynecologic Emergency Room in the Regiomed clinic Coburg during the period from 1 January 2020 until 30 June 2022. Coburg is a town in Bavaria, Germany with approximately 42,000 citizens (15). The hospital belongs to the Regiomed-Kliniken GmbH, which is a hospital group located in the south of Thuringia and in the north of Bavaria. The hospital in Coburg specializes at the perinatal level 1 classification. This is the highest level used in the German healthcare system: it considers the level of training in personnel, such as gynecologists and neonatologists, the availability of specialized equipment, and the organizational structures necessary to handle high-risk pregnancies, multiple or preterm births, and cases involving suspected or known severe diseases in either the mother or the child. On average, there are approximately 1200 births per year in Coburg's hospital.

4.2. Data collection

Patient records were gathered from the ORBIS database and paper files in the archive of the hospital in Coburg. ORBIS database is a computer program for various hospital applications. It helps to optimize procedures in the hospital setting, as it offers a platform for performing administrative tasks, planning procedures, viewing laboratory results or medical imaging of patients as well as documenting daily progress in patient files. This facilitates the information flow between specialties and nursing personnel. Moreover, past cases can be reviewed easily if a patient is admitted multiple times (16).

Data was entered into a paper questionnaire (Supplement 1) followed by digitalizing in the REDCap application. The questionnaire, which was kindly prepared and shared by Dr. Lisa Amir who is leading the international collaboration, contains 40 questions, with several sub-headings to further explore management options. The following topics were addressed: general information (e.g., date and time of admission) (N=4), gynecological and peripartum history (e.g., gravidity, parity, mode of delivery, weeks postpartum, method of infant feeding) (N=8), current symptoms (e.g., pain, tenderness, redness, swelling, fever) (N=13), past history (breast surgery) (N=2) and management (e.g., ultrasonography, breastfeeding advice, antibiotics, analgesics, milk culture, treatment of breast abscess) (N=13).

4.3. Participants

All women/ lactating individuals of all age consulting a medical doctor in Coburg's Emergency department from 1 January 2020 until 30 June 2022 with symptoms of lactational mastitis and breast abscess were included in the study. Patient selection was based on International Classification of Diseases-10 (ICD-10) code O91.1 'Abscess of breast associated with childbirth' and O91.2 'Non-purulent mastitis associated with childbirth' from the ICD-10 Version of 2016. Although there is a new ICD-10 version which was introduced on January 1, 2023, the author used the older version since all the data was obtained prior to January 1, 2023. Men/ Non-lactating individuals, individuals without lactational mastitis or breast abscess, patients presenting to Coburg's Emergency Department prior to 1 January 2020 or after 30 June 2022 were excluded.

4.4. Informed consent and ethical approval

Since the study was designed as a retrospective, descriptive study and the data had already been collected, the study had no effect on treatment or patient outcome. Therefore, any risk of possible injuries, pain, stress, or discomfort for the patients was excluded.

REDCap is a secure web application for managing online databases and was approved for data collection by the Ethics Committee in Australia, leading on the study.

The study complies with the General Data Protection Regulation (GDPR). Collected data was anonymized and protected according to the Declaration of Helsinki (17). All questionnaires were stored securely in a folder and will be kept for ten years, according to German recommendations. Access from non-authorized persons is not possible. The statistical data has been stored in a password-secured Microsoft Excel file and Microsoft Word file, respectively.

Ethics approval for this study, including the questionnaire, was granted by the Institutional Review Board (IRB) of the Medical School REGIOMED Coburg on 22 November 2022 (Supplement 2).

4.5. Sample size estimation

Based on previous studies on the prevalence of lactational mastitis in Germany and the number of births per year in the Regiomed clinic Coburg and the commuting area of the city Coburg, it was estimated to find approximately 50 to 100 records in the study period(18) .

4.6. Data analysis

Data was entered into Excel tables and processed using Microsoft Excel for Mac version 16.73 (Microsoft Cooperation; 2023) and Microsoft Word for Mac version 16.74 (Microsoft Cooperation; 2023).

4.7. Statistical analysis

Statistical analysis of the data was conducted using the program JASP version 0.17.2. (JASP, Pennsylvania; jasp-stats.org; 2023) (19).

The presentation of categorical variables was designated as descriptive statistics (mean, whole numbers, and percentages) to evaluate current management of mastitis/ breast abscess in lactating women at Coburg's Emergency Department.

5. RESULTS

During the period from 1 January 2020 to 30 June 2022, 29 patients with either lactational mastitis or breast abscess attended the Emergency Department in Coburg to seek medical aid and all of them were included into this study.

Figure 2 shows that patients entering the Emergency Department with lactational mastitis and/or breast abscess were aged between 19 and 39 years old. The mean age was 30.24 years. When considering women 30 years of age or younger (N=16; 55,17%) and those older than 30 years old (N=13, 44,83%), one can see that they are nearly evenly distributed on either side. It needs to be mentioned, that most women (N=27) in this study were 27 years old or older, and only two participants were aged 19 and 23 years.

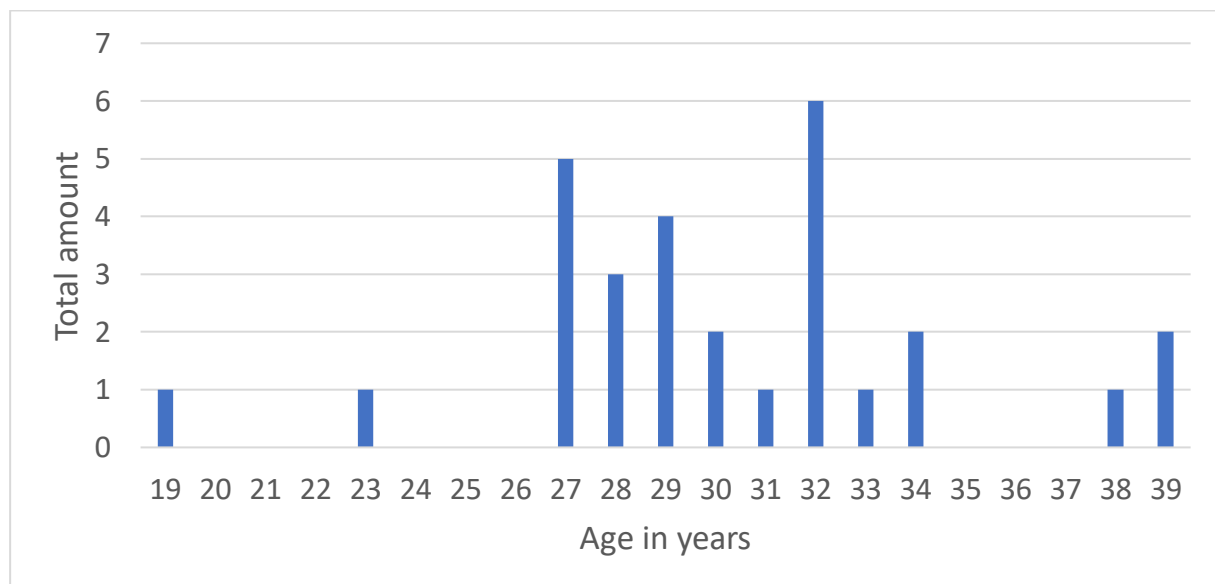


Figure 2. Age

Table 2 shows the parity of women admitted to the Emergency Department with lactational mastitis/breast abscess. When comparing women who delivered their first child (primipara), with women that had already delivered two or more children (multipara), one can see that first-time mothers are affected more commonly, comprising approximately 55% of all participants in this study (N=16). Whereas multiparous women in this study were only affected in approximately 38% (N=11). Two cases could not be included into this allocation, as no information was documented for one patient and the other one was prepartum at 29 weeks gestation.

Table 2. Parity of participants with lactational mastitis/ breast abscess

Parity	N	%
Primipara	16	55.17
Multipara	11	37.93
Not recorded*	2	6.90

* 1 participant was prepartum

Table 3 depicts the mode of delivery. Approximately 62% of participants had a vaginal birth (N=18), and more than a quarter of patients had a C-section (N=8; 27.59%), with two patients not recorded, of which one was prepartum

Table 3. Mode of delivery of study participants

Mode of delivery	N	%
Vaginal	18	62.07
C-section	8	27.59
Not recorded*	3	10.34

* 1 participant was prepartum

Table 4 shows that the prevalence of lactational mastitis and breast abscess decreases over time (12). The prevalence of lactational mastitis is highest in the first 6 weeks postpartum (N=16). A few episodes occurred within the 3rd month postpartum (N=6), and when considering the whole three-month period postpartum 75% of all patients are included (N=22). The last patients reported lactational mastitis six months to one year after delivery (N=3).

Table 4. Timing of lactational mastitis/abscess

Weeks postpartum	N	%
<3	9	31.03
4-6	7	24.14
7-12	6	20.69
13-24	1	3.45
25-46	3	10.34
Not recorded*	3	10.34

* 1 participant was prepartum

Table 5 shows that there is almost no difference in the breast affected during episodes of lactational mastitis. Both breasts were affected almost equally (N=13 and N=14, respectively). Rarely, both sides were affected simultaneously (N=2).

Table 5. Breast affected during lactational mastitis/breast abscess

Side of breast	N	%
Left	14	48.28
Right	13	44.83
Both	2	6.90

As seen in Table 6, most patients (N=18) presented to the Emergency Department after an extended time of symptom onset (>48 hours), some presented within 12 to 24 hours (N=5) and a few within 24 to 48 hours (N=2). The fewest presented within 12 hours of symptom onset (N=1).

Table 6. Duration of presence of symptoms upon presentation to the ER

Time (hours)	N	%
<12	1	3.45
12-24	5	17.24
25-48	2	6.90
>48	18	62.07
Not recorded	3	10.34

Table 7 shows the most frequently reported symptoms. Most common symptoms were breast lump/ firmness (N=21), breast erythema (N=21) and breast pain (N=17). 11 patients experienced fever at some time in their disease course, whereas 12 patients were afebrile. Upon admission fever could only be recorded in seven patients, whereas the majority were afebrile (N=14), no temperature measurement was documented in eight cases. A smaller number of patients (N=5) reported shivering and feeling unwell. Individual patients (each N=1) reported symptoms like rigor, feeling hot, headache, abdominal pain, anxiety, nipple discharge or nausea. These symptoms were not recorded for the other patients (N=28), except two patients who declined feeling hot. In most patients (N=24), nipple trauma was not recorded, leaving only five patients with nipple trauma. In 55.17% of patients breast abscess, as a complication of lactational mastitis, was present.

Table 7. Most common symptoms at presentation to ER (multiple answers possible)

Symptom	N	%
Breast lump/ firmness	21	72.41
Breast erythema	21	72.41
Breast pain	17	58.62
Fever	11	37.93
Shivering/ shaking	5	17.24
Lethargy/ feeling unwell	5	17.24

Previous breast surgery was documented in three patient histories. Two patients were treated for previous breast abscess and one of them had undergone breast augmentation surgery.

As seen in Table 8, eleven patients stated that they already had a history of mastitis in this lactation; in all the other patients (N=18), no information regarding this matter was documented.

Table 8. History of mastitis

Occurrence of mastitis	N	%
In this lactation	11	37.93
In previous lactation	0	0
No previous mastitis	0	0
Not recorded	18	62.07

Ultrasonography was performed in a large proportion of women participating in this study (79.31%; N=23). As presented in Table 9, the most frequent findings on ultrasonography were breast abscess (N=15), followed by changes consistent with breast abscess (N=5).

Table 9. Results of breast ultrasonography

Results	N	%
Breast abscess*	15	65.22
Changes consistent with mastitis	5	21.74
“No breast abscess”	2	8.70
Cystic changes	1	4.35
Total†	23	100

* All patients with breast abscess (N=16), 87.50%

†Ultrasonography was performed in 23 cases (79.31%)

Table 10 illustrates other frequently ordered investigations that were performed in the Emergency Department. They consisted mostly of blood work, such as a complete blood count (N=28), CRP (N=28), blood culture (N=4), electrolytes (N=1), and arterial blood gas analysis (N=1), respectively. Moreover, urine culture (N=6), urine dip stick examination (N=1). In case of breast abscess, pus swabs for microbiology and culture were commissioned in 15 cases. In no patient was a milk culture performed.

Table 10. Other investigations conducted on admission to ER (multiple answers possible)

Investigation	N	%
Blood count	28	96.55
CRP	28	96.55
Swab from pus (micro and culture) *	15	51.72
Urine culture	6	20.69
Blood culture	4	13.79

* Investigation of pus only in patients with breast abscess

→ 16 of 29 patients had a breast abscess (55.17%)

→ 15 of 16 patients had pus micro and culture → 93.75%

Table 11 illustrates the C-reactive protein (CRP) results in respective patients. There are various reference values regarding normal CRP values ranging from 3 mg/l, over 5 mg/l up to 9 mg/l (20–22). In Germany values less than 5 mg/l are usually considered normal (20), therefore the classification from StatPearls Publishing LLC. was adapted to this value. CRP values ranged from normal values up to values over 100 mg/l. 50% of patients had CRP levels between 10 and 100 mg/l. 25% of patients even had a marked CRP-elevation from 100 to 500 mg/l. Four patients had normal CRP values and in two patients only a minor CRP elevation could be detected.

Table 11. C-reactive protein (CRP) values

CRP values (mg/l)	Classification	N=28*	%
<5	Normal	4	14.29
5-10	Minor elevation	2	7.14
>10-100	Moderate elevation	15	53.57
>100-500	Marked elevation	7	25.00
>500	Severe elevation	0	0

* No record of CRP values in 1 patient

Table 12 depicts the results from swabs taken intraoperatively upon abscess incision and drainage as well as from fluid and pus aspirate upon fine-needle aspiration, which was performed in 15 out of 16 patients with breast abscess. *Staphylococcus aureus* was by far the most frequently encountered, comprising approximately 73% of all organisms.

Table 12. Results from swabs of pus (microbiology and culture)

Microorganism	N=15	%
<i>Staphylococcus aureus</i>	11	73.33
<i>Streptococcus pneumoniae</i>	1	6.67
<i>Prevotella bivia</i>	1	6.67
<i>Brevibacterium casei</i>	1	6.67
No growth	1	6.67

Table 13 shows the recommendations for management of lactational mastitis and breast abscess. Breast care (N=17) and the recommendation to continue breastfeeding (N=12) were the mainstay of conservative measures. No recommendations on conservative management of lactational mastitis and breast abscess were documented in eight patients. Antibiotics were prescribed to approximately 86% of participants. 17 patients received a prescription for analgesics (approximately 59%).

Table 13. Recommendations on management of lactational mastitis / breast abscess (Multiple answers possible)

Recommendations	N	%
Breastfeeding continuation	12	41.38
Stop breastfeeding	0	0
Suspend formula	0	0
Breast care*	17	58.62
Antibiotic therapy	25	86.21
Analgesics	17	58.62

* Massage, expressing milk, compress, use of suitable appropriate, proper technique of breastfeeding, emptying suitable of the breast

Table 14 depicts the use of antibiotics for the management of mastitis/abscess. Antibiotic treatment was part of the management in 25 patients (approximately 86%), of which 16 patients commenced antibiotic therapy, whereas nine women were already taking antibiotics. Five of them continued their previous therapy, four changed to another drug. Three quarters of patients were treated with cephalosporins (N=22; 75.86%), most of them received Cefuroxime (N=21) and one patient received Cefazolin. The minority of patients received other antibiotics, such as Clindamycin (N=2) and Amoxicillin (N=1), respectively.

Table 14. Antibiotic treatment

Antibiotic*	N	%
Cefuroxime	21	72.41
Cefazolin	1	3.45
Amoxicillin	1	3.45
Clindamycin	2	6.90

* Prescription of antibiotics in 25 cases (86.21%)

In 12 patients no analgesic therapy was prescribed. As illustrated in Table 15, analgesic therapy was documented in 17 patients. Ibuprofen was the most frequently prescribed drug (N=14), followed by paracetamol (N=8) and, in one case, metamizole.

Table 15. Analgesic treatment in patients with mastitis/abscess (multiple answers possible)

Analgesics*	N=17	%
Ibuprofen	14	48.28
Paracetamol	8	27.59
Metamizole	1	3.45

16 of 29 patients were diagnosed with breast abscess (55.17%). As seen in Table 16, invasive treatment of breast abscess included ultrasound-guided fine needle aspiration (N=4) and, the more commonly performed procedure, surgical incision and drainage (N=12).

Table 16. Management of breast abscess

Management	N=16	%
Ultrasound-guided fine needle aspiration	4	25.00
Incision and drainage	12	75.00

Table 17 shows that approximately three quarters of patients were admitted for inpatient treatment (N=22; 75.86%).

Table 17. Admission to hospital for lactational mastitis/abscess

	N	%
Admission to hospital	22	75.86
Not applicable	7	24.14

Figure 3 depicts outpatient presentation of patients and referral to the hospital and outpatient treatment. 15 patients sought help in the outpatient setting prior to presenting at the Emergency Department. 13 patients presented to a licensed gynecologist, 9 of which were treated prior to referral to the hospital. Additional 2 patients received recommendations on conservative measures from their midwives prior to hospital treatment.

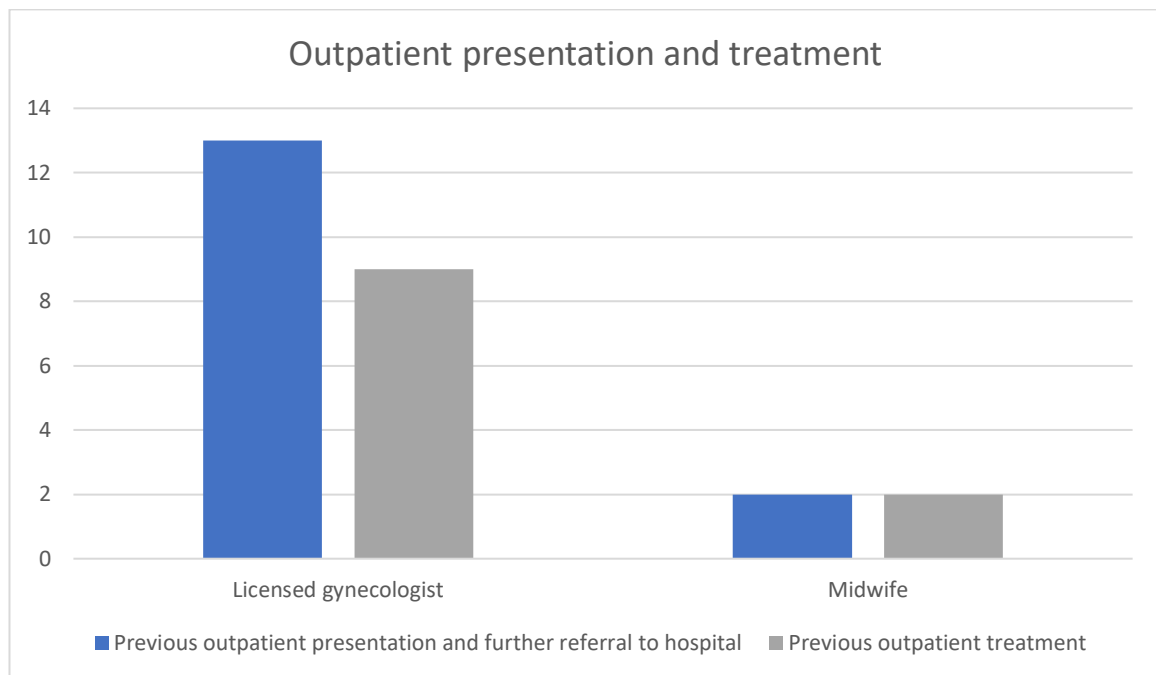


Figure 3. Outpatient presentation and treatment

Table 18 summarizes the management of lactational mastitis and breast abscess in Coburg's Emergency Department in comparison to the guidelines from Germany, the World Health Organization (WHO) and the Academy of Breastfeeding Medicine (ABM).

Table 18. Comparison of Coburg's Management vs. recommendations in current guidelines

	German Guideline, 2013	WHO, 2000	ABM Guideline, 2022	Coburg's Management
Milk culture	Option for determination of infectious or non-infectious mastitis	Recommended to secure appropriate prescription of antibiotic	Esp. in recurrent mastitis	Not performed
Breastfeeding continuation	Recommended <ul style="list-style-type: none"> • Proper technique and frequency of breastfeeding • Cracked nipples • Hygiene 	Recommended <ul style="list-style-type: none"> • Proper technique and frequency of breastfeeding • Efficient milk removal 	Recommended <ul style="list-style-type: none"> • Feeding on demand • Cooling with application of ice or cabbage 	Recommended (41.38%)
Breast care	<ul style="list-style-type: none"> • Manual milk expression in blocked areas • Application of warmth prior to breastfeeding • Cooling after breastfeeding 	<ul style="list-style-type: none"> • Application of heat • Bed rest • Adequate intake of fluids 	<ul style="list-style-type: none"> • Lymphatic drainage • Avoid nipple shields • Treatment of nipple blebs 	Recommended (58.62%)
Analgesics	NSAIDs	Ibuprofen Alternatively: Paracetamol	NSAIDs	NSAIDs (58.62%)
1st line antibiotic	<ul style="list-style-type: none"> • 1st or 2nd generation Cephalosporins for 10-14 days • Betalactamase-inhibitors • Allergies: Clindamycin 	<ul style="list-style-type: none"> • Beta-lactamase resistant antibiotics • Cephalexin (250-500 mg 6 hourly) • Flucloxacillin (250 mg 6 hourly) • Therapy for 10–14 days 	<ul style="list-style-type: none"> • 500 mg Dicloxacillin or 500 mg Flucloxacillin for 10-14 days 	Cefuroxime (2 nd generation Cephalosporin) (72.41%)
Management of breast abscess	1 st line: Fine needle aspiration 2 nd line: Incision & drainage	Thorough fine needle-aspiration	Incision & drainage	Incision & drainage (75.00%)

6. DISCUSSION

Most patients were aged 27 years or older, with only two cases of young women being aged 19 and 23 years, respectively. This limits the ability to draw conclusions about younger women. Nevertheless, the mean maternal age on birth of their first child is 30.8 years of age in Bavaria and therefore fits the resulting mean age in this study (23). It remains questionable if the age has any impact on occurrence of lactational mastitis and breast abscess.

Regarding parity and mode of delivery it was shown that primiparous women are more commonly affected than multiparous women. This raises the question whether the risk factors differ between these two groups or if the lower prevalence of lactational mastitis and breast abscess in multiparous women bears relation to being more experienced in breastfeeding and possibly breast care. The ABM identifies increased intravenous fluid intake during delivery as a risk for interstitial fluid accumulation, edema, and engorgement (9). This leads to the question of whether there is an association between increased intravenous fluid intake, particularly in the cases of prolonged labor (which is more common among primiparous women), and the occurrence of lactational mastitis and breast abscesses among the participants in this study who had a vaginal birth.

Consistent with the current literature, lactational mastitis and breast abscesses most frequently occurred during the first six weeks after childbirth. One possible explanation for that may be that mothers and their infants require some time to adapt to breastfeeding, learning how to properly latch the baby, which positions to use, and how frequently the child needs to be fed. A German study from 2011 called 'STELLA' discovered, that cracked nipples (58%) and difficulties in latching and suckling of the baby (54%) were the most frequently reported problems related to breastfeeding in the first six days postpartum (24). These factors, once again, serve as risk factors for the development of lactational mastitis and breast abscess. Further studies are required to explore the underlying mechanisms and factors contributing to why some patients experience lactational mastitis and breast abscesses while others do not. Moreover, it is noteworthy that a small number of patients with these conditions presented up to one year after delivery. The reason for this temporal pattern remains unexplained, highlighting the importance of investigating potential implications for preventive measures and timely interventions.

Ultrasonography was performed in 23 out of the 29 participants (79.31%). Current guidelines recommend ultrasonography in cases of breast abscess. Indeed, in 15 patients a breast abscess could be confirmed, in two patients the ultrasound was evidently ordered to exclude the presence of breast abscess, in one patient cystic changes and in five patients changes consistent with mastitis were detected. The high prevalence of breast abscesses detected via ultrasonography underlines the importance of diagnosing this condition as well as its value in differential diagnosis. Ultimately ultrasonography may also be used as a therapeutic tool in ultrasound-guided needle aspiration of breast abscesses with the possibility of subsequent microbiological culture of fluid aspirate. This enables the doctor in charge to choose or subsequently change an appropriate antibiotic for given bacteria.

Almost all patients had blood work ordered, consisting mostly of a complete blood count and CRP, occasionally blood cultures were ordered. The utilization of inflammatory markers in laboratory values are controversial since they are not significant for lactational mastitis or breast abscess. Marked elevation of CRP values, which was observed in 25% of patients, might serve as an additional indicator for determining the need for initiating antibiotic therapy. Moreover, the high frequency of ordered blood work may be attributed to the significant rate of hospitalization, which accounts for approximately 76% of the study group. Within the hospital setting, laboratory tests can serve as valuable parameters for monitoring the progression of the disease and assessing the response to the initiated therapy.

Milk cultures were not ordered in any patient. Studies recommend evaluation via milk cultures for resistant and/ or less common pathogens if symptoms do not improve after 48 hours of first-line treatment (3,9). Moreover, the ABM recommends to order milk cultures in case of recurrent mastitis (9). 11 patients of this study experienced their second episode of mastitis in this lactation. One should consider ordering a milk culture to verify the choice of an appropriate antibiotic especially in prolonged or recurrent episodes of lactational mastitis or breast abscess or in case of presence of severe symptoms already from the onset of disease (3,9,14).

Swabs of fluid or pus were sent for microbiology and culture in 15 out of 16 patients with breast abscess after fine-needle aspiration or incision and drainage. *Staphylococcus aureus* was the most frequently encountered microorganism (73.33%), aligning with current literature. It is advised to obtain material for microbiological examination to choose a suitable antibiotic (3,9,14).

Continuation of breastfeeding and breast care is recommended in all reviewed guidelines (3,9,14). Doctors in charge also suggested this to their patients in Coburg in approximately 41% and 59%, respectively, which is very encouraging. It remains open for discussion, whether the rate of recommendation should be increased, especially considering, that it was never advised to stop breastfeeding, or if it is related to a lack of documentation.

Prescription of analgesics is recommended not only for pain control but also for other signs of inflammation, such as tissue edema and erythema (3,9). Approximately 59% of patients received prescriptions for analgesics. According to the literature, one could consider increasing the prescription rate. However, it is important to note that most non-steroidal anti-inflammatory drugs, including ibuprofen, as well as paracetamol, are available over the counter. Therefore, it is possible that analgesics were recommended without a written prescription, especially for ambulatory patients.

Most patients received antibiotic therapy (approximately 86%) which might be in relation to the high prevalence of breast abscesses (approximately 55%) and the persistence of symptoms >48 hours (approximately 62%). Multiple recommendations regarding the selection of appropriate antibiotic are provided in referenced guidelines. Cefuroxime was prescribed to approximately 72% of patients, aligning with the current German S3 guideline, which suggests the use of First- and Second-generation Cephalosporins. However, it is important to consider the presence of local microbial resistance to Cefuroxime, and therefore, evaluation through milk cultures or other microbiological tests may be necessary. In case of breast abscesses, intraoperative swabs were obtained to examine fluid or pus and identify the microorganisms present, as well as their sensitivity to specific antibiotics. The WHO and ABM publications advise different antibiotic preparations such as Flucloxacillin and Cephalexin. It remains unclear whether the choice of Cefuroxime is based on empirical knowledge among local physicians or other factors that are yet to be determined. Based on the available antibiogram results, Cefuroxime demonstrated sensitivity in almost all cases, as evaluated by the author.

Among the study participants, a high prevalence of breast abscesses (approximately 55%) and the need for inpatient treatment (approximately 76%) were identified. This situation may be attributed to various factors. One of which could be the healthcare system in Germany, which is organized in a way that emphasizes treating as many patients as possible in an outpatient setting. Firstly, almost all women have a midwife, who provides guidance during pregnancy and the initial weeks after delivery. Midwives assist with postpartum body recovery, baby care, breastfeeding, and any related issues. Therefore, the woman's midwife might be the first point of contact in the case of lactational mastitis and associated conditions. If there are suspicions of pathology or the need for further treatment, the midwife might refer women to a licensed gynecologist. Additionally, scheduled appointments with a licensed gynecologist are typically 4-6 weeks after childbirth. Lastly, general practitioners act as gatekeepers in Germany's healthcare system. Consequently, some women might choose to initially visit their GP. If inpatient treatment is deemed necessary, such as in case of breast abscess, the licensed gynecologist or GP will refer the patient to a hospital for further treatment.

This theory is undermined by the fact, that approximately half of the patients (approximately 52%) sought help from their midwife or licensed gynecologist prior to their admission to hospital. This could be one of the reasons why participants in this study admitted to hospital at a relatively late stage. In this case, most patients (approximately 69%) presented more than 48 hours after the onset of symptoms. Future research could investigate the role of primary care providers in the early identification and management of lactational mastitis and related conditions, aiming to improve outpatient treatments and to prevent complications such as breast abscesses.

Regarding the management of breast abscesses, most patients (75%) were treated with incision and drainage, aligning with the recommendations of the ABM. In this regard, it should be noted that the leading authors of this protocol are breast surgeons (25,26). However, even the authors of the ABM protocol acknowledge that other guidelines suggest performing an ultrasound-guided fine-needle aspiration, followed by microbiological examination of obtained material (3,9,14). This procedure is less invasive, less expensive, and can be performed in an outpatient setting, enabling the mother/infant dyad to remain together. Nevertheless, in some cases (especially in cases of large abscesses), incision and drainage might be the better initial option to consider, since fine-needle aspiration carries the risk of necessary recurrent aspirations.

It was not possible to draw conclusions upon all asked topics in the questionnaire due to missing data. In Germany an unwritten law exists saying ‘What hasn’t been documented, hasn’t been done’ and this is also the way one would be treated when facing court. Nevertheless, especially considering the current shortage of healthcare personnel and the pressure on attending doctors, it is plausible that not every detail of the recommendations is documented and might only be communicated verbally along the way to patients.

Although most women with lactational mastitis seek medical attention through their midwives, gynecologists, and GPs, sometimes they attend the Emergency department to request treatment (27). Management of mastitis varies which is probably related to a lack of training of medical professionals during their studies (10). “Awareness is growing that inefficient removal of milk resulting from poor breastfeeding technique is an important underlying cause, but mastitis remains synonymous with breast infection in the minds of many health professionals. They are often unable to help a woman with the condition to continue to breastfeed, and they may advise her unnecessarily to stop. “((3), p. 1) Hence, training of health professionals in the management of mastitis, and how to support women to breastfeed, is necessary.

In conclusion, it is important to acknowledge the limitations of this study. The small sample size limits the representativeness of the results and is the reason for random bias in this study. For example, this study only represents a limited number of young women and documented information regarding previous episodes of lactational mastitis and breast surgeries were missing in many cases. Nevertheless, this emphasizes the need for further studies with larger sample sizes to establish conclusive findings. In fact, the author intends to continue data collection for an additional year to increase the number of participants to improve comparability with other participating institutions in the larger study. It will be intriguing to compare study results from different countries with the data collected in Coburg, particularly if there are similarly sizable study groups available for analysis.

Additionally, due to the lack of sample randomization, the study is prone to selection bias. To minimize this effect, this study included a consecutive sample of women, meaning all women who presented to the Emergency Department during the study period. Moreover, clearly defined inclusion and exclusion criteria minimize this error. Evaluated data comes from only one hospital during a limited time frame, but results will be compared with other study groups from different countries in the abovementioned study.

As mentioned earlier not all information was available from medical records, which leads to information bias. The provided questionnaire helped to structure data and to exclude patients where the data quality is insufficient. Although, in this study, no patient was excluded.

When considering the generalizability of the study, one should examine both the internal and external validity of the research. Chosen outcome measures have been determined to test our hypothesis, based on a detailed search of the current scientific literature. To improve the internal validity of our research we adhered to standard research methods and appropriate reporting guidelines. Moreover, since it is a descriptive study, the collected data was not influenced by any intervention and reflects the real world. By explaining in a detailed way how the study was designed and conducted, other researchers will be able to replicate the study. Mastitis/ abscess in lactating women is a worldwide problem and therefore is of global interest.

Finally, since the study was designed in a retrospective manner, it had no effect on the treatment of patients and did not generate any ethical issues. The study was not funded.

7. CONCLUSION

In conclusion, we can state that the management of lactational mastitis and breast abscess in Coburg's Emergency Department partially follows current recommendations.

One should reassess whether all the blood work is necessary in diagnosing lactational mastitis and breast abscess or if the results have any consequence in subsequent treatment. Nevertheless, especially considering the high hospitalization rate, it is reasonable to assume that consecutive CRP-values and leucocyte counts were used to control the success of initiated therapy in the inpatient setting.

Sonography is a simple, cost-efficient, and non-invasive procedure that allows for a quick assessment of multiple conditions without any associated risk. As such, it can be employed not only in case of suspected breast abscess but also in cases of uncertainty, particularly among young and inexperienced physicians.

No milk cultures were performed. It is recommended to evaluate for resistant and/ or less common pathogens if symptoms do not improve after 48 hours of first-line therapy. Moreover, one should consider ordering a milk culture if a patient suffers from recurrent mastitis to validate whether an appropriate antibiotic was chosen.

Recommendations regarding continuation of breastfeeding, breast care and taking analgesics could be improved. Breastfeeding should be continued, regardless of the presence of bacterial mastitis, breast abscess etc. NSAIDs should not only be prescribed for pain control but also for relieving symptoms of breast inflammation.

Antibiotic prescriptions are according to first line recommendation of the German S3 guideline of 2013 but differ from the suggestions stated in the protocols of the WHO and the ABM. Local resistances and results from microscopy and culture of respective specimens as well as milk cultures should be evaluated to review the effectiveness of Cefuroxime in treating lactational mastitis and breast abscess.

Whenever possible, the least invasive treatment option should be chosen. Against current recommendations, more abscess incision and drainages were performed, although needle aspiration is considered first line treatment in the German S3 guideline. Reassessment of treatment options of breast abscess is needed.

Further training regarding up-to-date management of lactational mastitis is recommended for doctors in charge of treating patients with lactational mastitis in Coburg's Emergency Department. There might be a requirement for the improvement of documentation skills.

Nevertheless, as stated earlier, due to the small study size, the results are not representative, and further studies with larger cohorts are required to accurately interpret the study findings and generalize them to a larger population.

8. REFERENCES

1. Bundesministerium für Ernährung und Landwirtschaft. Stillen - Die beste Ernährung in den ersten Lebensmonaten [Internet]. 2021 [cited 2022 Jul 21]. Available from: <https://www.bmel.de/DE/themen/ernaehrung/gesunde-ernaehrung/schwangerschaft-und-baby/stillen.html>
2. WHO Team. Breastfeeding [Internet]. [cited 2023 Jan 4]. Available from: https://www.who.int/health-topics/breastfeeding#tab=tab_1
3. World Health Organization. Mastitis Causes and Management. 2000.
4. Bell H, Peters G, Lynchd A, Harlea R. Breast Disorders During Pregnancy and Lactation: The Differential Diagnoses. J Clin Gynecol Obstet [Internet]. 2013 [cited 2023 Jun 19];2(2):47–50. Available from: <https://www.jcgo.org/index.php/jcgo/article/view/140/69#:~:text=The%20main%20differential%20diagnoses%20for,breast%20tissue%20with%20lactational%20change.>
5. Amir LH, Forster DA, Lumley J, McLachlan H. A descriptive study of mastitis in Australian breastfeeding women: Incidence and determinants. BMC Public Health. 2007;7:1–5.
6. Blackmon MM, Nguyen H, Mukherji P. Acute Mastitis [Internet]. StatPearls. StatPearls Publishing.; 2023 [cited 2023 Jul 17]. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/25516860>
7. Dixon JM, Chagpar AB, Sexton DJ, Hall KK. Primary breast abscess [Internet]. 2022 [cited 2023 Jul 11]. Available from: <https://www.uptodate.com/contents/primary-breast-abscess#:~:text=The%20incidence%20of%20breast%20abscesses,those%20with%20obesity%2C%20and%20smokers.>
8. Fetherston C. Characteristics of lactation mastitis in a Western Australian cohort. Breastfeed Rev. 1997;5(2):5–11.
9. Mitchell KB, Johnson HM, Rodríguez JM, Eglash A, Scherzinger C, Widmer K, et al. Academy of Breastfeeding Medicine Clinical Protocol #36: The Mastitis Spectrum, Revised 2022. Breastfeeding Medicine [Internet]. 2022;17(5):360–76. Available from: <https://www.liebertpub.com/doi/10.1089/bfm.2022.29207.kbm>

10. Amir LH, Zakarija-Grković I, Željka Topić Challenges in the treatment of lactational mastitis for general practitioners. *Breastfeeding Review* . 2015;23(3):23–8.
11. Cleveland Clinic medical professional. Mastitis [Internet]. 2023 [cited 2023 Jul 17]. Available from: <https://my.clevelandclinic.org/health/diseases/15613-mastitis>
12. Mitchell KB, Johnson HM, Rodriguez JM, Eglash A, Scherzinger C, Zakarija-Grkovic I, et al. Academy of breastfeeding medicine position statement and guideline: Infant feeding and lactation-related language and gender. *Breastfeeding Medicine*. 2021 Aug 1;16(8):587–90.
13. Cusack L, Brennan M. Lactational mastitis and breast abscess - diagnosis and management in general practice. *Aust Fam Physician* [Internet]. 2011 Dec;40(12):976–9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22146325>
14. Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF). S3 Leitlinie Therapie entzündlicher Brustentzündungen in der Stillzeit. 2013 [cited 2023 Jan 4]; Available from: https://www.awmf.org/uploads/tx_szleitlinien/015-0711_S3_Therapie_entzundlicher_Brustentzundungen_Stillzeit_2__2013-02-abgelaufen.pdf
15. Bayrisches Staatsministerium für Digitales. Stadt Coburg [Internet]. 2022 [cited 2023 Jun 24]. Available from: <https://www.freistaat.bayern/dokumente/behoerde/56664870387>
16. DH Healthcare GmbH. Ganzheitliche Steuerung von Klinikprozessen [Internet]. [cited 2023 Jun 29]. Available from: <https://www.dedalus.com/dach/de/our-offer/products/orbis/orbis/>
17. World Medical Association Inc. WMA DECLARATION OF HELSINKI – ETHICAL PRINCIPLES FOR MEDICAL RESEARCH INVOLVING HUMAN SUBJECTS [Internet]. 2022 [cited 2023 Jun 29]. Available from: <https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/>

18. Stachs A, Stubert J, Reimer T, Hartmann S. Benign Breast Disease in Women. Dtsch Arztebl Int. 2019 Aug 19;
19. JASP Team. JASP [Internet]. 2023 [cited 2023 Jun 16]. Available from: <https://jasp-stats.org>
20. Herold G. Innere Medizin. Köln; 2018. 966–966 p.
21. Cleveland Clinic medical professional. C-Reactive Protein (CRP) Test [Internet]. 2022 [cited 2023 Jun 24]. Available from: <https://my.clevelandclinic.org/health/diagnostics/23056-c-reactive-protein-crp-test>
22. Nehring SM, Goyal A, Patel BC. C Reactive Protein [Internet]. 2023 [cited 2023 Jun 24]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK441843/>
23. Statistisches Bundesamt. Daten zum durchschnittlichen Alter der Mutter bei Geburt insgesamt und 1. Kind nach Bundesländern [Internet]. 2022 [cited 2023 Jun 19]. Available from: <https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Geburten/Tabellen/geburten-mutter-alter-bundeslaender.html>
24. Spegel H, Meyer N, Hendrowarsito L, Schwegler U, Fromme H, Bolte G. Endbericht: STELLA – Studie zum Ernährungsverhalten im Säuglingsalter Interventionsprojekt zur Verbesserung der Stillbedingungen in einer Modellregion.
25. Katrina B. Mitchell. About: Katrina B. Mitchell, MD, IBCLC, PMH-C [Internet]. 2023 [cited 2023 Jul 6]. Available from: <https://physicianguidetobreastfeeding.org/about-the-physician/>
26. bfmed. ABM Candid Conversations: A Virtual Interview with Protocol Authors Helen Johnson, MD and Katrina Mitchell, MD IBCLC [Internet]. 2020 [cited 2023 Jul 6]. Available from: <https://bfmed.wordpress.com/2020/09/22/abm-candid-conversations-a-virtual-interview-with-protocol-authors-helen-johnson-md-and-katrina-mitchell-md-ibclc/>
27. Summers A. Managing mastitis in the emergency department. Emerg Nurse. 2011 Oct;19(6):22–5.

9. SUMMARY

Objectives: To assess the management of postpartum women with lactational mastitis/breast abscess in Coburg's Emergency Department and determine if it aligns with best practice guidelines.

Subjects and methods: The study was designed as a retrospective, cross-sectional study, collecting data from patient records between January 2020 and June 2022. A questionnaire with 40 questions was employed to explore various aspects of management. All lactating individuals presenting with symptoms of mastitis and breast abscess during the study period were included, based on specific ICD-10 codes.

Results: 29 patients with lactational mastitis and breast abscess were included in the study. The mean age was 30.24 years. The prevalence of lactational mastitis was highest within the first 6 weeks postpartum (75%). Both breasts were affected almost equally. Most patients presented to the Emergency Department more than 48 hours after symptom onset with breast lump/firmness, breast inflammation/erythema, and breast pain being the most common symptoms reported. Ultrasonography was performed in approximately 79% of patients, with the most frequent findings being breast abscess. Breast care and breastfeeding continuation were the main conservative measures. Antibiotic therapy was prescribed to approximately 86% of participants, with Cefuroxime being the most used antibiotic. Ibuprofen was the most frequently prescribed analgesic, followed by paracetamol. Approximately 55% of patients were diagnosed with breast abscess, which was treated with surgical incision and drainage in 75% of cases. The most frequently encountered microorganism was *Staphylococcus aureus* (approximately 73%). Approximately 76% of patients were admitted for inpatient treatment.

Conclusion: The management of lactational mastitis and breast abscess in Coburg's Emergency Department partially aligns with current recommendations. Antibiotic prescriptions differ from international guidelines, and local resistances and cultures should be evaluated to review their effectiveness. Less invasive treatment options should be considered for the management of breast abscesses, and training for physicians on the management of mastitis/abscess should be encouraged.

10. CROATIAN SUMMARY

Naslov: Liječenje mastitisa/apscesa dojke u žena nakon poroda na odjelu hitne pomoći u Coburgu

Ciljevi: Procijeniti postupak liječenja žena nakon poroda s laktacijskim mastitisom/apscedom dojke na Odjelu hitne pomoći u Coburgu i utvrditi je li u skladu s kliničkim smjernicama.

Ispitanici i metode: Provedena je retrospektivna, presječna studija između siječnja 2020. i lipnja 2022. u Coburgu u Njemačkoj. Upitnik s 40 pitanja korišten je za prikupljanje podataka iz bolesničkih kartona o različitim vidovima liječenja mastitisa ili apscesa dojke. Uključene su sve dojilje koje su imale simptome mastitisa i apscesa dojke, na temelju specifičnih kodova ICD-10.

Rezultati: Uključeno je 29 bolesnica s laktacijskim mastitisom i/ili apscedom dojke. Prosječna dob bila je 30,24 godine. Prevalencija laktacijskog mastitisa bila je najveća unutar prvih 6 tjedana nakon poroda (75%). Obje dojke bile su zahvaćene gotovo podjednako, s rijetkim slučajevima istodobnog zahvaćanja obje strane. Većina pacijentica došla je na odjel hitne pomoći više od 48 sati nakon pojave simptoma, pri čemu su tvrda dojka, crvenilo i bol u dojci bili najčešći simptomi. Kod većine bolesnica učinjen je ultrazvučni pregled, a najčešći nalaz bio je apsces dojke. Njega dojke i nastavak dojenja bile su glavne konzervativne mjere liječenja. Antibiotička terapija propisana je za približno 86% sudionica, a cefuroksim je bio najčešće korišten antibiotik. Ibuprofen je bio najčešće propisivan analgetik, a potom paracetamol. U približno 55% sudionica dijagnosticiran je apsces dojke, koji je u 75% slučajeva liječen incizijom i drenažom. Najčešći mikroorganizam bio je *Staphylococcus aureus* (oko 73%). Otprilike 76% pacijentica primljeno je na bolničko liječenje.

Zaključci: Liječenje laktacijskog mastitisa i apscesa dojke na Odjelu hitne pomoći u Coburgu djelomično je u skladu s trenutnim preporukama. Propisani antibiotici razlikuju se od međunarodnih smjernica, ali lokalne otpornosti treba uzeti u obzir. Trebalo bi razmotriti manje invazivne mogućnosti liječenja apscesa dojke te nuditi liječnicima mogućnost dodatne edukacije o laktacijskom mastitisu/apscesu.

11. SUPPLEMENTS

Supplement 1: Questionnaire

The questionnaire was used with permission from Dr. Lisa Amir.

Audit form

Title: Audit of management of mastitis

Professor Lisa Amir, La Trobe University

Study ID -

Institution

- ☐₁ Hospital São Paulo, Brazil
☐₂ Hospital Ipiranga, Brazil
☐₃ Hospital Maternidade Leonor Mendes de Barros, Brazil
☐₄ Split site 1, Croatia
☐₅ Split site 2, Croatia
☐₆ Royal Women's Hospital, Melbourne, Australia

1 Hospital UR/MRN number

2 Date of visit/admission ____/____/____ (01/ Apr / 2021 format)

3 Time of visit/admission : (24 hour clock)

4 First presentation with this episode of mastitis/breast abscess?

- ☐₀ No (has already presented to this ED/hospital for this episode)
☐₁ Yes
☐₉₉₉ Not recorded

INFORMATION ABOUT WOMAN WITH MASTITIS/ BREAST ABSCCESS

5 Temperature

☐₀ No

☐₁ Yes

☐₉₉₉ Not recorded

5.1 **Temperature** . °C

6. Maternal Date of birth ____/____/____ (01/ Apr / 1990 format)

6.1 Maternal age years

7. Parity?

☐₁ Primiparous

☐₂ Multiparous

☐₉₉₉ Not recorded

8. Method of birth?

☐₁ Vaginal birth

☐₂ Caesarean section

☐₉₉₉ Not recorded

9. How many weeks postpartum?

☐₀ No

☐₁ Recorded

☐₉₉₉ Not recorded

9.1 How many weeks postpartum? weeks (completed)

[enter 0 for less than 1 week]

10. Method of infant feeding? (in the last 24 hours if available)

☐₁ Fully breastfeeding

☐₂ Breastfeeding + expressed breast milk

☐₃ Expressed breast milk only

- ☐₄ Breastfeeding + formula
- ☐₅ Breastfeeding + expressed breast milk + formula
- ☐₆ Expressed breast milk + formula
- ☐₇ Fully formula feeding
- ☐₈ Baby not feeding yet (e.g. very prem/ very ill)
- ☐₉ Not recorded/unclear

11. Which breast is affected?

- ☐₁ Left breast
- ☐₂ Right breast
- ☐₃ Both breasts
- ☐₉₉₉ Not recorded

12. How long have symptoms/signs been present?

- ☐₁ < 12 hours
- ☐₂ 12 to < 24 hours
- ☐₃ 24 to < 48 hours
- ☐₄ 48 hours or more
- ☐₉₉₉ Not recorded

Recorded signs and symptoms

		No	Yes	Not recorded
13.	Breast pain	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₉₉₉
14.	Breast lump/firm area	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₉₉₉
15.	Breast inflammation/red area	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₉₉₉
16.	Rigor/s	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₉₉₉
17.	Feeling hot/cold	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₉₉₉
18.	Shivering/shaking	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₉₉₉

19.	Unwell/lethargy	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
20.	Dizziness	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
21.	Headache	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
22.	Abdominal pain	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
23.	Anxiety	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
24.	Other (please describe)	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
			
24.1	Fever	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
24.2	[Saída de exsudato/ exudate Outlet]	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
24.3	[Odinofagia/ Odynophagia]	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
24.4	Myalgia	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999
24.5	Nausea	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 999

25 Nipple trauma present? [any mention of skin damage: crack, blister, scab, etc]

☐0 No

☐1 Yes

☐999 Not recorded

PAST HISTORY

26 History of breast surgery?

☐0 No

☐1 Yes (please explain below)

☐999 Not recorded

26.1 Please describe surgery performed

27 History of mastitis?

- ☐₀ No
- ☐₁ Yes, in this lactation
- ☐₂ Yes, in previous lactation
- ☐₉₉₉ Not recorded

MANAGEMENT RECORDED

28 Breastfeeding advice?

- ☐₁ Continue breastfeeding (or expressing/pumping)
- ☐₂ Stop breastfeeding (or expressing/pumping)
- ☐₃ Breast care (massage, expressing, compress, proper technique of breastfeeding)
- ☐₄ [Referred to milk bank – Brazil version]
- ☐₅ Suspend formula
- ☐₆ Other advice
- ☐₉₉₉ Not recorded

28.1 Describe other advice

29. Were antibiotics prescribed?

- ☐₀ No
- ☐₁ Already taking antibiotics, continued (indicate below)
- ☐₂ Already taking antibiotics, changed (indicate new medicine below)
- ☐₃ Yes, antibiotics commenced (indicate below)
- ☐₉₉₉ Not recorded

30. Name of antibiotic? [if more than one, write both under “Other”]

☐₀ Not applicable

☐₁ Flucloxacillin (Flopen, Floxapen, Staphylex)

☐₂ Dicloxacillin (Diclocil, Distaph, Dicloxsig)

☐₃ Cephalexin (Keflex, Cilex, DBL Cephalexin, Ibilex) or Cefactor (Ceclor)

☐₄ Erythromycin (EES, Eryc, Emu-V, E-Mycin, Erythrocin oral, Ilosone)

☐₅ Roxithromycin (Rulide, Biaxsig)

☐₆ Amoxycillin (Amoxil, Amohexal, Alphamox, Cilamox, Moxacin)

☐₇ Amoxycillin / Clavulanate (Augmentin, Augmentin Duo Forte, Clamoxyl, Clavulin)

☐₈ Penicillin V (Abbocillin VK, Cilicaine VK, Cilopen VK, LPV, PVK)

☐₉ **Other**

☐₁₀ Cefadroxil

☐₁₁ Clindamycin

☐₁₂ Ciprofloxacin

☐₁₃ Ceftriaxone

☐₁₄ Metronidazole

☐₉₉₉ Not recorded

30.1 Describe other antibiotic

31. Analgesia prescribed?

☐₀ No

☐₁ Ibuprofen

☐₂ Diclofenac

☐₃ Paracetamol / acetaminophen

☐₄ Codeine

☐₅ Tramadol

☐₆ Combination product

<input type="checkbox"/> _7	Other
<input type="checkbox"/> _8	Ketoprofen
<input type="checkbox"/> _9	Dipyron
<input type="checkbox"/> _10	Piroxicam
<input type="checkbox"/> _11	Nimesulide
<input type="checkbox"/> _12	Decadron
<input type="checkbox"/> _999	Not recorded

31.1 Please name other analgesic

31.1.2 Outras condutas registradas/ Other registered conducts.
 Brazilian No
 version Abscess drained
 only Laser therapy to breast

INVESTIGATIONS ORDERED?

32. Milk culture ordered?

<input type="checkbox"/> _0	No
<input type="checkbox"/> _1	Yes
<input type="checkbox"/> _999	Not recorded

33. Results of milk culture? [list from Kvist et al. *Int Breastfeed J* 2008]

[if more than one list separately, i.e. below]

<input type="checkbox"/> _0	Not applicable
<input type="checkbox"/> _1	No growth
<input type="checkbox"/> _2	“Normal skin flora”
<input type="checkbox"/> _3	<i>S. epidermidis</i>
<input type="checkbox"/> _4	Coagulase neg staph
<input type="checkbox"/> _5	<i>S. aureus</i> sensitive to all antibiotics
<input type="checkbox"/> _6	<i>S. aureus</i> resistant to penicillin
<input type="checkbox"/> _7	<i>S. aureus</i> resistant to methicillin/oxacillin
<input type="checkbox"/> _8	Viridans Streptococci

- ☐₉ Group B streptococci
- ☐₁₀ *Enterococcus faecalis*
- ☐₁₁ Group G streptococci
- ☐₁₂ Group A streptococci
- ☐₁₃ Pneumococci
- ☐₁₄ Corynebacteria
- ☐₁₅ Enterobacteriaceae
- ☐₁₆ Other
- ☐₁₇ Gram-positive coccus [extra option **added in REDCap**]
- 33.1** Describe other milk culture results.....

34 Results of milk culture? 2nd organism isolated

[if more than two isolated, please write others in notes below]

- ☐₀ Not applicable
- ☐₁ No growth
- ☐₂ “Normal skin flora”
- ☐₃ *S. epidermidis*
- ☐₄ Coagulase neg staph
- ☐₅ *S. aureus* sensitive to all antibiotics
- ☐₆ *S. aureus* resistant to penicillin
- ☐₇ *S. aureus* resistant to methicillin/oxacillin
- ☐₈ Viridans Streptococci
- ☐₉ Group B streptococci
- ☐₁₀ *Enterococcus faecalis*
- ☐₁₁ Group G streptococci
- ☐₁₂ Group A streptococci
- ☐₁₃ Pneumococci

- ☐₁₄ Corynebacteria
- ☐₁₅ Enterobacteriaceae
- ☐₁₆ Other
- ☐₁₇ Gram-positive coccus [extra option added in REDCap]
- 34.1** Describe other milk culture results.....

35. Diagnostic breast ultrasound ordered?

- ☐₀ No
- ☐₁ Yes
- ☐₉₉₉ Not recorded

36. Results of breast ultrasound?

- ☐₀ Not applicable
- ☐₁ Normal breast, consistent with lactation
- ☐₂ Changes consistent with mastitis/inflammation
- ☐₃ Breast abscess, please record size of collection below
- ☐₄ Other, please summarise below
- ☐₉₉₉ Not recorded

36.1 Please record the size of the breast abscess collection

36.1.2 Record the total volume of breast abscess collections

36.2 Please summarise other results of breast ultrasound.

37. Other investigations ordered?

- ☐₀ No
- ☐₁ Yes
- ☐₉₉₉ Not recorded

37.1.2

- ☐₁ Blood count
- ☐₂ Erythrocyte sedimentation rate (ESR)
- ☐₃ Blood culture
- ☐₄ Urine culture
- ☐₅ Arterial blood gas
- ☐₆ C-reactive protein (CRP)
- ☐₇ Biopsy

38 Other notes?

- ☐₀ No
- ☐₁ Yes

38.1 Describe other notes.....

39. Management of breast abscess (tick all that apply)

- ☐₀ Not applicable
- ☐₁ Ultrasound guided needle aspiration (enter total number below)
- ☐₂ Incision and drainage
- ☐₃ Other

39.1 Number of aspirations in total

40. If admitted to hospital, duration of hospital stay

- ☐₀ Not applicable
- ☐₁ Admitted to hospital

41.1. Number of days

days

Supplement 2: Ethics Approval



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per email
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Unser Zeichen
STWAMICA

Coburg, 22.11.2022
www.regiomed-kliniken.de

Assessment of the research project: Management of mastitis/breast abscess in postpartum women in Coburg's emergency department

Dear Prof. Brachmann,
Dear Dr. Prange,
Dear Ms Rosenbauer,

Based on § 2 of the statutes for the IRB of the Medical School REGIOMED Coburg, the committee decided as follows with regard to your above-mentioned research project:

There are no objections to the implementation of the research project.

I would point out that the IRB does not carry out any legal reviews of the projects.

I wish you all the best in carrying out your research project.

Sincerely

Prof. Dr. Walter Strohmaier
Chairman of the IRB