

## **Evidence tables for mastitis, abscess and related conditions and issues**

Tabulation of studies on mastitis illustrates the heterogeneity of study design, definition of mastitis, and factors investigated. Recent studies on mastitis in Western populations have been included, with some older studies of particular interest.

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**Table A: Incidence and treatment of Mastitis:**

**Factors associated with incidence (possible risk factors); also studies of treatment experienced by women with mastitis:**

Author date	Type of study	Definition of mastitis	Outcomes measured	Results	Comments
Scott 2008 <b>UK</b>	Prospective longitudinal cohort study  420 breastfeeding women in Glasgow, followed up at 3,8,18 and 26 weeks were asked about cases of mastitis they had experienced	Red, tender, hot, swollen area of the breast accompanied by one or more of: <ul style="list-style-type: none"> <li>• Temperature <math>\geq 38^{\circ}\text{C}</math></li> <li>• One or more of body aches, headaches chills</li> <li>• Diagnosis of mastitis from medical practitioner</li> </ul>	Incidence of mastitis, reoccurrence, timing of episodes. Duration of breastfeeding after mastitis Type of care received from health professionals	<p>18% (95% CI 14%, 21%) had at least one episode of mastitis 68% of those with mastitis reported only one episode, 23 reported two episodes and 9% reported three or more episodes.</p> <p>53% of initial episodes and 43% of all episodes occurred during the first four weeks postpartum</p> <p>Women who had had mastitis were significantly more likely to be breastfeeding at 26 weeks than those who did not have mastitis (Log-rank test <math>\chi^2 = 8.81</math>, <math>df = 1</math>, <math>p=0.003</math>)</p> <p>37% of women managed their first episode of mastitis without consulting a health professional. Those seeking help consulted GP (37%); Community MW (32%) and HV (21%). 21% consulted more than one professional.</p> <p>78% of women consulting a HP were prescribed an antibiotic. This was 53% of women with mastitis</p> <p>6out of the 57 women with mastitis (one in ten) were inappropriately advised to either stop breastfeeding from the affected breast, or altogether</p>	<p><b>72% of women invited to take part participated. 95% follow up rate.</b></p> <p>Authors comment that almost half of women in study were continuing to breastfeed at 26 weeks, while national average for Scotland is 25%.</p> <p>Of the women who could recall the antibiotic they were prescribed (20 women), 9 were prescribed an antibiotic “that was not consistent with current practice guidelines” (p5).</p>
Kvist 2008	Descriptive	Any mixture of	Relationship between	Five main bacterial species identified:	<b>These results</b>

Sweden	<p>study. Breast milk from 192 women with mastitis and 466 healthy controls was examined.</p> <p>Data was collected during the RCT described in other Kvist papers (see below)</p>	erythema (redness), increased breast tension not relieved by breastfeeding, fever, pain and breast lumps	bacteriological content of milk samples, clinical symptoms, occurrence of abscess and recurring symptoms	<p>coagulase negative staphylococci (CNS); viridians streptococci, Staph aureus; group B streptococci (GBS) and Enterococcus faecalis. CNS was identified significantly more often in the milk of healthy controls, OR = 0.60 (95% CI: 0.35, 0.91). Others more likely in cases were: viridians streptococci (OR: 1.43, 95% CI 1.02, 2.01); S aureus (OR: 1.81, 95% CI: 1.29, 2.60); GBS (OR: 2.40, 95% CI 1.50, 3.71).</p> <p>GBS in breast milk was associated with significant increase in number of contact days with clinic (=duration of symptoms) (t= -2.44, p = 0.02). Presence of other bacteria did not affect contact days.</p> <p>No significant correlation between bacterial counts of these 5 main species and maternal temperature, breast erythema, breast tension, pain or severity at first contact.</p> <p>15% of case women received antibiotic therapy: there was no significant difference in bacterial counts with other women with mastitis who did not receive antibiotics or between those with and without abscess.</p> <p>Many women with potential pathogens in their breastmilk recovered spontaneously from mastitis or did not have any symptoms (control women). Increasing bacterial counts did not influence the clinical manifestation of mastitis.</p>	<p><b>suggest that division of mastitis into infective and non-infective may not be feasible. Using the WHO criteria (based on Thomsen) would have resulted in higher levels of antibiotic usage.</b></p> <p><b>Authors suggest that daily contact with women is required to ensure that appropriate antibiotic prescribing takes place. "It is important, in our opinion, that symptoms improve within 24 to 48 hours after initiation of care interventions."</b> (p6 of 7)</p>
Amir, et al 2007  Australia	<p>Descriptive cohort study: 1193 women (primips)</p> <p>Combination of data collected</p>	<p>At least two breast symptoms (pain, redness, lump) <b>AND</b> at least one of fever or flu-like symptoms</p> <p>(only asked about</p>	<p>Incidence of mastitis in the first 6 months (retrospective)</p> <p>Comparison of mastitis in different segments of population</p>	<p>17.3% women in study experienced mastitis in first 6 months.</p> <ul style="list-style-type: none"> <li>• 15% in public hospital</li> <li>• 23/24% in birth centre &amp; private hospital</li> </ul>	<p>High rate of breastfeeding continuation in the study sample (and Australia has higher rates than NI).</p>

	during an RCT of breastfeeding education, and a survey of two different birthing venues  Retrospective phone follow up at 6 months – single interview	symptoms and did not ask about mastitis directly)	Factors associated with mastitis	54% of episodes occurred in first 4 weeks, 71% in first 2 months and 83% in first three months.  Nipple damage (pain and cracks) associated with mastitis – may predict mastitis (OR 1.92, 95% CI 1.29, 2.86)  2.9% of women taking antibiotics for mastitis developed an abscess	Hard to equate effect of different birthing venues with NI/UK situation.  (Nipple thrush associated with mastitis – could be reverse causality and not a predictive factor.)
Kvist 2007 Sweden	205 women who were in an RCT of treatment types (see table z) were also sent a questionnaire	Any mixture of erythema (redness), increased breast tension not relieved by breastfeeding, fever, pain and breast lumps	Incidence estimated  Associated factors	Estimated incidence of mastitis (taking records of births locally and numbers of women referred for mastitis symptoms) approx 6% 58.6% of cases experienced in first 4 weeks pp. No association between length of recovery time and initial fever  36% of women with mastitis had damaged nipples. More women in 'less favourable outcome group' had damaged nipples OR = 2.70 (95% CI 1.40, 5.14) Use of nipple shield increased risk of unfavourable outcome NO association between mastitis and use of dummy/pacifier	More favourable outcome = ≤ 5 days symptoms; less favourable outcome = ≥6 days  Use bottle / pacifier may be marker for nipple trauma.
Potter 2005 UK	Retrospective (at 6 months) population survey (273 women) + follow up interviews (10 out of 56 women who were willing)	Any of: <ul style="list-style-type: none"> <li>• Temperature &gt;38%</li> <li>• Throbbing pain in breast</li> <li>• Breast painful to touch</li> </ul> Wedge -shaped hot red area of breast	Incidence of mastitis  Reasons for some women being unsure if they had mastitis, even if reported symptoms	Cumulative incidence 40% (95% CI, 25%, 37%) 15% were sure they had had mastitis, 11% not sure as symptoms were not severe.. 7 out of 10 women managed an episode of mastitis without consulting health care professionals.  Peaks of incidence at 4 week and 12 weeks postpartum	High incidence (higher than other studies) explained as not all women sought help from HPs.
Wambach	Descriptive	Medical diagnosis	Onset time	Diagnosis any time from 1-36 weeks pp,	Anticipatory

<p>2003 USA</p>	<p>study of 31 women diagnosed with mastitis</p> <p>Daily phone calls until 7 days post-mastitis, then at 2 &amp; 6 weeks after onset</p>	<p>(scale of symptoms developed by Fetherston used during the study)</p> <p>All but one woman received antibiotic therapy (and one woman received IV antibiotics).</p>	<p>Symptoms Self-care</p> <p>Treatment</p> <p>Burden of mastitis (see <i>table Q</i>)</p> <p>Symptom reoccurrence complications</p>	<p>median of 3.5 weeks</p> <p>Most localised symptoms in upper-outer, lower-outer and upper-inner breast quadrants.</p> <p>Breast pain peaked in severity on days 1 and 2, breast warmth on days 1-3, redness days 2 &amp; 3. 71% reported no pain by day 7. (All but 1 received antibiotics)</p> <p>Continued breastfeeding most commonly followed advice – rated as most useful. Also advised and found useful: analgesia, breast massage, hot packs, increased oral fluids, extra rest, pumping, increasing breastfeeding</p> <p>16% at 2 weeks and 19% at 6 weeks experienced reoccurrence</p> <p>13% experienced symptoms for more than 7 days</p> <p>10% had candidia infections (vaginal/breast)</p>	<p>guidance about length of symptoms when women combine antibiotic therapy with self-help measures.</p> <p>Most women completed antibiotic course, so reoccurrence not connected with non-compliance.</p>
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<p>Foxman 2002 USA  Lawrence 2002 provides a commentary on this study</p>	<p>Prospective: 946 breastfeeding women</p>	<p>Self report of mastitis diagnosed by health care provider  (described symptoms: -breast tender 98% - fever 82% - malaise 87% - chills 78% - redness 78% - hot spot 62% <b>of cases)</b></p>	<p>Incidence (to 12 weeks)  Describe treatment  Associations</p>	<p>Overall incidence = 9.5 %</p> <ul style="list-style-type: none"> <li>• 8.1% one case</li> <li>• 1.3% two cases</li> <li>• 0.1% three cases</li> </ul> <p>Highest in first few weeks, then fell.</p> <p>Almost half changed breastfeeding practices 88% received medications (antibiotics, analgesics)</p> <p>Women experiencing mastitis with previous child more likely to have episode (23.9% incidence) OR = 4.0. (95% CI 2.64, 6.11)</p> <p>Nipple sores or cracks in the same week as mastitis episode OR = 3.4 (95% CI 2.04, 5.51)</p> <p>Use of anti-fungal cream (presumed for nipple thrush) in same 3 weeks OR 3.4 (95% CI 1.37, 8.54)</p> <p>Use of manual pump (for women with no previous history of mastitis) OR = 3.3 (95% CI 1.92, 5.62)</p> <p><i>Decreased</i> risk if feeding fewer than 10 times a day (in same week) 7-9 times OR = 0.6 (95 CI 0.41, 1.01); ≤ 6 times OR 0.6 (95%CI 0.19, 0.82)</p>	<p>Authors say no difference in incidence if using symptoms to define.</p> <p>Duration of breastfeeding was not associated with mastitis.</p> <p>Use of creams may introduce pathogens.</p> <p>Women who sometimes started with the same breast at consecutive feeds may have done so to relieve engorgement.</p>
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<p>Kinlay 2001 Australia</p>	<p>Prospective cohort study to 6 months</p> <p>Three questionnaires during study period</p> <p>1075 women</p>	<p>Painful red area on one or both breasts and one of:</p> <ul style="list-style-type: none"> <li>- temperature &gt;38C</li> <li>- fever symptoms</li> </ul> <p>Or diagnosis from a medical practitioner</p>	<p>Incidence in first 6 months</p> <p>Factors statistically related to mastitis</p>	<p>20% of women</p> <p>Past history of mastitis HR =1.74 (95% CI 1.07-2.81)</p> <p>University or college education HR = 1.93 (95% CI 1.18-3.16)</p> <p>Blocked ducts HR = 2.43 (95% CI 1.68-3.49)</p> <p>Cracked nipples HR = 1.44 (95% CI 1.00-2.07)</p> <p>Use of creams on cracked nipples HR =1.83 (95% CI 1.22-2.73) ; particularly papaya cream RR = 1.83 (95% CI 1.36-2.47)</p> <p>Always feeding from alternate breasts HR = 2.28</p>	<p>Authors suggest use of creams may introduce pathogens and should be avoided. Papaya cream unlikely to be relevant in NI</p>
<p>Kinlay 1998 Australia</p> <p>Same study as Kinlay 2001</p>	<p>Prospective cohort study for 6 months</p> <p>1075 women</p>	<p>Painful red area on one or both breasts and one of:</p> <ul style="list-style-type: none"> <li>- temperature &gt;38C</li> <li>- fever symptoms</li> </ul> <p>Or diagnosis from a medical practitioner</p> <p>(as above)</p>	<p>Incidence in first 6 months and timing</p> <p>Identify health care services used and treatment received</p>	<p>Incidence 20% over 6 months (95% CI 18%, 22%)</p> <p>25% cases occurred within 14 days; 50% by 21 days ;75% by 49 days (7 weeks)</p> <p>15% had two episodes</p> <p>12% had three or more episodes</p> <p>73% consulted GP; 6% hospital casualty; 11% no one</p> <p>Of women with mastitis, 77% received antibiotics, 68% told to keep breastfeeding</p> <p>Of the women prescribed antibiotics, 6% did not take and 81% did not take for 10 days.</p>	<p>There was a strong relationship between number of symptoms and seeking medical advice.</p> <p>10 days = minimum recommended</p>
<p>Vogel 1999 New Zealand</p>	<p>Prospective cohort study 350 women, excluding premature, and</p>	<p>Maternal report of mastitis or receiving antibiotics for a breast infection</p>	<p>Incidence</p> <p>Outcomes</p>	<p>23.7% women had mastitis</p> <p>41% of cases in first month</p> <p>Sore nipples in the first month associated with an increased risk of mastitis RR = 1.68 (95% CI 1.17, 3.66)</p>	<p>High recurrence rate may be due to length of follow up.</p>

	lower birth weight babies Follow up to 12 months			15.7 % had first episode after 6 months 17.4% reported symptoms plus fever 16% received antibiotics for mastitis 8.5% had recurrent incidence mastitis Reduced risk of mastitis in women who smoked, supplemented with water or used a dummy daily in first month  Mothers with mastitis symptoms in first year less likely to cease than those with no symptoms RR = 0.61 (95% CI 0.44, 0.84)	These factors might lead women to have lower milk supply – authors hypothesise that mastitis is more likely in women with an ample milk supply. Hence last finding.
Fetherston 1998  Australia	Case control group (39 women with/without mastitis) nested within prospective cohort (see Fetherston 1997 a & b)	Symptoms for at least 24 hours: <ul style="list-style-type: none"> <li>Elevated temp <b>and</b></li> <li>systemic illness (chills/flu-like aching) <b>and</b></li> </ul> pink/red, tender, hot swollen area on breast	Identify risk factors in first-time and experienced mothers.	Blocked ducts most significant predictor OR = 3.11 (no confidence intervals given) For experienced breastfeeding mothers, other factors were <u>previous history of mastitis</u> and <u>stress</u> ; for first time mothers other factors were <u>attachment difficulties</u> and <u>nipple pain during a feed</u> The most common protective factor was <u>feeding more frequently than normal.</u>	The small number of women with candida infection of the breast were more likely to develop mastitis.  The authors relate all the risk factors to milk stasis and ineffective emptying of the breast.
Fetherston 1997b  Australia (same study as Fetherston 1997a & b)	Descriptive account of treatment experienced in 78 cases of mastitis identified in cohort study (see previous paper)  <i>Description of practice now &gt;10 years old</i>	Symptoms for at least 24 hours: <ul style="list-style-type: none"> <li>Elevated temp <b>and</b></li> <li>systemic illness (chills/flu-like aching) <b>and</b></li> </ul> pink/red, tender, hot swollen area on breast	Source of advice and description of management adopted by and treatment strategies suggested to women with mastitis in Australian cohort	Advice: 81% from GP  Most common strategies were: <ul style="list-style-type: none"> <li>Massaging affected area prior to feed (85%)</li> <li>Feed frequently (74%)</li> <li>Apply heat (51%)</li> <li>Feed from affected breast first (44%)</li> <li>Apply cold (40%)</li> </ul> Antibiotics: <ul style="list-style-type: none"> <li>85% received prescription</li> <li>17% of these did not complete course</li> <li>27% of these suffered recurrent</li> </ul>	Women were often presented with only one or two strategies for dealing with mastitis. Their perception of what was helpful focussed on symptomatic relief.  One woman had Strep B upon

				<p>episodes</p> <p>All women who sought help from medical practitioner received antibiotic therapy (study is over 10 years old).</p> <p>Causes: 29% reported caregiver attempted to determine cause of episode. Women's perceptions of causes were more detailed and specific than caregivers'.</p>	<p>culture: only cultured after 4 episodes – then resolved with correct antibiotics.</p>
<p>Fetherston 1997a</p> <p>Australia</p>	<p>As above</p> <p>Cohort of 306 women (still breastfeeding at 7 days) followed for 3 months</p>	<p>Symptoms for at least 24 hours:</p> <ul style="list-style-type: none"> <li>Elevated temp <b>and</b></li> <li>systemic illness (chills/flu-like aching) <b>and</b></li> <li>pink/red, tender, hot swollen area on breast</li> </ul>	<p>Incidence of mastitis</p> <p>Recurrence rates</p>	<p>20.6% -- 51% cases within 14 days</p> <p>6.5% of cases recurred</p> <p>No significant difference between primips / multips</p> <p>At three months, 71% of cohort women were still breastfeeding, 18% of those who stopped cited mastitis as reason for stopping</p> <p>Mean duration of breast symptoms was 3.9 days (range 24 hours – 12 days). Longest durations experienced in cases of early onset (could be hospital acquired infections)</p> <p>In both left and right breasts, the areas most often affected by redness and swelling were the same: upper and lower outer lateral aspects and lower inner aspect - due to tight bra?</p>	<p>This study sought to establish incidence without relying on medical diagnosis as many women do not consult medical practitioners.</p> <p>Cases of longer duration had higher degree of erythema and oedema.</p>
<p>Foxham 1994</p> <p>USA</p>	<p>Women with mastitis selected from a survey of all women in two hospitals completed 7-9 days pp.</p> <p>9 cases, plus 8 through other</p>	<p>A mother reporting treatment for mastitis</p>	<p>Diet, stress and symptoms (for case women) in week prior to mastitis episode/matched week</p>	<p>Unable to find strong associations between experience of mastitis and breastfeeding practices such as nursing positions: however, women with mastitis more likely to experience breast/nipple pain, and nipple cracks and less likely to have had time for naps than controls.</p>	

	referral matched to controls (from survey)  Telephone questionnaire to all cases & controls				
Jonsson 1994  Finland	Questionnaire 670 women at 5-12 weeks. 255 advised breast massage during pregnancy and after the birth	Doctor of midwife diagnosis	Incidence of mastitis  Effect of breast massage  Mother's skin type	24% Of 329 multips, 54% who had an episode of mastitis had experienced this with previous baby. In a woman who had mastitis with a previous baby, the probability of subsequent mastitis is threefold (P=0.007)  No effect on incidence  No effect on incidence	Findings suggest the importance of preventative measures for first time mothers.
Kaufmann 1991  USA	Retrospective cohort study 933 women Women gave birth 1984-5, data collected from medical records	Doctor diagnosis (Record of mastitis in clinical records made during routine post-partum check ca 6 weeks.)	Incidence	2.9% during first 7 weeks No association with parity Strong association of mastitis with both mother and father having professional, technical or managerial occupations	
Riordan 1990  USA	Descriptive study – surveys conducted during breastfeeding conferences  91 women	Breast soreness and redness, flue-like aches and temp >100.4F	Incidence  Mother's perception of trigger factors	33% 48% cases in first 4 months, cases continued throughout breastfeeding (22% after 12 months)  Stress	Highly selected population, with greater than average interest in breastfeeding and possible greater likelihood of responding if had experienced mastitis.  Notable for showing that

					women may experience mastitis as long as they continue breastfeeding.																																																				
Thomsen 1984 Denmark	RCT of management  213 women with 339 cases of mastitis (each breast considered separately)  Cases diagnosed as milk stasis, non-infectious mastitis and infectious mastitis  RCT of treatment/non intervention	Initial symptoms which qualified for entry into study = 'inflammatory symptoms of the breast'  Cases divided into three groups: * milk stasis (low leukocyte and low bacteria count) * non-infectious mastitis (high leukocyte and low bacteria count) * infectious mastitis (high leukocyte and high bacteria count)  Within each category, patients randomised for treatment / non treatment	Within these three categories, outcomes between treatment and non treatment arms compared  Milk stasis – treatment arm received emptying of the breast  Noninfectious mastitis—treatment arm receive emptying of the breast  Infectious mastitis—two treatment groups received emptying of the breast with or without antibiotics	<table border="1"> <tr> <td colspan="4">63 cases in each arm.</td> </tr> <tr> <td>Treatment</td> <td>Duration symptoms</td> <td>Result = normal lactation</td> <td>Result = poor</td> </tr> <tr> <td>None</td> <td>2.3 days</td> <td>57 cases</td> <td>6 cases</td> </tr> <tr> <td>Breast emptying</td> <td>2.1 days</td> <td>58 cases</td> <td>4 cases</td> </tr> <tr> <td colspan="4">24 cases in each arm</td> </tr> <tr> <td>Treatment</td> <td>Duration symptoms</td> <td>Result = normal lactation</td> <td>Result = poor</td> </tr> <tr> <td>none</td> <td>7.9 days</td> <td>5 cases</td> <td>19 case</td> </tr> <tr> <td>Breast emptying</td> <td>3.2 days</td> <td>23 cases</td> <td>1 case</td> </tr> <tr> <td colspan="4">55 cases in each of the three arms</td> </tr> <tr> <td>Treatment</td> <td>Duration symptoms</td> <td>Result = normal lactation</td> <td>Result = poor</td> </tr> <tr> <td>None</td> <td>6.7 days</td> <td>8 cases</td> <td>47 cases</td> </tr> <tr> <td>Breast emptying</td> <td>4.2 days</td> <td>28 cases</td> <td>27 cases</td> </tr> <tr> <td>Antibiotics &amp; breast emptying</td> <td>2.1 days</td> <td>53 cases</td> <td>2 cases</td> </tr> </table>	63 cases in each arm.				Treatment	Duration symptoms	Result = normal lactation	Result = poor	None	2.3 days	57 cases	6 cases	Breast emptying	2.1 days	58 cases	4 cases	24 cases in each arm				Treatment	Duration symptoms	Result = normal lactation	Result = poor	none	7.9 days	5 cases	19 case	Breast emptying	3.2 days	23 cases	1 case	55 cases in each of the three arms				Treatment	Duration symptoms	Result = normal lactation	Result = poor	None	6.7 days	8 cases	47 cases	Breast emptying	4.2 days	28 cases	27 cases	Antibiotics & breast emptying	2.1 days	53 cases	2 cases	This study showed dramatically worse outcomes for women with both non-infective and infective mastitis if they received no treatment. Non infective mastitis treated by breast emptying only. In infective cases, better outcomes were achieved with BOTH antibiotic treatment AND breast emptying than with just breast emptying, but antibiotics alone were NOT TESTED.  Poor outcomes included: recurrence of symptoms and impaired lactation: in infectious group also abscess, sepsis symptoms.  NB <i>differentiation of infective from non-infective mastitis on the basis used in this</i>
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								<i>study has since been questioned (see Kvist, 2008, Fetherston, 2001, citing Abakada et al, 1992)</i>
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#### **Table B: Reviews of the literature:**

#### **Table B1: Core Reviews:**

**This table lists recent reviews which are likely to be most useful for practitioners.**

<b>Author, date</b>	<b>Type of review</b>	<b>Comments</b>
Deshpande, 2007	Brief review for UK health visitors	Short, useful update on recognising, treating mastitis and supporting mothers, written for practicing health visitors, who are often the people who need to give initial diagnosis and treatments and need to know when to refer.
Betzold, 2007	Detailed review by US Nurse practitioner	Covers differential diagnosis between infective versus non-infective mastitis, and with candida infection. Recurrent mastitis and abscess also discussed. Management to improve breast drainage and reduce women's discomfort, antibiotic therapy and alternative therapy are discussed. This is a useful review which could inform anyone caring for women who may have mastitis.

Mitchie 2003	Review of etiology and treatment, including discussion of the role of mastitis in vertical transmission or viruses	This is an overview of targeted at paediatricians, covering the medical aspects and recent research. The emphasis is on prevention and management through effective breastfeeding. "Mastitis needs to be actively prevented: paediatricians can assist with this process." P 820
World Health Organisation, 2000	Thorough review of the global literature on mastitis. Authoritative summary of research up to date of publication.	This is a useful basis for any understanding of mastitis. The differential diagnosis between infective and non-infective mastitis as well as identifying differentiating from engorgement, blocked ducts and abscess are all covered. Using this as a starting point, subsequent research on mastitis and discussions within research papers can be better understood.

### References:

Deshpande W. Mastitis. Community Practitioner 2007; 80(5): 44-5.

Betzold CM. An update on the recognition and management of lactational breast inflammation. Journal of Midwifery & Women's Health 2007; 52(6): 595-605.

Michie C, Lockie F, Lynn W. The challenge of mastitis. Archives of Disease in Childhood 2003; 88(9): 818-21.

World Health Organisation (WHO). Mastitis. Causes and management. Geneva: WHO, 2000.

### Table B2: Other review sources

Author & date	Type of source
Jones 2006	Powerpoint presentation summarising evidence and recommendations for practice in the UK. Author is UK Community Pharmacist and also a Breastfeeding Supporter. Accompanying papers on this website are updated.
Academy of Breastfeeding Medicine 2002	Protocol on the treatment of mastitis. This is an authoritative group of US physicians interested in supporting breastfeeding through evidence based practice.
Revision: 2008	Revision includes discussion of MRSA.

## References:

The Academy Of Breastfeeding Medicine. Protocol #4: Mastitis 2002 <http://www.bfmed.org/ace-files/protocol/ProtocolMastitis4rev.pdf>

The Academy of Breastfeeding Medicine Protocol Committee ABM Clinical Protocol #4: Mastitis, Revision, May 2008. Breastfeeding Medicine 3(3): 177-180

Jones W. Breastfeeding and Mastitis. 2006 <http://www.breastfeedingnetwork.org.uk/mastitis-health-professionals.html>

### Table B3: Further reviews

**In general the reviews above are more likely to be informative, however a few notes indicate aspects of special interest in the papers listed below.**

Author & date	Comments
Barbosa-Cesnik, 2003	
Marchant 2002	Particularly useful discussion of other causes of breast inflammation: galactocele, fat necrosis, subareolar abscess (duct ectasia), etcetera.
Prachniak 2002	(only part of review covers mastitis)
Fetherston 2001	In-depth discussion on differentiating between non-infective and infective mastitis.
Ripley 1999	
Inch 1995	Commentary by respected UK practitioners, easy to read.

## References:

Barbosa-Cesnik C, Schwartz K, Foxman B. Lactation mastitis. JAMA 2003; 289(13): 1609-12.

Inch S, Fisher C. Mastitis: infection or inflammation? Practitioner 1995; 239(1553): 472-6.

Fetherston C. Mastitis in lactating women: physiology or pathology?[erratum appears in Breastfeed Rev 2001 Jul;9(2):21]. Breastfeeding Review 2001; 9(1): 5-12.

Marchant DJ. Inflammation of the breast. Obstetrics & Gynecology Clinics of North America 2002; 29(1): 89-102.

Prachniak GK. Common breastfeeding problems. Obstetrics & Gynecology Clinics of North America; 29(1): 77-88.

Ripley D. Mastitis. Primary Care Update for OB/GYNS 1999; 6(3): 88-92.

**Table C: Women’s experience of mastitis:**

Author, year, country	Study details	Findings
Amir; 2006  Australia	94 breastfeeding women in a case control study provided written comments on their experience	<p>Themes:</p> <ul style="list-style-type: none"> <li>• Acute physical illness</li> <li>• Negative emotions</li> <li>• Life disrupted</li> <li>• To continue breastfeeding or not?</li> <li>• minor theme = support for mastitis research</li> </ul> <p>Mastitis has emotional as well as physical aspects. “General practitioners can help women by acknowledging the difficulties involved in breastfeeding and providing support and encouragement”. P 747 and should refer to skilled breastfeeding help</p>
Kvist 2006  Sweden	14 women who had taken part in RCT on treatment were interviewed: data analysed using grounded theory	<p>Core category = the will to breastfeed (reflecting the importance of breastfeeding to these women’s self concept). 5 conceptual categories:</p> <ul style="list-style-type: none"> <li>• perspectives on breastfeeding</li> <li>• personal strategies</li> <li>• enduring and adjustment</li> <li>• support</li> <li>• causal frameworks</li> </ul> <p>This study reflects women’s need to understand why they had mastitis and also the commitment and time needed to devote to breastfeeding in order to establish sufficient regular breast drainage. Women needed lots of family and professional support during mastitis. The authors suggest that midwives need to make clear ‘the need for life-style adjustments after the birth of a baby’. P145</p>
Potter; 2005  UK	10 women were interviewed out of 56 experiencing mastitis in a cohort study of breastfeeding women	<p>Preferred management strategies:</p> <ul style="list-style-type: none"> <li>• hot/cold compresses 84%</li> <li>• analgesics 57%</li> <li>• massage 54%</li> <li>• changing feeding patterns 30%</li> <li>• expressing (pump) 20%</li> <li>• changing feeding position 18%</li> <li>• express (hand) 16%</li> </ul> <p>Women identified causes of their mastitis as: incorrect attachment of baby; incomplete emptying of breast; producing a lot of milk; tight or badly fitting bras.</p> <p>Women valued good support from health professionals and information on prevention.</p>
Wambach 2003	31 women with	As part of this study of women’s experiences, the ‘burden’ of mastitis was explored. Women were asked: “How

USA	mastitis – telephone interviews  See Table A	much has mastitis interfered today with breastfeeding / activities of daily living?” Interference most pronounced for first three days. By day 7 more than 50% reported no effect. Greater impact on daily living than on breastfeeding (most mothers continued with this) – suggesting that recommendation to rest during mastitis is realistic.
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### References:

Amir LH, Lumley J. Women's experience of lactational mastitis--I have never felt worse. Australian Family Physician 2006; 35(9): 745-7.

Kvist LJ, Larsson BW, Hall-Lord, ML A grounded theory study of Swedish women's experiences of inflammatory symptoms of the breast during breast feeding. Midwifery 2006 22, (2): 137-146.

Potter B. Women's experiences of managing mastitis. Community Practitioner 2005; 78(6): 209-12.

Wambach KA. Lactation Mastitis: a descriptive study of the experience. Journal of Human Lactation 2003; 19(1): 24-34.

## Tables D: Abscess

### D1: Incidence of abscess

Author date	Study design	Outcome measure	Results	Comments
Kvist 2007 Sweden	See fuller notes in Table A 291 women with mastitis who took part in RCT of treatments	Incidence of abscess among women with mastitis referred to clinic	3.3% of women with mastitis developed abscess, estimated incidence in population of breastfeeding women = 0.1%  None stopped breastfeeding and no adverse effects on babies were reported	These results are a small part of a larger study – noted here as there are few other estimates available  Sweden has high breastfeeding rates.
Amir: 2004 Australia	Same study as Amir 2007: cohort of 1193 women; 207 experienced mastitis	Incidence of abscess	5 women developed abscess: 0.4% of breastfeeding women; 2.9% of women who took antibiotics for mastitis	Earlier estimates of abscess varied widely, only recent cohort study

### References:

Amir LH, Forster D, McLachlan H, Lumley J. Incidence of breast abscess in lactating women: report from an Australian cohort. BJOG: An International Journal of Obstetrics & Gynaecology 2004; 111(12): 1378-81.

Kvist LJ, Hall-Lord ML, Larsson BW. A descriptive study of Swedish women with symptoms of breast inflammation during lactation and their perceptions of the quality of care given at a breastfeeding clinic. *Int Breastfeed J* 2007; 2: 2.

## D2: Interventions for abscess

Author, date	Study type	Outcome measure	Results	Comments
Moazzez 2007 USA	Retrospective case review of microbiologic cultures – 44 women with abscess	Microbiological features of abscess and sensitivity to therapy	28 of 46 specimens (61%) showed bacterial growth. <i>S. aureus</i> was most common organism (32%) with MRSA in 58% of these cases. Conclude best empirical oral antibiotic drug therapy for breast abscess is trimethoprim-sulfamethoxazole	Discussion of variety of bacteria found and treatments.
Schulman 2006 USA	Review of research literature on biopsy / aspiration for abscess			Short section only on breast abscess
Eryilmaz 2004 Turkey	RCT of treatments 45 women with abscess : 23 received incision and drainage, 22 aspiration No use of ultrasound	Compare various outcomes between incision and drainage and aspiration	Incision group = all successfully treated, one had a reoccurrence and 70% not pleased with cosmetic outcome. Aspiration group: 3 had one aspiration, 10 (45%) had multiple aspirations, 9 (41%) did not heal and required incision and drainage subsequently	Risk factors for failure of aspiration: abscess larger than 5 cm diameter; large volume of pus aspirated; delay in treatment
Berna-Serna 2003 Spain	Review of cases—39 retrospective. Aspiration vs catheter drainage	Description of outcomes and algorithm of treatment given.	Needle aspiration performed when abscess <3cm and catheter drainage when >3.	ONLY 2 WOMEN LACTATING Hard to assess relevance for lactation abscesses.
Dener 2003 Turkey	128 lactating women with breast infection – 102 mastitis and 26 abscess – who presented to general surgery clinic  Abscess diagnosed as fluctuant mass in addition to mastitis: redness, warmth, tenderness.	Assess factors contributing to abscess formation in women with mastitis Describe and evaluate treatments	Ultrasound examination in all cases. All women given 7 days of twice daily 1 gram amoxicillin / clavulinate Abscesses treated by ultrasound guided aspiration and saline irrigation repeated every other day until clear (38%). If unsuccessful, surgical drainage performed (62%). <i>S aureus</i> in 33% of mastitis women and 38% abscesses. 17% had cracked nipples. Mean duration symptoms and healing time higher for abscess patients. Duration of symptoms before treatment only independent risk factor for abscess	In clinically suspected cases of abscess, 34%-50% not detected by ultrasound.  Women with abscess 'tended to present late for medical intervention' (p131).  Authors stress importance of early treatment

			10% had recurrence (in same breast) during 24 week follow up: 11/13 mastitis and 2/13 abscess.	
Hogge 1999 USA	Review of literature on spectrum of pathologic entities in pregnancy and lactation	Review of literature and discussion	Description, including ultrasound images, of variety of breast conditions. Ultrasound recommended as initial imaging examination in cases of palpable abnormality.	Any breast mass which develops should be promptly evaluated – possibility of pregnancy-associated breast cancer
O'Hara 1996 UK	Descriptive retrospective review of practice of 2 years / 53 patients with suspected abscess referred to hospital  38% of women NOT LACTATING	Description of treatment and outcomes  No detail on whether cases in lactating women differed from non-lactating women	22 / 53 abscesses aspirated – 19 resolved, 3 required subsequent incision and drainage 8 / 53 had primary incision and drainage; 1 required repeat of procedure 5/53 had spontaneous recovery of abscess 18 / 53 had clinical features of abscess without evidence of focal pus and received antibiotic therapy. 16 / 18 recovered 1 / 18 developed abscess, which was drained 1 / 18 had inflammatory cancer	Of 36 women having ultrasound scan, no false positives but 1 false negative for diagnosis abscess  Ultrasonic scan 'could prevent about one-third of patients undergoing unnecessary surgical intervention'.
Karstrup 1993 Denmark	Description of ultrasonically guided aspiration in 19 breastfeeding women presenting with abscess (at time when incision and drainage was standard approach)	Description of outcome Follow-up for 12 months  Describes procedure	18 / 19 (95%) of women successfully treated; 1 re-occurrence 1 / 19 required incision & drainage after catheter fell out No reoccurrences within 12 months 42% continued breastfeeding during and after treatment (abscesses developed between 9 – 90 days after delivery) S aureus cultured in all cases Cosmetically good results in all cases	10 women treated on an outpatient basis, performing irrigation themselves at home

## References:

Berna-Serna JD, Madrigal M, Berna-Serna JD. Percutaneous management of breast abscesses. an experience of 39 cases. *Ultrasound in Medicine & Biology* 2004; 30(1): 1-6.

Dener C, Inan A. Breast abscesses in lactating women. *World Journal of Surgery* 2003; 27(2): 130-3.

Eryilmaz R, Sahin M, Hakan Tekelioglu M, Daldal E. Management of lactational breast abscesses. *Breast* 2005; 14(5): 375-9.

Hogge JP, de Paredes ES, Magnant CM, Lage J. Imaging and Management of Breast Masses During Pregnancy and Lactation. *Breast Journal* 1999; 5(4): 272.

Karstrup S, Solvig J, Nolsoe C, Nilsson, P, Khattar S, Loren I, Nilsson A, et al. Acute puerperal breast abscesses: US-guided drainage. *Radiology* 1993; 188: 807-9.

Moazzez A, Kelso R, Towfigh S, Sohn H, Berne T, Mason R. Breast abscess bacteriologic features in the era of community-acquired methicillin-resistant *Staphylococcus aureus* epidemics. *Archives of surgery* 2007; 142(9): 881-4.

O'Hara RJ, Dexter SP, Fox JN. Conservative management of infective mastitis and breast abscesses after ultrasonographic assessment. *British Journal of Surgery* 1996; 83(10): 1413-4.

Shulman SG, March DE. Ultrasound-guided breast interventions: accuracy of biopsy techniques and applications in patient management. *Semin Ultrasound CT MR* 2006; 27(4): 298-307.

### Table E: Overabundant milk supply

Over abundance of milk is conjectured to be one underlying feature of mastitis (Amir 2007) The following papers explore this: features relating to mastitis are principally considered.

Author date	Type of paper	Findings
van Veldhuizen-Staas 2007 Netherlands	Four cases from a private practice Lactation Consultant, plus discussion of this condition	Overabundant milk supply in an otherwise healthy lactating woman can be an underlying factor in development of mastitis and increases her risk of mastitis. The author describes how overabundance may be triggered by the mismanagement of breastfeeding, hyperprolactinemia or congenital predisposition. The baby may struggle to cope with milk flow and experience gastric discomfort. The author describes her 'full drainage and block feeding method' for managing and reducing overproduction and illustrates this with four different case histories.
Livingstone 1996 Canada	Discussion of this condition on the basis of author's consultations with >8,000 breastfeeding families as Family Practice Physician	Incomplete breast drainage leads to mastitis. Author describes the approach: improving breast drainage through better attachment of baby to breast, expressing or stripping the breast to deal with blockages, and treating infection promptly. Mothers with overabundant milk should become skilled at palpating their breasts and expressing as needed. Infant behaviour in response to overabundant milk is described. This is useful as women often interpret such infant behaviours as sign of 'not enough milk'. Author describes how overabundance can, in fact, lead to infant faltering growth. Value of taking a thorough breastfeeding history and observing a breastfeed are emphasised.

### References:

van Veldhuizen-Staas CGA. Overabundant milk supply: an alternative way to intervene by full drainage and block feeding. *International Breastfeeding Journal* 2007 2:11.

Livingstone V. Too much of a good thing: Maternal and infant hyperlactation syndromes. *Can Fam Physician*. 1996 January; 42: 89–99.

**Table F: Chronic breast pain**

Author & date	Type of study	Outcomes	Comments
Eglash 2007 USA	Case report of a woman with chronic breast pain	<p>The woman described developed cracked nipples and breast pain, and was treated with antifungals. Mastitis was diagnosed concurrently and she received antibiotic therapy. She continued to experience nipple pain and was diagnosed with a bacterial lactiferous duct infection and received 14 days' clindamycin. There was some improvement and she received a further 14 days'. She received a further 14 days' clindamycin and also fluconazole. After 6 weeks with continued pain she was changed to azithromycin: after one week pain resolved.</p> <p>"Lactating women with chronic breast pain who have suspected bacterial lactiferous duct infections usually need 4-8 weeks of an antibiotic that will cover S aureus. The antibiotic is changed after 2-3 weeks if the woman has no improvement in symptoms and the response to different antibiotics varies widely among women." (p103)</p>	This case study demonstrates the complexity in some women. The detailed history and examination required for such complex cases as well as treatment regime is of interest.
Eglash 2006 USA	<p>Chart review study of patients referred to a physician lactation specialist over 6 years.</p> <p>Patients had received antibiotics for chronic (lasting more than one week) breast and/or nipple pain NOT diagnosed as acute mastitis.</p> <p>69 women identified: 5 excluded due to lack of follow up</p>	<p>Median time of onset of pain was 1 week, with 78% experiencing pain in the first 1-2 weeks. 69% were first time mothers. Of multiparous women, 40% reported having had similar symptoms in previous lactation.</p> <p>More than 75% of women complained of tender, bilateral breast pain of deep, dull aching quality, occurring before and after feeding. Approx half had sharp shooting pain, and nearly all had either a bruised or burning type of pain. 75% had recent history of nipple cracks and sores and half of women had a recent history of mastitis.</p> <p>69% of the women had been treated for candidiasis before referral: 43% reported some symptomatic relief with antifungal treatment.</p> <p>Half of the 60 women whose milk was cultured had pathogenic bacteria. The women with negative cultures improved with antibiotic therapy at the same rate as women with positive cultures.</p> <p>All women in these cases received antibiotics for a minimum of 3 weeks, and some more than 6 weeks (average time 5.7 weeks). 40% received antifungal therapy in addition. Most patients had resolution of pain by 6</p>	<p>Deep breast pain without mastitis symptoms is often diagnosed as candida: descriptions of the pain are similar to descriptions of candida.</p> <p>Bacterial lactiferous duct infection may follow mastitis.</p> <p>The finding that 75% had a history of nipple cracks suggests "that good management of breastfeeding early postpartum ...could potentially prevent subsequent breast infections and chronic breast pain." (p 432)</p> <p>Many of the women appear to have had a combination of candida and bacterial infections.</p>

		weeks after starting antibiotics. 94% had resolution.	
		16% weaned due to the pain, even though 70% of these had pain resolution on treatment.	

**References:**

Eglash A, Plane MB, Mundt M. History, physical and laboratory findings, and clinical outcomes of lactating women treated with antibiotics for chronic breast and/or nipple pain. *Journal of Human Lactation* 2006; 22(4): 429-33.

Eglash A, Proctor R. Case report: a breastfeeding mother with chronic breast pain. *Breastfeed Med.* 2007 Jun;2(2):99-104.

**Table G: Mastitis and breast augmentation**

Author & date	Type of study	Outcome	Comments
Johnson 1995  USA	Case report of a mother of twins who had previously received silicone gel breast implants, which had been replaced with saline implants	After the mother experienced symptoms of fever and unilateral engorgement, she received antibiotic therapy and expressed from the affected breast. After 14 days there was no relief of symptoms. Ultrasound showed a complex fluid collected surrounding the implant. Various interventions are described, which were accompanied by discontinuation of breastfeeding by mother's choice.  Authors recommend early antibiotic treatment with ultrasound evaluation of the breast and implant, with culture and drainage where a collection of fluid or abscess is evident.	This report appears to be the only available one of mastitis in a woman with breast augmentation. It is now some years old: unknown if changes in augmentation procedures would affect comments.  Authors suggest that plastic surgeons need to be aware of the possibility of mastitis during lactation.

**References:**

Johnson PE, Hanson KD. Acute puerperal mastitis in the augmented breast. *Plastic & Reconstructive Surgery* 1996; 98(4): 723-5.

**Table H: Alternative treatments for mastitis**

Author date	Type of study	Definition of mastitis	Outcomes measured	Results	Comments
Kvist 2007  Sweden	Randomised, non-blinded controlled trial of	Any mixture of: <ul style="list-style-type: none"> <li>erythema</li> <li>breast</li> </ul>	Length of contact time for recovery Index score for severity of symptoms	Incidence of inflammatory breast symptoms in this population estimated at 6%.  No statistically significant differences were found	Oxytocin nasal spray is a common element of

	<p>acupuncture and care interventions</p> <p>[follows on from Kvist 2004 study]</p> <p>205 women with 210 cases mastitis/ breast inflammation randomised into 3 groups- all advised on emptying breasts and comfort measures; Group 1 =comfort measures plus oxytocin; group 2 = Heart 3 and Gall Bladder 21, group 3 = Heart 3 Gall Bladder 21 and Spleen 6.</p>	<p>tension</p> <ul style="list-style-type: none"> <li>• pyrexia</li> <li>• pain</li> <li>• resistances in the breast tissue</li> </ul> <p>during lactation</p> <p>All mothers had milk sampled</p>	<p>Whether use of acupuncture hastens treatment time for mastitis</p>	<p>between the three groups for the number of mothers with lowest possible severity index score: no statistically significant differences for number of contact days needed for mother to feel well enough to stop contact with clinic. No significant difference for numbers of mothers with less favourable outcomes.</p> <p>Comparisons of severity index scores for Days 3 and 4 of contact (mean contact was 5 days) showed significant differences:</p> <ul style="list-style-type: none"> <li>• group 1/traditional care had significantly higher severity index scores than group 2 and 3 on days 3 &amp; 4 (<math>P \leq 0.01</math>)</li> </ul> <p>15% of whole group received antibiotic treatment – no significant difference in rate between treatment groups. 3.3% of women developed abscesses = 7 women, 5 in group 1, one each in groups 2 and 3.</p> <p>No significant differences were found in bacterial milk cultures from the groups. There was an increased risk of less favourable outcome if Group B streptococci were present (OR = 2.3, 95%CI 1.1, 4.9) [See table xxx on Strep B in breast milk]</p> <p>Mothers with less favourable outcomes had, at first contact with midwife, had attachment corrected (OR = 2.6, 95% CI 1.2-5.9).</p> <p>Although acupuncture did not mean shorter length of symptoms, the severity of symptoms on days 3 and 4 was considerably less, leading authors to suggest that acupuncture with comfort measure may be preferable to use of oxytocin spray during mastitis.</p> <p>Low rate of antibiotic use in this study may be because initial treatment was by midwives who were practiced in suggesting comfort measures: there was also daily contact to check on how mothers were progressing.</p>	<p>treatment for mastitis in Sweden: this makes the findings somewhat difficult to interpret for NI, where it is not used.</p> <p>Acupuncture at Spleen 6 is deemed to have similar effects as oxytocin: group 2 received neither.</p> <p>The low rate of antibiotic treatment without severe outcomes which authors suggest is attributable to expertise in recommending care interventions and daily contact is of interest.</p>
Kvist 2004	Randomised	Any mixture of	Length of contact time for	On the third day after treatment commenced, there were	Participants

Sweden	trial 88 women with mastitis randomised into 3 groups- all advised on emptying breasts and comfort measures; 2 groups received acupuncture: Group 1 =comfort measures plus oxytocin; group 2 = Heart 3 and Gall Bladder 21, group 3 = Heart 3 Gall Bladder 21 and Spleen 6.	symptoms: <ul style="list-style-type: none"> <li>• erythema of the breast tissue</li> <li>• tension of the breast</li> <li>• resistances in the breast tissue</li> <li>• pain in the breast</li> <li>• pyrexia during lactation</li> </ul>	recovery Index score for severity of symptoms Use of antibiotics  <i>Oxytocin spray is commonly used for treatment of mastitis in Sweden: the 'control' group therefore received oxytocin, although acupuncture groups did not</i>  All women received advice on intervals and duration of breastfeeding episodes; emptying by hand expressing, pump or warm shower; unrefined cotton wool on breast [traditional treatment]	no significant differences between the 3 groups (P = 0.11) or for satisfaction with the breastfeeding situation (P = 0.16). No significant differences between the groups for number of women needing more than 3 contact days (P = 0.68)  9% of women in the study received antibiotics  The study was ended early as it was felt necessary to adjust the design to include cultivation of milk samples for all participants.  Authors conclude that care interventions play as great a part in recovery as either acupuncture or oxytocin spray.  A further study with more participants, with the power to establish reliability of results is planned.	and midwives were not blinded as 'sham' acupuncture not used.  Hard to interpret findings as oxytocin is not a standard treatment in the UK/NI.
Castro 1999 USA	Review of literature and explanation of use of homeopathy for mastitis			The selection of the appropriate homeopathic remedy is not straightforward as it takes into account patterns of symptoms, rather than specifying one particular remedy for all.	Gives guidelines for treatment: however no supporting evidence is given.

**References:**

Castro M. Homeopathy. A theoretical framework and clinical application. Journal of Nurse-Midwifery 1999; 44(3): 280-90.

Kvist LJ, Hall-Lord ML, Rydhstroem H, Larsson BW. A randomised-controlled trial in Sweden of acupuncture and care interventions for the relief of inflammatory symptoms of the breast during lactation. Midwifery 2007; 23(2): 184-95.

Kvist LJ, Wilde Larsson B, Hall-Lord ML, Rydhstroem H. Effects of acupuncture and care interventions on the outcome of inflammatory symptoms of the breast in lactating women. International Nursing Review 2004; 51(1): 56-64.

**Table I: Physiology of mastitis during lactation**

These are papers which focus on understanding the underlying physiology and pathology of mastitis

Author & date	Type of study	Outcomes
Fetherston 2006a Australia	Investigated levels of lactose excreted in urine during episodes of mastitis  26 mothers (at risk of mastitis) followed prospectively from day 5 pp with blood, milk and urine samples collected during first three months. 14 women suffered 22 episodes of mastitis	Excretion of lactose in urine was higher during mastitis ( $p < 0.001$ ), peaking at the start and decreasing over time. This accurately predicts breast permeability Increased severity of symptoms was a significant predictor for increased lactose in urine ( $p < 0.022$ ) In increase in the area of breast inflammation was predictive of increased breast permeability and changes in milk composition.
Fetherston 2006b Australia	Investigation of C-reactive protein (CRP) in breastmilk to examine any relationship between changes in CRP and severity of mastitis symptoms  As above, Fetherston 2006a.	CRP was elevated during mastitis ( $p < 0.001$ , $df:1,81$ , $F = 19$ ) Severity of systemic symptoms was a significant predictor for CRP blood changes. However, asymptomatic breast also had significantly higher CRP so this marker of little use in making a differential diagnosis between infective and non-infective mastitis.  A high count of <i>Strep. viridans</i> was present in milk from affected breasts, compared with milk from unaffected breasts. Authors say 'it cannot be discounted that the presence of either CNS or <i>Strep. viridans</i> within the breast... may be the causative mechanism for what is normally considered "noninfective" episodes of mastitis'.
Fetherston 2006c Australia	Investigate changes in milk composition before, during and after mastitis.  As above, Fetherston 2006a	Significant difference in sodium, chloride, serum albumin and lactose in a breast with mastitis when compared with the woman's unaffected breast and with 'healthy' breasts. Inflammation of the breast significantly predicted decreased glucose, and hyperacute symptoms predicted both decreased glucose and increased lactoferrin and slga.  <b>During mastitis there is increased breast permeability, reduced milk synthesis and increased concentration of immune components.</b>
Fetherston 2001 Australia	Review of literature on the role of milk itself in the defence of breast tissue against mastitis	"If non-infective forms of mastitis can produce symptoms similar to those of infective mastitis, this poses many questions that require investigation. ... A better understanding of the pathogenesis and physiology of mastitis is necessary to facilitate better prevention and treatment of mastitis in lactating women." P189
Buescher 2001 USA	Examination of milk from 8 women with clinical mastitis to determine anti-inflammatory components	Mastitis milk had the same anti-inflammatory components and characteristics of normal milk with some elevations in components which may help protect the baby from developing clinical illness due to feeding on mastitis milk.

Osterman 2000 Sweden	Compared CRP, leukocytes, haemoglobin, clinical signs, treatment and outcome between 41 cases of mastitis (40 women) grouped by bacterial cultures of milk. Group A = 25 cases with cultures for normal skin flora Group B = 16 cases where pathogenic bacteria cultured Treatment differentiated – rest and breast emptying	Group A women experienced cures with rest and frequent emptying of breast; no complications observed. Group B – most frequently isolated organism was S aureus. Leukocyte counts higher than in Group A. 75% group B women had sore nipples / 12% group a: sore nipples was strongly associated with potential pathogenic bacteria in milk 92% of group A women continued to breastfeed and no severe complications observed Outcome poor for 81% group B women: 31% weaned due to mastitis episode; 81% had symptoms for more than one week; one abscess, one case septic fever. 9 / 13 received antibiotic therapy <b>Authors conclude that bacterial cultivation is of value for identification of women with mastitis at risk of complications</b>
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### References:

Buescher ES, Hair PS. Human milk anti-inflammatory component contents during acute mastitis. Cellular Immunology 2001; 210(2): 87-95.

Fetherston CM, Lai CT, Mitoulas LR, Hartmann PE. Excretion of lactose in urine as a measure of increased permeability of the lactating breast during inflammation. Acta Obstetrica et Gynecologica Scandinavica 2006a; 85(1): 20-5.

Fetherston CM, Wells JI, Hartmann PE. Severity of mastitis symptoms as a predictor of C-reactive protein in milk and blood during lactation. Breastfeeding Medicine: The Official Journal of the Academy of Breastfeeding Medicine 2006b; 1(3): 127-35.

Fetherston CM, Lai CT, Hartmann PE. Relationships between symptoms and changes in breast physiology during lactation mastitis. Breastfeeding Medicine: The Official Journal of the Academy of Breastfeeding Medicine 2006c; 1(3): 136-45.

Osterman KL, Rahm V-A Lactation Mastitis: bacterial cultivation of breast milk, symptoms, treatment, and outcome. Journal of Human Lactation 2000 16(4): 297-302.

### Table J: Role of specific pathogens

### Table J1: Role of Staphylococcus aureus in mastitis

'Breast abscesses in lactating women are predominantly caused by S aureus' Amir 2002, referencing Dixon 1988; Benson 1989 [refs not included].

Author	Type of study	Definition of	Details	Comments
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date		mastitis		
Amir 2006  Australia	Case control study: 100 women with mastitis matched with breastfeeding women without mastitis as controls  Nasal specimens collected from mother and baby: women completed questionnaires	At least 2 breast symptoms: pain, redness, lump AND One systemic symptom: fever or flu-like symptoms -- present for at least 12 hours	There was no difference between nasal carriage of <i>S. aureus</i> in women with mastitis (42/98, 43%) vs those without (45/98, 46%). Significantly more infants of mothers with <i>S. aureus</i> were nasal carriers: 72/88 (82%) compared to controls 52/93 (56%). Infants of mothers with mastitis had OR 3.23 (CI 1.30, 8.27) to have nasal <i>S. aureus</i> . Association remained strong when adjusted for confounding factors (income, private health insurance, difficulty with breastfeeding, nipple damage and tight bra). There was a strong association between nipple damage and mastitis (OR 9.34 95%CI 2.99, 29.20) Women with mastitis were more likely (23% vs 12% controls) to have self-reported history of staphylococcal infection(s) 84% of women with cracked nipple had a baby with nasal <i>S. aureus</i> , compared to 63% of women without – a significant association OR 9.34 (95% CI 2.04, 5.51). No association between cracked nipple and nasal carriage in mother. 46% mothers with mastitis had <i>S. aureus</i> in milk.	Investigated due to anecdotal evidence of link between nasal carriage <i>S. aureus</i> and mastitis.  Authors comment that despite a robust association of nasal <i>S. aureus</i> in the baby and mastitis in their mother, no causal link is proven and the direction of transmission is not clear.  Authors recommend investigation of role of nasal <i>S. aureus</i> in recurrent mastitis.
Amir 2004  Australia	RCT – double blinded to investigate whether antibiotics prevent mastitis in women with <i>S. aureus</i> -colonised cracked nipples.		This study was intended to assess the use of oral antibiotics in women with cracked nipples colonised by <i>S. aureus</i> (see Livingstone, 1999).  In the event, only 10 women were recruited and randomised (over 500 had been sought) and the trial was discontinued.	This paper provides interesting insights into the difficulties of conducting research in this area.  <b>The research question remains untested.</b>
Heikkilä 2003  Finland	Isolates from breast milk samples from 40 women were tested for commensal bacteria with antimicrobial activity against <i>S. aureus</i>	N /a	509 anaerobic colonies were isolated and identified. Staphylococci were obtained from 39 samples (64% of total colonies) ; streptococci were found in 29 samples (30% colonies) Colonies exhibiting inhibitory activity against <i>S. aureus</i> were found in 36 samples out of 40: most only partially inhibited. <i>S. aureus</i> was identified in 5 / 40 samples	The species diversity and importance of normal bacterial flora of breast milk have received little attention.  Authors state that commensal bacteria of breast milk may have a role in preventing growth of pathogens.

<p>Amir 2002 Australia</p>	<p>3 case reports of women with S aureus infections: * 1 skin infections * 1 recurrent mastitis (wound infection in caesarean scar) * 1 with mastitis and abscess</p>		<p>Case 1: Mother developed all over skin rash at same time as Candida infection of nipples. Treatment regime of anti-fungals followed by antibiotics (once mis-diagnosis of rash corrected) Case 2: Mother's baby had tongue tie and difficulty attaching to breast – causing nipple damage. After infection of caesarean scar and antibiotic treatment, she developed Candida on nipples. Despite relief with anti-fungals she experienced mastitis symptoms until receiving further antibiotic treatment Case 3: Mother had recurrent mastitis and abscess; baby had boil. Other family members had boils, mother Candida, finally cleared.</p>	<p>All women referred to author because they had candida infection of nipples: S aureus was commensal infection</p> <p>Illustrates complexities of cases in which several infections present, and inter-relations between these, e.g. via nasal carriage of S aureus in either mother or infant</p> <p>Beta-lactamase resistant antibiotics are preferred: e.g. dicloxacillin. May need topical nasal mupirocin. Other prescribing suggestions.</p>
<p>Livingstone 1999 Canada</p>	<p>Prospective randomised clinical trial to compare 4 treatment regimes for S aureus infected nipples</p> <p>84 women (who had come to breastfeeding clinic) with sore nipples and positive culture for S aureus. 4 treatment s compared: • Optimal breastfeeding technique alone • Topical mupiricin</p>	<p>Not applicable</p>	<p>8% mothers improved with optimal breastfeeding technique alone 16% improved with topical mupiricin 29% improved with topical fusidic acid 79% improved with oral antibiotics (<math>p &lt; .0001</math>)</p> <p>Systemic antibiotics in treatment of S aureus infected nipples helped prevent mastitis developing: the risk of developing mastitis within 7 days of presentation to clinic was 25% among women not treated systemically compared to 5% of mothers receiving oral antibiotics.</p> <p>Optimal breastfeeding technique alone cannot heal cracked nipples if they are infected with S aureus.</p> <p><b>The study was stopped early due ethical concerns at the high incidence of treatment failure for women not receiving systemic antibiotics</b></p>	<p>17% if mothers had 'poorly graspable nipples'; 10% infants had a short frenulum; 12% had significant retrognathia: no correlations established</p>

	<ul style="list-style-type: none"> <li>• Topical fusidic acid</li> <li>• Oral antibiotics</li> </ul>			
Amir 2001 & Livingstone 2001	Letter commenting on study above, with author reply		Amir challenges findings of Livingstone 1999 as not statistically significant due to small sample size, especially after trial ended early. She calls for a randomised controlled trial with adequate sample size.  Authors defend the study and statistical methods.	
Livingstone 1996 Canada	227 breastfeeding mothers were questioned about sore nipples to determine if S aureus infection could be inferred from symptoms		51% of women had sore nipples; 23% positive nipple culture 15% grew S aureus on swab culture  Risk of S aureus infection was 4.8 times greater if nipple pain was moderate or severe vs mild. A break in nipple skin gave 35% chance of having S aureus culture – 5times greater than with intact skin.  Mothers of infants under one month of age 2.4 times more likely to have S aureus	High rate of nipple soreness in this study – however this was a group of women referred for breastfeeding difficulties.

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### Table J2: Mastitis and MRSA

Author and date	Type of paper	Outcomes measured	Results	Comments
Kriebs  2008 USA	Review of MRSA in obstetric setting in general		Comments on mastitis include: Women with MRSA should be aware that MRSA may cause mastitis. They should ensure careful hygiene and also inform care providers of MRSA status if they experience breast symptoms. “Persistent mastitis should be treated as if the diagnosis could be MRSA until culture results are known.” (p 249) Suggests that the only time breastfeeding should not continue is if the baby is in neonatal intensive care and expressed milk might be the only contact with mother.	
Reddy 2007  USA	Retrospective case control study 48 cases of S aureus- associated mastitis 1998 – 2005  Cases were women with mastitis and positive culture for MRSA; controls were women with mastitis and positive culture for methicillin-susceptible S aureus (MSSA)  21 MRSA and 27 MSSA cases identified	Risk factors, complications and outcomes among patients with community acquired postpartum MRSA	A relative increase in MRSA mastitis was noted in later years of study (P = 0.04).  39 /48 women underwent needle aspiration: 7 (41%) MRSA and 5 (23%) MSSA required repeat aspiration. 9 MSSA patients underwent incision and drainage after aspiration, whereas only one MRSA required subsequent débridement.  In 17/21 MRSA cases antibiotic use was documented: 12 patients received effective therapy, but only 2 received this initially. Median time to effective coverage was 5 days. Median duration of therapy was 19 days. In MSSA; all 18 cases were susceptible to initial regimens. Duration of therapy was a median of 13.5 days.  No transmission of MRSA to family members was documented in medical records reviewed.  57% of MRSA women and 33% of MSSA women were multiparous.  “Therapy against community acquired- MRSA should be considered in refractory or severe cases of mastitis until wound, drainage, or breast milk cultures can be obtained. Adjunct surgical drainage or aspiration is often warranted in such cases.” (p301).	This increase may reflect conditions within this individual setting, or reflect a wider trend. Authors comment that reasons for this are not clear.

**References:**

Kriebs, JM. Methicillin-Resistant Staphylococcus aureus Infection in the Obstetric Setting. Journal of Midwifery and Women's Health 2008; 53(3): 247-250.

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**Table J3: MRSA mastitis and abscess case study**

Author and date	Type of paper	Case description	Comments
Wilson-Clay 2008  USA	Case report  One woman's experience of mastitis leading to multiple abscess with identification of MRSA	This woman experienced persistent cracked nipples which did not heal. She had an imbalance in production between her two breasts. In addition to breastfeeding, she was regularly pumping, which the author speculates may have stimulated oversupply. She developed multiple, linked abscesses in the breast with greater supply. These were initially aspirated, and later surgically incised and drained.  MRSA was isolated from aspirated material. No nasal swab was obtained from the baby. The woman experienced a tender node in her breast and felt hot and sweaty but <b>did not have fever.</b>	<b>Initial prescription was made without examining this woman.</b>  <b>The mother ceased breastfeeding when being treated for abscess – later realacted on unaffected breast and able to mix breast and formula feeds for some months</b>  <b>Author emphasises that women should always be examined; non-healing nipple cracks should be investigated.</b>  <b>Infection control practices should be standard to avoid transmission of MRSA.</b>

**References:**

**Wilson-Clay B. Case report of methicillin-resistant staphylococcus aureus (MRSA) mastitis with abscess formation in a breastfeeding woman. Journal of Human Lactation 2008; 24(3) 326-329.**

**Table J4: Role of Corynebacterium**

Author date	Type of study	Comments
Paviour 2002  New Zealand	Case notes were retrospectively reviewed for 24 women (8 of whom were breastfeeding) who had bacterium isolated from breast tissue, pus or deep wound swabs: 12 had gram-positive bacilli. Of these, 9 had granulomatous lobular mastitis: "an inflammatory breast disease of unknown etiology that generally affects women of child-bearing age within a few years after they have given birth". (p1435) Case notes, including treatments, are given. Authors intend a prospective study of mastitis to help define the role of corynebacteria and	20 of the women were Maori or Polynesian: although these ethnic groups were 26% of total community. Some of the women who were breastfeeding had suffered abscesses. Hard to assess clinical relevance of this paper, future study may be of interest.

effective treatments.

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Paviour S, MUSAAD S, Roberts S, Taylor G, Taylor S, Shore K, et al. Corynebacterium species isolated from patients with mastitis.[see comment]. Clinical Infectious Diseases 2002; 35(11): 1434-40.

**Table K: Effects on the baby**

**Table K1: Effects of mastitis on the baby**

Author & date	Type of study	Outcomes
Jones 2001  Australia	Review / discussion	Brief discussion of the issue of bacteria in breast milk during mastitis. Although bacteria may be present during mastitis, the author asserts that this “usually poses little problem to the infant unless a breast abscess develops”, when “cessation of feeding through the affected breast is advised until the abscess is drained and/or appropriately treated with antibiotics”. (p 576)

**References:**

Jones CA. Maternal transmission of infectious pathogens in breast milk. Journal of Paediatrics & Child Health 2001; 37(6): 576-82.

**Table K2: Antibiotic treatment of women during lactation – effects on the infant**

Author & date	Type of study	Outcomes	Comments
Kummeling 2008  Netherlands	Prospective birth cohort study of 2764 families. Maternal and infant antibiotic use and eczema and wheeze were recorded through questionnaires and 815 infants had blood samples examined for immunoglobulin E against common	Antibiotic exposure through breastfeeding (or independently) was not associated with eczema. No association was found between exposure and allergic sensitisation.  Antibiotic exposure through breastfeeding was associated with a higher risk of recurrent wheeze (adjusted OR 1.55; 95% CI 1.02, 2.37) but not prolonged wheeze (adjusted OR 1.12; 95% CI 0.62, 2.02)	This is a potential effect of antibiotics that prescribers should be aware of.

	allergens.		
Benyamini 2005 Israel	<p>Study evaluating safety for infants of two antibiotics during lactation. Amoxicillin/Clavulanic acid was compared in 67 women with amoxicillin in 40 controls. Cefuroxime in 38 women with cephalxin in 11 controls.</p> <p>Breastfeeding women who called a drug consultation centre were recruited</p>	<p>Of 156 women in the study, 16 of their infants experienced one adverse effect and 3 infants 2 adverse effects.</p> <p>In the amoxicillin/clavulanic acid group 15 infants had adverse effects (22.3%) while in amoxicillin group 3 experienced adverse effects. However, when each individual effect was compared (restlessness, diarrhea, rash, constipation) no significant differences were observed between the groups. There was one adverse effect in each of cefuroxime and cephalxin groups.</p> <p>Authors conclude that newer antibiotics may be safe during lactation but a larger study is needed.</p>	Not all women in this study were taking antibiotic therapy for mastitis, some were receiving it for other conditions: none of the women receiving amoxicillin had mastitis.
Chung 2002 USA	Review of current literature on maternal antibiotic use during breastfeeding	<p>Thorough review of the effects of antibiotic therapy of the mother on her infant. Different classes of antibiotics considered and discussed.</p> <p>Some health care professionals recommend discontinuing breastfeeding when antibiotic therapy is indicated "this recommendation is rarely, if ever, necessary as the vast majority of maternally administered antibiotics will not achieve sufficient systemic concentrations in the breastfed infant for any meaningful pharmacologic effect." (P834)</p> <p>Rare effects are listed.</p>	
Hager 1996 USA	<p>Prospective randomised single blinded study comparing amoxicillin with cephradine treatment for mastitis.</p> <p>Mastitis defined as all of: temperature <math>\geq 37.56C</math>, erythema and tenderness of the breast(s)</p>	<p>No significant differences between two antibiotic regimes in cure rate, mean days to resolutions or recurrence within 30 days.</p> <p>All women also advised to use moist warm compresses on their breasts and continue breastfeeding.</p> <p>Two treatment failures were in patients initially treated with amoxicillin and the one abscess was also in an amoxicillin patient, leading researchers to recommend use of cephalosporin.</p>	

	27 women enrolled.		
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**References:**

Benyamini L, Merlob P, Stahl B, Braunstein R, Bortnik O, Bulkowstein M, et al. The safety of amoxicillin/clavulanic acid and cefuroxime during lactation. Therapeutic Drug Monitoring 2005; 27(4): 499-502.

Chung AM, Reed MD, Blumer JL. Antibiotics and Breast-Feeding: A Critical Review of the Literature. Pediatric Drugs 2002; 4(12): 817-37.

Hager W, Barton J. Treatment of sporadic acute puerperal mastitis. Infectious Diseases in Obstetrics and Gynecology 1996; 4: 97-101.

Kummeling I, Stelma FF, Dagnelie PC, Snijders BEP, Penders J, Huber M, et al. Early Life Exposure to Antibiotics and the Subsequent Development of Eczema, Wheeze, and Allergic Sensitization in the First 2 Years of Life: The KOALA Birth Cohort Study. Pedia

**Table K3: Maternal Strep B infections and effects on the baby through breastfeeding**

Author & date	Type of Study	Outcomes
Wang 2007  Taiwan	Case study	A baby who had an early onset of Strep B infection (meningitis): while being treated, the baby experienced a reoccurrence through drinking infected breast milk: at this time her mother experienced tenderness and erythema of the breast. Group B strep isolates from the baby and the mother’s milk were identical. The mother’s infection was successfully treated with amoxicillin. Authors speculate that neonatal oropharyngeal colonisation led to subsequent nipple colonisation which caused the mastitis which reinfected the infant. Breastfeeding was stopped as soon as the second infection was identified.
Muller 2006  Netherlands	Review of all various maternal group B streptococcal infections during pregnancy, delivery and postpartum: these may threaten not only the mother but her infant.	Maternal infection with group B strep appears to follow colonisation of the infant during delivery; infant infection can then result via breast milk.  “It is important to be aware of the possibility of GBS mastitis and GBS carriage in breast milk. Since the pathogenesis of GBS mastitis is unclear, prevention is difficult. In case of suspected or recurrent GBS neonatal disease, breast milk should be cultured and breastfeeding stopped until the cultures are negative.” (p1031)  Authors suggest that all cases of GBS mastitis be treated with ampicillin.
Kotiw 2003  Australia	Three case studies of infants with GBS where the mothers also had GBS in	Case 1 was a baby with recurrent GBS infection: his mother had developed mastitis by the time of his second infection. The baby responded well to therapy. Case 2 were 32-week twins. The mother developed GBS mastitis, and one twin became ill, and was hospitalised. The other twin began receiving milk from both breasts (previously each twin fed from a dedicated breast) and became

	their milk.	<p>ill. The first twin died after 4 days in hospital, the other twin made a good recovery following treatment and weaning. Case 3 was one of a pair of 33 week twins. She became ill and at 12 months was developmentally delayed and suffered from severe seizure disorder. Her mother had no obvious mastitis, but BGS was isolated from her milk. Breastfeeding was discontinued and the other twin remained well.</p> <p>Authors recommend that breastfeeding should not continue in the presence of GBS infection in breastmilk.</p>
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## References:

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Wang L-Y, Chen C-T, Liu W-H, Wang Y-H. Recurrent neonatal group B streptococcal disease associated with infected breast milk. *Clinical Pediatrics* 2007; 46(6): 547-9.

**Table L: Prevention of mastitis**

Author & date	Type of study	Outcomes	Comments
<p>Jiménez 2008</p> <p>Spain</p>	<p>RCT of women with staphylococcal mastitis receiving either daily probiotic or placebo.</p> <p>10 women in each arm of study.</p> <p>Received probiotic originally isolated from breast milk of healthy women</p>	<p>In the treatment arm, the probiotic group had a lower staph count in milk samples at day 30. In the treatment group at 14 days, women had no clinical signs of mastitis, while mastitis persisted in the placebo group.</p> <p>All women had received 2-4 weeks of antibiotic therapy prior to the study, but had ceased this treatment at least 2 weeks before the current study.</p>	<p>Women in this study had already had persistent mastitis which did not improve with antibiotic therapy. For the women taking the placebo, they continued to suffer symptoms of mastitis for the 30 days of the study. No management measures (eg expressing or improvement in feeding technique) were described, nor were outcomes either for babies or for continued breastfeeding.</p> <p>This therapy may be useful in the future, but more studies need to be conducted.</p>
Filteau 2004	Commentary on		Comments on the feasibility of using

Sweden	Svensson study		cereals as tested by Svenson in Africa where mastitis may increase transmission of HIV during breastfeeding.
Svenson 2004 Sweden	<p>Randomised trial: 40 women at 3-7 days pp. Intervention group received cereal heat-treated which had the effect of inducing anti-secretory factor in their milk: controls received inert cereal.</p> <p>Anti-secretory factor (AF) may have anti-inflammatory and anti-infectious properties (theory partially based on veterinary evidence).</p>	<p>When women had eaten the cereal for 4 -5 weeks their milk was tested.</p> <p>11 out of 40 women entering the study dropped out early.</p> <p>Mastitis: 1/12 mothers in experimental vs 6/17 in control group experienced mastitis (<math>p= 0.0086</math>, permutation test). The mother in experimental group who had mastitis had only eaten the cereals on 5 days a week.</p> <p>Median AF levels in milk varied: experimental 1.1 (0.7 – 1.25) units vs control 0.1 (0.0 – 0.25). <math>Z = -4.492</math>, <math>p &lt; 0.0001</math>.</p> <p>Comparing median levels of AF in control mothers with or without mastitis showed significant difference: 0.0 (0.0 – 0.1) vs 0.5 (0.2-1.1), <math>Z = -2.399</math>, <math>p = 0.017</math>.</p>	<p>This study would need replication on a larger scale to see if it offers a potentially useful method of helping to prevent mastitis.</p> <p>In particular, the large number of women who left the study early is of concern.</p> <p>Authors comment that the cereal may not be acceptable in all cultures.</p>

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