

Issue date: February 2010

Donor breast milk banks: the operation of donor milk bank services

NICE clinical guideline 93

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Introduction

Research has consistently shown that breast milk is the best nourishment for babies and that it is highly beneficial to their health in the short, medium and long term. Women are recommended to breastfeed their baby exclusively for 6 months and continue to breastfeed after 6 months as part of a balanced diet (see www.dh.gov.uk for the latest Department of Health guidance on breastfeeding).

If, after discussion with experienced staff, a mother is unable to express sufficient milk or does not wish to express milk for a baby unable to feed at the breast, donor breast milk can be used.

In this guideline, donor breast milk is defined as breast milk expressed by a mother that is then processed by a donor milk bank for use by a recipient that is not the mother's own baby. Payment for the donated milk is not given.

A Health Technology Assessment (HTA) report entitled 'Breastfeeding promotion for infants in neonatal units: a systematic review and economic analysis' was published in 2009. This report used systematic review methodology and health economic modelling to assess which interventions, including the availability of donor breast milk, effectively promote the initiation and duration of breastfeeding in neonatal, special and intensive care settings. The authors noted that in the UK, donor breast milk is neither widely nor readily available in the majority of units; this was reflected through modelling the use of donor breast milk by availability, not need. They concluded that if mechanisms by which donor milk is provided were improved, donor milk would become cost effective compared with using formula. This was based on a significant improvement in the operation of milk banking, and suggested models include setting up a national donor milk banking system similar to that for blood (Renfrew et al. 2009).

Although this guideline does not make recommendations on the configuration of services, it does make recommendations on the safe and effective operation of donor milk services.

Throughout development, the safety of donor breast milk was considered to be the aim of the guideline and recommendations were made to minimise the risk to recipients of donor milk. Maximising safety comes at a cost and recommendations were made to observe the best possible safety standards without exceeding opportunity costs acceptable to society.

Person-centred care

This guideline offers best practice advice on the operation of donor breast milk bank services.

Good communication between healthcare professionals and service users is essential. It should be supported by evidence-based written information

tailored to the person's needs. All information that service users are given should be culturally appropriate. It should also be accessible to people with additional needs such as physical, sensory or learning disabilities, and to people who do not speak or read English.

1 Summary

1.1 *Key priorities for implementation*

Quality assurance

- Use Hazard Analysis and Critical Control Point (HACCP) principles in all quality assurance processes.
- Validate, calibrate and maintain all equipment used in donor milk handling and processing and keep records of this. Ensure that the equipment is used according to the manufacturer's instructions.
- All milk bank staff should have ongoing training that is relevant to their job and is recorded. Training should cover good practice and should ensure that each staff member:
 - is competent in performing their job
 - understands the technical processes relevant to their job
 - understands how the milk bank is organised and how its health and safety and quality systems work
 - understands the regulatory, legal and ethical aspects of their work.
- All donor milk administered in the NHS should be from milk banks that can demonstrate adherence to the NICE guidance on the operation of donor milk banks.

Screening and selecting donors

- Follow the stepped screening process detailed in recommendations 1.2.12 to 1.2.21 when recruiting donors.
- Do not routinely repeat serological tests while the donor is donating milk.

Handling donor milk at the milk bank

- Before pasteurisation, test a sample from each batch of pooled donor milk for microbial contamination and discard if samples exceed a count of:

- 10^5 colony-forming units (CFU)/ml for total viable microorganisms **or**
- 10^4 CFU/ml for Enterobacteriaceae **or**
- 10^4 CFU/ml for *Staphylococcus aureus*.
- Regularly test pasteurised donor milk for microbial contamination. Base the testing schedule on the volume and throughput of milk. Test:
 - either at least once a month or every 10 cycles, depending on which comes first,
 - and**
 - on an ad-hoc basis if any new processes, equipment or staff are introduced, or if there are concerns about any part of the process.

Tracking and tracing

- At all stages, donor milk containers should be labelled clearly for identification. Clearly identify milk that is ready to be used.
- Only supply donor milk to hospitals or neonatal units that agree to comply with the tracking procedures for milk outlined by the milk bank.

1.2 List of all recommendations

The recommendations in this guideline are all key to the process of donor milk banking and are dependent on each other. For example, the recommendations on testing milk post-pasteurisation are dependent on the application of the recommendations on quality assurance and equipment maintenance. The safety of donor milk therefore depends on the implementation of all recommendations.

Quality assurance

There is no recognised NHS standard for human milk pasteurisers. In the UK, donor milk banks have been following guidance issued by various bodies, including in 1981, a report on the collection and storage of human milk. (Committee on Medical Aspects of Food Policy 1981) and more recently, guidelines issued in 2006 by the UK Association for Milk Banking. The following recommendations, specifically on maintenance of equipment, need to be viewed in this context.

- 1.2.1 Use Hazard Analysis and Critical Control Point (HACCP) principles in all quality assurance processes.
- 1.2.2 Clean and store all donor milk containers and equipment according to local protocols based on HACCP principles.
- 1.2.3 Validate, calibrate and maintain all equipment used in donor milk handling and processing and keep records of this. Ensure that the equipment is used according to the manufacturer's instructions.
- 1.2.4 Regularly inspect all equipment used in donor milk handling and processing, following the manufacturer's instructions. Ensure that all equipment that may affect temperature or contamination levels has sensors and alarms so that constant conditions can be maintained.
- 1.2.5 All milk bank staff should have ongoing training that is relevant to their job and is recorded. Training should cover good practice and should ensure that each staff member:
- is competent in performing their job
 - understands the technical processes relevant to their job
 - understands how the milk bank is organised and how its health and safety and quality systems work
 - understands the regulatory, legal and ethical aspects of their work.
- 1.2.6 Train milk bank staff in HACCP principles, food hygiene and pasteurisation, and provide ongoing support so that practices reflect these principles.

1.2.7 All donor milk administered in the NHS should be from milk banks that can demonstrate adherence to the NICE guidance on the operation of donor milk banks.

1.2.8 Implement a quality control system that is followed by all staff and is reviewed regularly. It should encompass:

- collecting, testing, processing, storing and transporting milk
- personnel, required documentation, premises and equipment
- batch recall, external and internal auditing, non-conformance to processes and self-inspection
- continuous quality improvement.

Recruiting donors

1.2.9 When promoting the donation of breast milk, aim to reach as many potential donors as possible through a variety of channels, including:

- providing written information to be left in:
 - GP surgeries
 - antenatal clinics and postnatal wards
 - volunteer and other organisations working in maternity and childbirth
 - children's or Sure Start centres
 - maternity shops
- direct referrals or recommendations by:
 - current and previous donors
 - staff at neonatal intensive care units
 - paediatricians assessing babies' progress
 - health visitors (or other healthcare professionals providing postpartum care)
 - childbirth educators
 - organisers and attendees of prenatal and postnatal classes
 - breastfeeding mothers' support groups and related organisations

- features in the media.

1.2.10 Use clear, non-technical language when communicating the use of donor milk and the process of donor milk banking in any written information and activities.

Screening and selecting donors

The following strategy of screening and selection is part of the whole process of donor milk handling and therefore is intrinsically linked with the recommendations on testing and treating the donor breast milk.

1.2.11 Follow the stepped screening process detailed in recommendations 1.2.12 to 1.2.21 when recruiting donors.

1.2.12 Advise a potential donor that she is not eligible to donate milk if she:

- currently smokes or uses nicotine replacement therapy (NRT)
- regularly exceeds recommended alcohol levels for breastfeeding mothers (1 to 2 units, once or twice a week) (see www.dh.gov.uk for information on alcohol and breastfeeding)
- is using, or has recently used, recreational drugs
- has previously tested positive for HIV 1 or 2, hepatitis B or C, human T-lymphotropic virus (HTLV) type I or II, or syphilis
- is at an increased risk of Creutzfeldt–Jakob disease (CJD) (see www.hpa.org.uk for information on the risk of CJD).

Include this information in recruitment material so that potential donors can self-screen for these criteria.

1.2.13 Using a process of informal interview, referring to medical sources (with consent) if necessary, ask the potential donor questions on the topics that follow. Use the information she gives to make a balanced decision about her eligibility to donate based on possible risks to recipients and/or the results of subsequent serological tests (see recommendations 1.2.16 and 1.2.17). Ask questions about:

- her health: to confirm that she is in good general health
- her baby: document the age and health of the baby
- any exposure to passive smoke: is she exposed to high or sustained levels of passive smoke (for example, do other members of her household smoke heavily)?
- any medication that she is taking: is she currently taking any medication or undergoing any other medical therapy?
- any significant environmental or chemical exposure (such as contamination of the local water supply): is she exposed to high or sustained levels of environmental or chemical contaminants that can be expressed in breast milk?
- any recent exposure to infection (including HIV 1 or 2, hepatitis B or C, HTLV I or II, syphilis, herpes, or acute or chronic infections). Depending on the assessment of level of risk, further testing may be needed.
- any recent medical intervention (for example, exposure to diagnostic radioactive isotopes)
 - refer to guidance from the Department of Health on the safety of recent vaccination when breastfeeding (available from www.dh.gov.uk).

Advise the potential donor that depending on her answer to any of these questions she may not be eligible to donate milk.

- 1.2.14 If a potential donor is donating previously expressed breast milk, ask her to answer the screening questions (recommendations 1.2.12 to 1.2.13) for the period when the milk was expressed.
- 1.2.15 Conduct the screening interview, detailed in recommendations 1.2.12 and 1.2.13, with potential donors at a mutually acceptable time and place, either face-to-face or by telephone.

Serological testing

- 1.2.16 When donors first contact the milk bank about donating milk, explain that serological testing is mandatory to reduce the risk of passing on infections. Obtain informed consent before testing.
- 1.2.17 Undertake serological testing of all potential donors for the following and exclude women from donating who test positive for:
- HIV 1 or 2
 - hepatitis B or C
 - HTLV I or II
 - syphilis.
- 1.2.18 Perform all serological screening tests at the time of enrolling for donor milk banking; do not rely on antenatal test results.
- 1.2.19 All tests should be undertaken in laboratories with clinical pathology accreditation (CPA).
- 1.2.20 Ensure that laboratories communicate the results of serological testing clearly and that they provide appropriate interpretive comments.

- 1.2.21 Give serological test results to potential donors either in person or by telephone (unless they prefer to receive them in writing). If needed, offer further help and support based on local protocols, including information about counselling and local support groups.
- 1.2.22 Laboratories should archive samples of blood received from donors.

Consent and continued eligibility

- 1.2.23 Before accepting a donor's milk, obtain her consent for the processing and intended use of the donated milk. Advise her that once donated, milk will not be returned to her.
- 1.2.24 While a donor continues to donate, ask regularly about her general health and the exclusion criteria detailed in recommendations 1.2.12 to 1.2.13. Advise her that if her status or circumstances change in relation to these, she should contact the milk bank immediately.
- 1.2.25 Do not routinely repeat serological tests while the donor is donating milk.

Training and supporting donors

The recommendations in this section are specific to mothers expressing milk for donation, and may differ from advice given to mothers expressing milk for their own babies.

- 1.2.26 Provide all new donors with training, preferably face-to-face with additional information by telephone and in writing. Arrange training at a time and place suitable for both donor and trainer.
- 1.2.27 Training for new donors should cover:
- hand washing and the importance of this
 - good personal hygiene
 - collecting and expressing milk, including cleaning and using breast pumps and containers

- storing donated milk (including cooling and freezing)
- labelling donated milk, and documenting storage conditions
- transportation of donated milk (if needed).

1.2.28 Provide ongoing support to all donors according to their individual needs until no longer required. This may include:

- information and ongoing support on milk bank requirements for their diet and alcohol consumption
- continued support for collecting expressed milk and maintaining lactation
- emotional support.

1.2.29 Offer additional support and information on milk collection to donors whose milk has significant or repeated microbial contamination.

Stopping or suspending milk donations

The recommendations in this section are specific to mothers expressing milk for donation, and may differ from advice given to mothers expressing milk for their own babies.

1.2.30 Consider no longer accepting breast milk from donors who, despite support, consistently supply:

- breast milk that does not meet the microbiological criteria (see recommendation 1.2.58)
- small amounts of breast milk.

- 1.2.31 Advise donors to contact the milk bank to discuss suspending or stopping their breast milk donation if they develop a fever or have contact with a viral exanthematous disease.
- 1.2.32 Advise donors who begin taking any medication that they should contact the milk bank to discuss suspending or stopping their breast milk donation. Use appropriate reference sources¹.
- 1.2.33 Advise donors to contact the milk bank to discuss suspending or stopping their breast milk donation if they develop lesions or infections of the breast (including mastitis or herpes).
- 1.2.34 Provide donors who are stopping their breast milk donations with as much advice and support as needed.
- 1.2.35 Consider the size of the recipient population, the milk bank's stock levels, and the preferences of the donor when discussing how long a woman can donate milk.

Expressing milk at home for donation

- 1.2.36 Advise donors to collect expressed milk rather than 'drip' milk (milk that is passively collected from one breast while the baby feeds at the other) for donation.
- 1.2.37 Actively encourage donors to hand express milk; however, accept pump-expressed milk if donors prefer this method.

Handling donor milk at home

The recommendations in this section are specific to mothers handling and storing milk for donation, and may differ from advice given to mothers expressing milk for their own babies. This is because donated milk needs to undergo various testing and treatment processes at the donor milk bank, all of which affect the nutritional and immunological composition of the milk. The

¹ See the British national formulary for children, the Drugs and Lactation Database LactMed (www.toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?LACT) or the UK Drugs in Lactation Advisory Service (see www.ukmicentral.nhs.uk/drugpreg/guide.htm).

aim therefore is to make sure that milk for donation reaches the donor milk bank as soon as possible to ensure the highest quality before processing.

- 1.2.38 Advise donors that expressed milk collected for donation should be frozen as soon as possible to maintain the nutritional and microbiological quality of the milk. If this is not possible (for example, because of storage capacity), advise donors to refrigerate samples collected over 24 hours, and then freeze the batch.
- 1.2.39 Advise donors that expressed milk for donation should remain frozen during storage at home, and if they have any concerns about storage conditions or freezer temperatures, they should discuss these with the milk bank.
- 1.2.40 Advise donors that frozen expressed milk should be transported to the milk bank as soon as possible. However, if necessary, expressed milk for donation can be stored before transport to the milk bank for up to 3 months in a domestic freezer, at -18°C or lower. If a donor does not have access to a domestic freezer at her home, she may be able to access freezers for milk storage at local donor milk depots or children's centres.
- 1.2.41 Advise donors that expressed milk can only be accepted by the milk bank if it has been collected and stored in milk collection containers provided by, or acceptable to, the milk bank.
- 1.2.42 Advise donors that collection containers for expressed milk should be used according to instructions provided by the milk bank.
- 1.2.43 Ensure that donors can check and document their freezer temperature every day; this may include providing a thermometer.

Handling donor milk during transportation

- 1.2.44 Define critical conditions for transport, including temperature and time limit, to ensure that donor milk remains frozen during transport.

- 1.2.45 Transport donor milk in secure, tamper-evident containers and packaging.
- 1.2.46 If donor milk is transported to the milk bank by a contracted third party, ensure that a documented agreement is in place to maintain the conditions needed.
- 1.2.47 Define in writing the milk bank's procedures for transporting and storing donor milk. Ensure that these procedures maintain the quality of the donor milk and allow accurate identification of samples. Keep records of inventory and distribution (see also recommendations 1.2.68 to 1.2.75 on tracking and tracing).
- 1.2.48 Collect expressed milk from the donors, preferably using an agreed transport provider (ideally a medical courier) or a member of staff from the milk bank. In some instances, donors may be required or may wish to deliver their own milk to the milk bank or depot, in which case they should also follow the milk bank's requirements for transport as outlined. In all cases, use consistent monitoring processes, including recording the journey time.
- 1.2.49 Collect expressed milk from either the donor's home (see recommendations 1.2.38 to 1.2.43) or from donor milk depots that have practices for monitoring freezers and maintaining standards for quality control, storage and security. Ensure that similar processes are in place in any location where the donor milk is stored.

Handling donor milk at the milk bank

The following strategy of handling milk at the milk bank, specifically testing and treating donor milk, is part of the whole process of donor milk handling and therefore is intrinsically linked with the recommendations on recruiting and selecting the donors. It is also predicated on the effective functioning of the human milk pasteuriser.

- 1.2.50 Process all donated milk under hygienic conditions (a sterile environment is not necessary). Practise good hand hygiene at all times, and wear gloves whenever handling donor milk.
- 1.2.51 Check that donated milk arriving at the milk bank:
- is labelled correctly with the donor's name and the date of expression **and**
 - has remained frozen **and**
 - has not been tampered with.
- Transfer all donated milk immediately to the freezer.
- 1.2.52 Store pasteurised and unpasteurised donor milk in separate freezers and refrigerators.
- 1.2.53 Store donor milk awaiting pasteurisation in the freezer at the milk bank (at -20°C) for no longer than 3 months from the date of expression.
- 1.2.54 Discard breast milk from donors who do not meet the selection criteria detailed in recommendations 1.2.12, 1.2.13 and 1.2.17.
- 1.2.55 Before testing and pasteurising, thoroughly thaw the donor milk, and keep in the refrigerator for no longer than 24 hours. Prevent the donor milk from reaching 8°C while thawing.
- 1.2.56 Only pool pre-pasteurised breast milk from the same donor.
- 1.2.57 Do not pool:
- breast milk from different donors,
or
 - batches of pasteurised breast milk from the same donor.

- 1.2.58 Before pasteurisation, test a sample from each batch of pooled donor milk for microbial contamination and discard if samples exceed a count of:
- 10^5 colony-forming units (CFU)/ml for total viable microorganisms **or**
 - 10^4 CFU/ml for Enterobacteriaceae **or**
 - 10^4 CFU/ml for *Staphylococcus aureus*.
- 1.2.59 Ensure that laboratories communicate the results of microbial testing clearly and that they provide appropriate interpretive comments.
- 1.2.60 Seek help from microbiological laboratories to identify and investigate instances of significant or unusual contamination (for example, by undertaking further microbial tests).
- 1.2.61 Pasteurise donated milk at 62.5°C for 30 minutes in a human milk pasteuriser. Rapidly cool the milk to a temperature of 4°C or lower. Remove one bottle for testing if appropriate, then move the remainder of the batch to the freezer.
- 1.2.62 After pasteurising, store frozen donor milk for no longer than 6 months after the date of expression.
- 1.2.63 Do not open the lid of batches of pasteurised donor milk until the milk is to be used, unless it is to test the milk. If the milk is tested, discard the opened bottle.
- 1.2.64 Regularly test pasteurised donor milk for microbial contamination. Base the testing schedule on the volume and throughput of milk. Test:
- either at least once a month or every 10 cycles, depending on which comes first,
and

- on an ad-hoc basis if any new processes, equipment or staff are introduced, or if there are concerns about any part of the process.

- 1.2.65 Discard pasteurised donor milk that has a total viable microbial count of 10 CFU/ml or more.
- 1.2.66 Keep all donor milk in containers made of food grade materials.
- 1.2.67 Staff at the milk bank should not be responsible for adding anything to the donated milk.

Tracking and tracing

- 1.2.68 Track donated milk from the donor through to the recipient hospital.
- 1.2.69 Tracking and monitoring of donor milk processing should include freezer temperatures, pasteurisation processes and stock control.
- 1.2.70 At all stages, donor milk containers should be labelled clearly for identification. Clearly identify milk that is ready to be used.
- 1.2.71 For each donor milk batch, keep the following records.
- About the donor:
 - NHS number/donor ID
 - consent
 - relevant medical history
 - results of serological tests.
 - About each container before pasteurisation:
 - donor ID
 - a testing log, including the tests undertaken and their results.
 - For each pasteurised container:
 - samples making up the batch
 - the batch number
 - a testing log, including the tests undertaken and their results
 - pasteurisation details, including date of the pasteurisation.

- The hospital or neonatal unit that receives the donated milk, or the disposal date of the donated milk, as appropriate.
- 1.2.72 Label each container of pasteurised donor milk with the following information.
- A unique identification number.
 - Confirmation that it contains pasteurised donor breast milk.
 - Instructions to keep frozen, and use within 24 hours if defrosted.
 - An expiry date (no later than 6 months from expression).
- 1.2.73 Only supply donor milk to hospitals or neonatal units that agree to comply with the tracking procedures for milk outlined by the milk bank.
- 1.2.74 The receiving hospital or neonatal unit should keep a record of how the donor milk is used. It should document for each bottle of donor milk:
- the baby's name, NHS number and date of birth, and the date administered
 - the batch number and the date the donor milk was used in the patient record of each baby
 - the condition of the donor milk on arrival following transport
 - the storage conditions.
- 1.2.75 Ensure that all records (including raw data) that are critical to the safety and quality of the donor milk are kept for at least 30 years after expiry date, use or disposal. These records should be confidential.

1.3 Overview

1.3.1 Operating donor milk banks

Seventeen donor breast milk banks are currently in operation in the UK. These provide donor milk to babies, including pre-term babies and babies with growth restriction.

It is widely recognised that there is not enough high-quality evidence on the effectiveness of donor milk in improving health outcomes. There is also concern that research into both the effectiveness of donor milk and access to donor milk is being restricted because of a lack of understanding of the process of donor milk banking, and specifically procedures for ensuring the safety of banked donor milk.

The UK Association for Milk Banking issued 'Guidelines for the establishment and operation of human milk banks in the UK' in 2003. This is still relevant and in use, but is past its review date. There is therefore an urgent need for an updated national guideline to ensure that donor milk banks operate according to the best available evidence and standards of practice.

This short clinical guideline aims to improve the safety of donor milk by making evidence-based recommendations on the operation of donor milk banks.

1.3.2 Who this guideline is for

This document is intended to be relevant to donor milk bank staff, healthcare professionals who care for people who use donor milk, and hospitals or organisations who are considering starting a donor milk bank.

2 How this guideline was developed

2.1 Introduction

'Donor breast milk banks: the operation of donor breast milk services' (NICE clinical guideline 93) is a NICE short clinical guideline. For a full explanation of

how this type of guideline is developed, see 'The guidelines manual' (2009) at www.nice.org.uk/GuidelinesManual

During the initial development work for this guideline, it was clear that there were significant challenges to be addressed. These are reported below, along with strategies agreed with the NICE Short Clinical Guidelines Technical Team and the wider technical team within the Centre for Clinical Practice at NICE.

2.1.1 Evidence appropriate for questions about the operation of services

It is not clear which study designs are most appropriate to answer questions about the operation of services.

Other guidance in related areas ('Infection control' [NICE clinical guideline 2; available from www.nice.org.uk/guidance/CG2] and 'Patient safety and reduction of risk of transmission of Creutzfeldt–Jakob disease [CJD] via interventional procedures' [NICE interventional procedure guidance 196; available from www.nice.org.uk/guidance/IPG196]) placed no restriction on study design, only preferring 'in use' studies to those 'in vitro'.

For this guideline, no restriction was placed on the design of studies included in the evidence review.

In addition, a structured survey was developed by the technical team and two members of the Guideline Development Group (GDG). The aim of the survey was to assess current provision and needs to place the final recommendations in context; it was not intended to be used as primary evidence. The survey asked questions on the topics of:

- rates of donation and use of donor breast milk
- costs of service provision
- descriptions of models of service provision
- perceived problems with current services
- results of completed audits

- further information or research to support the development of services.

The results of the survey are presented in full in appendix 4.

2.1.2 Cost effectiveness of the operation of services

NICE guidelines are required to consider both clinical and cost effectiveness. The cost-effectiveness literature was reviewed for this guideline and we found evidence on the cost effectiveness of indications for donor breast milk, but not for aspects of how milk banks should operate. There was very little quantitative evidence on required data inputs for a de novo model evaluating, for example, milk testing strategies to maximise safety at an acceptable cost. However, we considered cost-effectiveness implications where deemed relevant for this guideline. A costing statement will be developed for the final version of the guideline.

2.1.3 Appraisal and evaluation of laboratory tests

Other guidance in related areas ('Infection control' [NICE clinical guideline 2; available from www.nice.org.uk/guidance/CG2] and 'Patient safety and reduction of risk of transmission of Creutzfeldt-Jakob disease [CJD] via interventional procedures' [NICE interventional procedure guidance 196; available from www.nice.org.uk/guidance/IPG196]) reported no formal quality assessment of studies of laboratory tests using validated checklists – reviewers reported study strengths and weaknesses only.

For this guideline, no formal quality assessment was made of studies of laboratory tests (unless an appropriate checklist was provided in 'The guidelines manual'; available from www.nice.org.uk/GuidelinesManual), but study strengths and weaknesses were documented in the full evidence report and review.

2.1.4 Lack of evidence specific to donor breast milk banking

Where appropriate, the evidence was limited to studies of donor milk banking, but, where there was no evidence, findings were extrapolated from existing evidence-based guidelines or Department of Health guidance on maternal breastfeeding. If no evidence was identified, consensus from within the GDG

was applied. However, the GDG was aware that, for most topics, there was limited or no high-quality evidence. The GDG therefore used formal consensus techniques when drafting and considering the recommendations.

Even in the absence of high-quality evidence, GDGs are generally able to reach agreement through informal consensus. However, because there was also the need for detailed service guidance, and the potential for a large number of recommendations, it was agreed that there was a role for formal consensus development techniques.

The GDG used a modified RAND approach (Brook 1994), similar to that used in 'Chronic fatigue syndrome/myalgic encephalomyelitis (or encephalopathy)' (NICE clinical guideline 53; available from www.nice.org.uk/guidance/CG53) and 'Feverish illness in children' (NICE clinical guideline 47; available from www.nice.org.uk/guidance/CG47) to reach consensus.

A full description of the methods and results are presented in full in appendix 3.

2.2 *Health economic modelling*

It was not considered appropriate or possible to construct a health economic model for this guideline. However, the GDG was mindful of the need to consider both costs and benefits. These considerations are documented, where relevant, in the 'Evidence to recommendations' sections below (for example, see sections 2.6.4 on the screening and selection of donors and 2.16.4 on testing donor milk).

2.3 *Evidence to recommendations*

An overview of the explanations is given in each section. Detailed considerations, as part of the formal consensus process, are presented in full in appendix 3.

2.4 Quality assurance

2.4.1 Review question

Quality assurance was reviewed as part of the evidence review on handling milk in general – see section 2.13.

2.4.2 Evidence review

No references made explicit reference to quality assurance.

2.4.3 Evidence statements

2.4.3.1 No studies were identified that made explicit reference to the use of a specific quality assurance process; however, most studies did make some reference to the need for adequate quality control.

It should be noted that the process of identifying ‘medical’ literature may not be the most effective method of retrieving the relevant evidence. See the ‘Evidence to recommendations’ section below for more details.

2.4.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Although no specific evidence on quality assurance was provided, relevant European directives were identified. Although these do not directly refer to donor milk, milk banks should consider these and use them when drafting their own quality assurance processes.

- Commission Directive 2006/86/EC of 24 October 2006 implementing Directive 2004/23/EC of the European Parliament and of the Council as regards traceability requirements, notification of serious adverse reactions and events and certain technical requirements for the coding, processing, preservation, storage and distribution of human tissues and cells
- Commission Directive 2005/62/EC of 30 September 2005 implementing Directive 2002/98/EC of the European Parliament and of the Council as

regards Community standards and specifications relating to a quality system for blood establishments.

More specifically, milk banks should use the method of HACCP (available from

www.food.gov.uk/foodindustry/regulation/hygleg/hygleginfo/foodhygknow)

to identify critical points in processes and design appropriate measures to prevent errors.

2.4.5 Recommendations

Recommendation 1.2.1

Use Hazard Analysis and Critical Control Point (HACCP) principles in all quality assurance processes.

Recommendation 1.2.2

Clean and store all donor milk containers and equipment according to local protocols based on HACCP principles.

Recommendation 1.2.3

Validate, calibrate and maintain all equipment used in donor milk handling and processing and keep records of this. Ensure that the equipment is used according to the manufacturer's instructions.

Recommendation 1.2.4

Regularly inspect all equipment used in donor milk handling and processing, following the manufacturer's instructions. Ensure that all equipment that may affect temperature or contamination levels has sensors and alarms so that constant conditions can be maintained.

Recommendation 1.2.7

All donor milk administered in the NHS should be from milk banks that can demonstrate adherence to the NICE guidance on the operation of donor milk banks.

Recommendation 1.2.8

Implement a quality control system that is followed by all staff and is reviewed

regularly. It should encompass:

- collecting, testing, processing, storing and transporting milk
- personnel, required documentation, premises and equipment
- batch recall, external and internal auditing, non-conformance to processes and self-inspection
- continuous quality improvement.

2.5 *Recruiting donors*

2.5.1 Review question

How should donor women be recruited, and what information should be provided?

2.5.2 Evidence review

Thirty-five of the 202 studies included in the review provided 73 evidence records (defined as quotes or short summaries of the relevant information from included studies). The studies contained:

- 18 service descriptions
- 8 narrative reviews
- 5 primary studies
- 2 position statements
- 2 opinion pieces.

Their publication dates ranged from 1951 to 2008.

The service descriptions reported practice in the UK, the USA, Denmark, Australia, China, India, Sweden, Poland and Germany.

There was general agreement that active recruitment strategies were needed, but there was less agreement on the most effective methods of recruitment. There was documented variation in the donors, or groups of donors, recruited, and the timing of approach. No specific reference to the costs of different approaches was made.

There was some limited evidence on the attitudes of women who do or do not donate, and the authors drew conclusions based on these for strategies to improve recruitment rates. No primary study compared different recruitment strategies.

2.5.3 Evidence statements

- 2.5.3.1 *Healthy mothers who are breastfeeding their own babies and have more milk than they need are suitable candidates for donating surplus milk².*
- 2.5.3.2 *'Drip' milk (milk that is passively collected from one breast while the baby feeds at the other) from mothers early in lactation may be suitable for donor milk³.*
- 2.5.3.3 *Surplus milk from mothers whose lactation is well established may be suitable for donor milk⁴.*
- 2.5.3.4 *Surplus milk from mothers who have expressed milk for their own babies in the neonatal intensive care unit may be suitable for donor milk⁵.*
- 2.5.3.5 *Mothers of babies who die may find that donating milk to help another baby live is a comforting way to remember their lost child, and may aid in their own grieving process⁶.*
- 2.5.3.6 *Potential donors can be reached through various channels. These can include:*
- *by providing written information to be left in*
 - *GP surgeries*
 - *hospitals (sometimes provided to mothers in the perinatal period)*
 - *volunteer and other organisations working in public health*

² Based on 1 position statement (Anon 1980) and 1 service description (Kimball et al. 1955).

³ Based on 1 position statement (Anon 1985) and 1 service description (Baum 1982).

⁴ Based on 1 position statement (Anon 1985).

⁵ Based on 1 service description (Arnold 1996).

⁶ Based on 2 narrative reviews (Bar-Yam 2003; Bar-Yam 2005).

- *shops for new mothers, babies and children*
- *through direct referrals or recommendation by*
 - *donor women*
 - *staff at the neonatal intensive care units*
 - *paediatricians assessing the progress of the baby*
 - *health visitors (or other healthcare professionals providing postpartum care)*
 - *childbirth educators*
 - *organisers and attendees of pre- or postnatal classes*
 - *breastfeeding mothers' support groups*
 - *organisations such as the La Leche League or the National Childbirth Trust*
- *through mass media contact such as*
 - *newspapers*
 - *newsletters*
 - *magazine articles*
 - *TV*
 - *radio*⁷.

2.5.3.7 *An active recruitment programme is needed because a continuous supply of new donors is required to maintain supplies*⁸.

2.5.3.8 *Recruitment of donors may be increased if the milk bank offers breastfeeding support and services to the donors*⁹.

2.5.3.9 *Many women who donate milk work in health or social services. It might therefore be appropriate for recruitment to target women working in other sectors*¹⁰.

2.5.3.10 *The need for donor milk should be explained in non-technical language*¹¹.

⁷ Based on 1 narrative review (Bar-Yam 2003), 1 position statement (Anon 1985), and 8 service descriptions (Arnold 1999; Beal et al. 1978; Cash and Giacoia 1981; Connor 1982; Kimball et al. 1955; Langerak and Arnold 1991; McEnery and Chattopadhyay 1978; Murray 1953)

⁸ Based on 1 narrative review (Holland 2006).

⁹ Based on 1 primary study (Azema and Callahan 2003).

¹⁰ Based on 1 primary study (Azema and Callahan 2003).

2.5.3.11 *Women may be willing to donate milk for many reasons. These include:*

- *to receive peer support while breastfeeding*
- *to provide milk for babies of family members¹².*

2.5.3.12 *Women are more likely to donate milk when they have:*

- *the presence of a 'significant other'*
- *no work outside the home*
- *less than three children*
- *a positive attitude towards breastfeeding even though they have experienced problems*
- *a desire to help others¹³.*

2.5.3.13 *Women may be unwilling to donate milk for many reasons. These may include:*

- *associating breast milk with female sexuality and body fluids*
- *fear of having an insufficient milk supply*
- *worry over the compatibility of their blood with that of the recipient of the milk*
- *a dislike of the idea¹⁴.*

2.5.3.14 *Ongoing education and motivation of women on postnatal wards may reduce concerns about donating milk and thus increase recruitment¹⁵.*

2.5.3.15 *The cultural beliefs and attitude of the healthcare professional discussing milk donation may influence the decision of the woman to donate¹⁶.*

¹¹ Based on 1 primary study (Azema and Callahan 2003).

¹² Based on 1 narrative review (Holland 2006) and 1 primary study (Ighogboja et al. 1995).

¹³ Based on 1 primary study (Azema and Callahan 2003) and 1 service description (Baum 1982).

¹⁴ Based on 1 narrative review (Holland 2006) and 2 primary studies (Egri-Okwaji et al. 1984; Ighogboja et al. 1995).

¹⁵ Based on 1 service description (Fernandez et al. 1993).

2.5.3.16 *The cultural beliefs and attitude of the woman may influence her decision whether to donate milk. For example, belief in milk kinship restricts the use of donor milk banks under strict Islamic law¹⁷.*

2.5.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

The GDG considered that any recruitment strategy should be broad, and not targeted at any specific group of potential donors. In addition, the milk bank should be able to recruit using a flexible approach that balances their workload and costs of recruiting with successful recruitment. Existing milk banks will have their own preferred strategies, but for any newly created milk banks or existing milk banks needing to increase their levels of recruitment, the suggested options will be a useful resource.

2.5.5 Recommendations

Recommendation 1.2.9

When promoting the donation of breast milk, aim to reach as many potential donors as possible through a variety of channels, including:

- providing written information to be left in:
 - GP surgeries
 - antenatal clinics and postnatal wards
 - volunteer and other organisations working in maternity and childbirth
 - children's or Sure Start centres
 - maternity shops
- direct referrals or recommendations by:
 - current and previous donors
 - staff at neonatal intensive care units
 - paediatricians assessing babies' progress
 - health visitors (or other healthcare professionals providing postpartum care)

¹⁶ Based on 1 narrative review (Holland 2006) and 1 opinion piece (Modi 2006).

¹⁷ Based on 1 narrative review (Holland 2006) and 1 opinion piece (Modi 2006).

- childbirth educators
- organisers and attendees of prenatal and postnatal classes
- breastfeeding mothers' support groups and related organisations
- features in the media.

Recommendation 1.2.10

Use clear, non-technical language when communicating the use of donor milk and the process of donor milk banking in any written information and activities.

2.6 *Screening and selecting donors*

2.6.1 Review question

What factors should be assessed to determine the suitability of potential donors?

What initial and repeat serological testing should be undertaken:

- when screening potential donors?
- in donor women while continuing to donate?

2.6.2 Evidence review

Forty-seven of the 202 studies included in the review provided 108 evidence records. The studies contained:

- 24 service descriptions
- 10 narrative reviews
- 5 position statements
- 4 opinion pieces
- 2 primary studies
- 1 case report and 1 meeting report.

Their publication dates ranged from 1951 to 2008.

The service descriptions reported practice in the UK, the USA, Canada, Australia, Sweden, South Africa, China, India, Poland, Germany and Denmark.

There was general agreement that screening and selection of donors was needed, but there was less agreement on the exact nature of these. As with recruitment strategies, there was considerable variation in the delivery, content and timing of screening and selection. There was no direct reference to costs.

There was little evidence on whether adequate screening and selection strategies resulted in less bacterial contamination of donor milk. One primary study (Almeida and Dórea 2006) evaluated all of its quality assurance measures, but did not use a control group for comparison and therefore could not determine that screening and selection alone were effective in reducing bacterial contamination of donor milk.

2.6.3 Evidence statements

- 2.6.3.1 *There is general agreement that any donor milk programme should have an agreed screening and selection process for potential donors. Screening and selection should be based on a balanced consideration of relative risk for the baby and aim to minimise bacterial contamination. However, there is a lack of evidence on what should be screened for based on good studies showing evidence of transmission of infection via donor milk¹⁸.*
- 2.6.3.2 *In the past, not all milk banks have screened potential donors, either by taking a history of past or current infection or by laboratory tests¹⁹.*
- 2.6.3.3 *One milk bank accepts donations of previously expressed breast milk. Although all potential donors are screened in the same way, questions relating to the use of prescription and recreational drugs, smoking, and alcohol must be answered retrospectively when donations have been expressed before the screening²⁰.*

¹⁸ Based on many reports and studies (Anon 1980; Anon 1995; Asquith et al. 1987; Hartmann et al. 2007; Kinsey 1984; Mortimer et al. 1988).

¹⁹ Based on 1 position statement (Anon 1985) and 1 service description (McEnery and Chattopadhyay 1978).

²⁰ Based on 1 service description (Hartmann et al. 2007).

- 2.6.3.4 *Women who are HIV positive or who are at high risk of HIV infection should not donate breast milk²¹.*
- 2.6.3.5 *Women who have received live rubella vaccination postpartum should not donate breast milk soon after vaccination because studies have shown rubella virus in milk 12 days after postpartum vaccination²².*
- 2.6.3.6 *Not all milk banks screen all potential donors for infections such as tuberculosis, syphilis, HIV, hepatitis B or cytomegalovirus (CMV). The decision to screen for an infectious agent may be based on some or all of the following.*
- *The availability of effective treatment processes that eliminate the specific contamination.*
 - *Local testing or screening programmes for pregnant women during the antenatal period.*
 - *Low regional or local prevalence, which means that screening is undertaken only in potential donors from high-risk groups.*
 - *National screening recommendations²³.*
- 2.6.3.7 *Potential donors are asked about:*
- *their general health and medical history (including acute or chronic infections, recent vaccinations, or past blood transfusions)*
 - *the health and nutritional status of their baby*
 - *their diet history and nutritional intake*
 - *any exposure to HIV, toxoplasmosis, tuberculosis, syphilis, hepatitis, rubella, herpes and CMV*

²¹ Based on 1 narrative review (Boyes 1987) and 1 position statement (Anon 1995).

²² Based on 1 position statement (Anon 1985).

²³ Based on 1 narrative review (Bromberger 1982), 2 opinion pieces (Braune 1982; Lucas 1987), 2 position statements (Anon 1985; Gutierrez and de Almeida 1998) and 7 service descriptions (Arnold 1999; Balmer and Wharton 1992; Baum 1982; Bjorksten et al. 1980; Connor 1982; Fernandez et al. 1993; McEnery and Chattopadhyay 1978).

- any exposure to CJD (for example, in the USA, milk donations are not accepted from women who were in the UK for more than 3 months, or in Europe for more than 5 years, between 1980 and 1996)
- use of any drugs and any other medical treatments
- any exposure to pollutants
- any occupational exposure to chemicals
- the presence of diarrhoea
- symptoms of other recurrent infections
- the use of recreational drugs, alcohol and smoking²⁴.

2.6.3.8 *Milk banks use the following tests or investigations when screening or selecting prospective milk donors.*

- General physical examination.
- Chest radiograph, purified protein derivative (PPD) or tine test (for tuberculosis).
- HIV antibody blood test (recommended by the Centers for Disease Control).
- Blood tests for HBsAg and anti-HBc (for hepatitis).
- Venereal disease research laboratory (VDRL) test (for syphilis).

2.6.3.9 *The tests may vary in different milk banks depending on tests routinely undertaken during antenatal and perinatal assessment in local hospitals²⁵.*

2.6.3.10 *The reasons for testing are explained to each woman when she first contacts the milk bank about donating milk. Consent for testing is sought from each woman²⁶.*

²⁴ Based on 1 narrative review (Bromberger 1982), 9 service descriptions (Asquith et al. 1987; Balmer and Wharton 1992; Bjorksten et al. 1980; Cash and Giacoia 1981; Davidson et al. 1979; Fernandez et al. 1993; Kimball et al. 1955; Langerak and Arnold 1991; McEnery and Chattopadhyay 1978), and 3 position statements (Anon 1985; Fernandez et al. 1990; Gutierrez and de Almeida 1998).

²⁵ Based on 8 service descriptions (Asquith et al. 1987; Balmer and Wharton 1992; Baum 1982; Bjorksten et al. 1980; Cash and Giacoia 1981; Connor 1982; Fernandez et al. 1993; Hartmann et al. 2007) and 2 position statements (Anon 1985; Fernandez et al. 1990).

- 2.6.3.11 *One milk bank asked potential donors to attend a follow-up appointment to receive the results of the blood test(s) in person²⁷.*
- 2.6.3.12 *In one milk bank, the potential donor is given a form by the milk bank nurse at her first visit (similar to that given to blood donors) that lists the high-risk groups for HIV infection. The nurse asks the woman not to offer her milk if she falls into a high-risk group. Each woman gives written consent to be tested for HIV antibodies. If a potential donor is HIV positive, arrangements for counselling are made²⁸.*
- 2.6.3.13 *In one milk bank, blood is tested at the potential donor's home to minimise any inconvenience to the woman²⁹.*
- 2.6.3.14 *Tests are repeated if a woman continues to donate 3 months after the date of the initial blood test³⁰.*
- 2.6.3.15 *Various methods are used to collect information for screening potential donors. Examples from different milk banks include information collected from:*
- *scheduled visits to healthcare professionals, such as gynaecologists and paediatricians*
 - *medical records from different healthcare professionals, such as primary care providers and paediatricians*
 - *a simple questionnaire*
 - *an interview at the milk bank*
 - *a visit to the potential donor's home (which may provide information on standards of hygiene).*
- 2.6.3.16 *Information is also collected by different members of staff, including the milk bank coordinator or the milk bank nurse³¹.*

²⁶ Based on 2 service descriptions (Balmer and Wharton 1992; Hartmann et al. 2007).

²⁷ Based on 1 service description (Hartmann et al. 2007).

²⁸ Based on 1 service description (Balmer and Wharton 1992).

²⁹ Based on 1 service description (Balmer and Wharton 1992).

³⁰ Based on 1 service description (Hartmann et al. 2007).

2.6.3.17 *Some studies suggest that because the composition of milk changes over time, any screening and selection of potential donors and/or samples should take this into account when matching adequate nutrition and immunological status for recipient babies³².*

2.6.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

The GDG considered the screening and selection of potential donors to be vital to ensure the safety of donated milk; screening and selection also links very closely to the evidence reviews and considerations on testing and treating donor milk.

It was clear that there was no consensus in the evidence on how potential donors should be screened, but there was agreement that it should be done; however, screening tests differed according to the local prevalences of infectious diseases. In the UK, potential donors should be screened for HIV 1 and 2, hepatitis B and C, HTLV I and II, and syphilis; these are all present to some degree in the UK population with local variation (see www.hpa.org.uk for information on the prevalence and incidence). These diseases are known to be transmitted via breast milk or breastfeeding (see www.hpa.org.uk for information on transmission via breastfeeding) or contained in the breast milk of infected mothers (Pronczuk et al. 2002), and have significant consequences if contracted. For other viral contaminants, such as CMV, although there is documented evidence on the risk of transmission, there is also evidence that pasteurisation and other processing techniques, including freezing, destroys the contamination (see section 2.16.4). The point therefore at which the risk is controlled is through adequate pasteurisation and storage, not through screening potential donors for CMV. This risk of transmission for other contaminants needs to be balanced against the effects of pasteurisation

³¹ Based on 1 primary study (Almeida and Dórea 2006), and 9 service descriptions (Arnold 1999; Asquith et al. 1987; Balmer and Wharton 1992; Beal et al. 1978; Connor 1982; Dempster 1982; Langerak and Arnold 1991; McEnery and Chattopadhyay 1978; Murray 1953).

³² Based on 2 narrative reviews (Anon 1987; Bromberger 1982).

and handling of milk (pasteurisation reduces viral and bacterial contamination, but, depending on the levels, may not eliminate all contamination).

The GDG considered that the risk of a recipient of donor milk contracting any of the screened diseases was so serious that any risk of transmission should be minimised through effective screening and pasteurisation of donated milk. Screening incurs an extra cost, but in this context this was considered necessary; the screening is also in line with that recommended for blood and tissue donor programmes in the UK (see www.transfusionguidelines.org.uk/index.aspx).

Screening should be a staged process with women being allowed to self-screen initially. This is followed by a formal testing stage, with a more detailed discussion of screening with potential donors before their acceptance by the milk bank. This is then followed up throughout the donation process, with donors informing the milk bank if their circumstances or situation has changed.

For the draft version of guidance, the GDG recommended a different strategy for ongoing donation compared with a one-off donation. Several concerns were raised about this at consultation, and the GDG discussed the rationale for this. After this discussion, the GDG agreed that there was no evidence on which to base this recommendation, and no rationale to support the recommended difference. One option could be to quarantine all milk until serological test results are available. However, the practicalities and costs of this make it unviable. The risk of both acquiring infection and transmitting it via donor breast milk was considered to be immeasurably small (a minimum estimate of seroconversion in pregnancy is 15%, with an overall prevalence rate in pregnant women of approximately 0.14% in the UK [see the Health Protection Agency website www.hpa.org.uk and the National Study of HIV in Pregnancy and Childhood website www.nshpc.ucl.ac.uk for latest figures from the National Audit on Perinatal Transmission]); particularly when donated milk is then pasteurised. The GDG considered that if the recommended processes are deemed safe for ongoing donation, then in the absence of evidence to the contrary, the same process should be recommended for a one-off donation.

There was no conclusive evidence identified on test accuracies to quantitatively evaluate optimal testing strategies, as well as cost effectiveness of donor screening. However, after the milk has been pasteurised the risk of a baby contracting the diseases screened for above is very low (no cases of transmission of any of the screened conditions via pasteurised donor milk were identified). Therefore, the quality-adjusted life year (QALY) loss associated with every extra avoidable case through relatively economical blood testing is likely to outweigh extra costs. The fact that a ‘stepped’ screening algorithm is proposed, where self-assessment is recommended before the formal testing stage, ensures that a proportion of donors who would not be eligible for donating breast milk will not have to undergo further, more resource-intensive testing.

As part of the requirements for tracking and tracing, laboratories should archive donor blood samples as recommended in current guidelines from the Royal College of Pathologists (available from www.rcpath.org).

2.6.5 Recommendations

Recommendation 1.2.11

Follow the stepped screening process detailed in recommendations 1.2.12 to 1.2.21 when recruiting donors.

Recommendation 1.2.12

Advise a potential donor that she is not eligible to donate milk if she:

- currently smokes or uses nicotine replacement therapy (NRT)
- regularly exceeds recommended alcohol levels for breastfeeding mothers (1 to 2 units, once or twice a week) (see www.dh.gov.uk for information on alcohol and breastfeeding)
- is using, or has recently used, recreational drugs
- has previously tested positive for HIV 1 or 2, hepatitis B or C, human T-lymphotropic virus (HTLV) type I or II, or syphilis
- is at an increased risk of Creutzfeldt–Jakob disease (CJD) (see www.hpa.org.uk for information on the risk of CJD).

Include this information in recruitment material so that potential donors can self-screen for these criteria.

Recommendation 1.2.13

Using a process of informal interview, referring to medical sources (with consent) if necessary, ask the potential donor questions on the topics that follow. Use the information she gives to make a balanced decision about her eligibility to donate based on possible risks to recipients and/or the results of subsequent serological tests (see recommendations 1.2.16 and 1.2.17). Ask questions about:

- her health: to confirm that she is in good general health
- her baby: document the age and health of the baby
- any exposure to passive smoke: is she exposed to high or sustained levels of passive smoke (for example, do other members of her household smoke heavily)?
- any medication that she is taking: is she currently taking any medication or undergoing any other medical therapy?
- any significant environmental or chemical exposure (such as contamination of the local water supply): is she exposed to high or sustained levels of environmental or chemical contaminants that can be expressed in breast milk?
- any recent exposure to infection (including HIV 1 or 2, hepatitis B or C, HTLV I or II, syphilis, herpes, or acute or chronic infections). Depending on the assessment of level of risk, further testing may be needed.
- any recent medical intervention (for example, exposure to diagnostic radioactive isotopes)
 - refer to guidance from the Department of Health on the safety of recent vaccination when breastfeeding (available from www.dh.gov.uk).

Advise the potential donor that depending on her answer to any of these questions she may not be eligible to donate milk.

Recommendation 1.2.14

If a potential donor is donating previously expressed breast milk, ask her to

answer the screening questions (recommendations 1.2.12 to 1.2.13) for the period when the milk was expressed.

Recommendation 1.2.15

Conduct the screening interview, detailed in recommendations 1.2.12 and 1.2.13, with potential donors at a mutually acceptable time and place, either face-to-face or by telephone.

Recommendation 1.2.16

When donors first contact the milk bank about donating milk, explain that serological testing is mandatory to reduce the risk of passing on infections. Obtain informed consent before testing.

Recommendation 1.2.17

Undertake serological testing of all potential donors for the following and exclude women from donating who test positive for:

- HIV 1 or 2
- hepatitis B or C
- HTLV I or II
- syphilis.

Recommendation 1.2.18

Perform all serological screening tests at the time of enrolling for donor milk banking; do not rely on antenatal test results.

Recommendation 1.2.19

All tests should be undertaken in laboratories with clinical pathology accreditation (CPA).

Recommendation 1.2.20

Ensure that laboratories communicate the results of serological testing clearly and that they provide appropriate interpretive comments.

Recommendation 1.2.21

Give serological test results to potential donors either in person or by telephone (unless they prefer to receive them in writing). If needed, offer

further help and support based on local protocols, including information about counselling and local support groups.

Recommendation 1.2.22

Laboratories should archive samples of blood received from donors.

2.7 Donor consent

2.7.1 Review question

What information should donors and parents or carers of infants using donor breast milk be given to ensure full informed consent, and how should this be recorded?

In discussion with the GDG, it was agreed that consent for use of donated breast milk was not relevant to this guideline; but parents or carers of recipients of donor milk should understand the process of donor milk banking and the 'Understanding NICE guidance' (a summary for patients and carers, available from www.nice.org.uk/guidance/CG93/PublicInfo) explains this.

2.7.2 Evidence review

Only 1 of the 202 studies included in the review contained a service description from a milk bank in Australia (Hartmann et al. 2007) that made reference to the process of recording donor consent; however, no details of the process of obtaining informed consent or the importance of this were reported.

2.7.3 Evidence statements

2.7.3.1 No included study made detailed reference to the process of obtaining consent from donors, although two milk banks did report documenting consent.

2.7.3.2 One milk bank recorded donor consent as part of the donor's medical record (Hartmann et al. 2007)³³.

³³ Based on 2 service descriptions (Hartmann et al. 2007; Penc 1996).

2.7.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

As with all donor programmes, donors need to give informed consent for both serological testing and the process of handling their donated milk.

2.7.5 Recommendations

Recommendation 1.2.23

Before accepting a donor's milk, obtain her consent for the processing and intended use of the donated milk. Advise her that once donated, milk will not be returned to her.

2.8 *Training and supporting donors*

2.8.1 Review question

This was extracted from the evidence review on recruitment – see section 2.5.

2.8.2 Evidence review

Twenty-five of the 202 studies included in the review provided 33 evidence records. The studies contained:

- 16 service descriptions
- 3 narrative reviews
- 4 position statements
- 1 case report
- 1 primary study.

The publication dates ranged from 1951 to 2007.

The service descriptions reported practice in the UK, the USA, Australia, Germany, South Africa, Sweden, Denmark, Canada and Brazil.

There was general agreement that training and support for donors was needed, but there was less agreement on the exact content of the training and

the level of support needed. When reported, support and training differed in delivery, content and timing. There was no direct reference to costs.

There was little evidence on whether adequate donor support and training strategies result in less bacterial contamination of donor milk. One primary study (Almeida and Dórea 2006) evaluated all of its quality assurance measures, but did not use a control group for comparison and therefore could not determine that support and training alone were effective in reducing bacterial contamination of donor milk.

2.8.3 Evidence statements

- 2.8.3.1 *Some studies found that donors need constant support, including psychological support, throughout the process of milk donation, because collecting milk is time consuming and the techniques of milk expression are key to successful lactation and its maintenance³⁴.*
- 2.8.3.2 *Frequent contact with, and feedback from, milk bank staff may help to maintain the commitment of donors to collect as much high-quality milk as possible³⁵.*
- 2.8.3.3 *Staff who collect donated milk from the donor's home can inform the milk bank staff about anything new in the donor's home environment that might compromise the quality of the milk. This gives the milk bank the opportunity to intervene as appropriate³⁶.*
- 2.8.3.4 *Donors can be supervised at home (for example, by health visitors) while collecting and storing donations. Such supervision may result in a lower level of contamination of milk, and thus fewer discarded donations³⁷.*

³⁴ Based on 1 narrative review (Bromberger 1982) and 1 position statement (Fernandez et al. 1990).

³⁵ Based on 1 service description (Asquith et al. 1987).

³⁶ Based on 1 service description (Asquith et al. 1987).

³⁷ Based on 2 service descriptions (Connor 1982; Davidson et al. 1979) and 1 position statement (Fernandez et al. 1990).

2.8.3.5 *There was general agreement that donors should be trained in the proper techniques for:*

- *milk expression and collection, including the use of pumps and containers, and their cleaning*
- *milk storage, including the cooling and freezing of milk*
- *personal hygiene, including hand washing and cleaning the breasts.*

Such training can help to minimise bacterial contamination³⁸.

2.8.3.6 *One milk bank trained donors in the proper processes for administration of milk samples, including instructions on the appropriate labelling of milk³⁹.*

2.8.3.7 *Two milk banks gave donors information on diet, and alcohol and caffeine consumption⁴⁰.*

2.8.3.8 *Training provided by the milk banks varied. Some provided written material, others provided face-to-face training by milk bank staff, and some provided both. Training was delivered at different times (for example, on discharge from hospital, at interview for donor selection, or at the donor's home when delivering the equipment provided)⁴¹.*

2.8.3.9 *Two milk banks considered that donors should be provided with the equipment needed for collection and storage of milk. This may include:*

- *a breast pump*

³⁸ Based on 3 narrative reviews (Bjorksten et al. 1980; Bromberger 1982; Kinsey 1984), 4 position statements (Anon 1980; Anon 1985; Fernandez et al. 1990; Gutierrez and de Almeida 1998), 1 primary study (Almeida and Dórea 2006), and 9 service descriptions (Asquith et al. 1987; Cash and Giacoia 1981; Connor 1982; Davidson et al. 1979; Dempster 1982; Hartmann et al. 2007; Kimball et al. 1955; Langerak and Arnold 1991; Morley-Peet 1983).

³⁹ Based on 1 service description (Asquith et al. 1987).

⁴⁰ Based on 2 service descriptions (Asquith et al. 1987; Cash and Giacoia 1981).

⁴¹ Based on 8 service descriptions (Asquith et al. 1987; Beal et al. 1978; Cash and Giacoia 1981; Connor 1982; Dempster 1982; Hartmann et al. 2007; Kimball et al. 1955; Langerak and Arnold 1991).

- *sterile bottles*
- *labels for donations*⁴².

2.8.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

It is important to provide donors with initial and ongoing training. The provision of training may be associated with lower levels of contamination in donor milk. The GDG has made recommendations for some important components of training, but any additional training and ongoing support should be individualised and based on the donor's needs.

There was no conclusive evidence linking training interventions, particularly ongoing training programmes, to surrogate outcomes (including levels of contamination in donor milk) or primary outcomes (such as recipient morbidity and mortality). However, the importance of adequate training has been stressed and should meet the donor's needs while ensuring that staff time is used efficiently (for example, arrange a telephone meeting when receiving samples and, instead of face-to-face meetings, when appropriate plan training after routine milk collection or delivery to reduce travel and time requirements for staff).

⁴² Based on 2 service descriptions (Asquith et al. 1987; Hartmann et al. 2007).

2.8.5 Recommendations

Recommendation 1.2.26

Provide all new donors with training, preferably face-to-face with additional information by telephone and in writing. Arrange training at a time and place suitable for both donor and trainer.

Recommendation 1.2.27

Training for new donors should cover:

- hand washing and the importance of this
- good personal hygiene
- collecting and expressing milk, including cleaning and using breast pumps and containers
- storing donated milk (including cooling and freezing)
- labelling donated milk, and documenting storage conditions
- transportation of donated milk (if needed).

Recommendation 1.2.28

Provide ongoing support to all donors according to their individual needs until no longer required. This may include:

- information and ongoing support on milk bank requirements for their diet and alcohol consumption
- continued support for collecting expressed milk and maintaining lactation
- emotional support.

Recommendation 1.2.29

Offer additional support and information on milk collection to donors whose milk has significant or repeated microbial contamination.

2.9 *Stopping or suspending milk donations*

2.9.1 Review question

When should donor women be advised to stop donating milk, either temporarily or permanently?

2.9.2 Evidence review

Twelve of the 202 studies included in the review provided 14 evidence records. The studies contained:

- 9 service descriptions
- 2 narrative reviews
- 1 primary study.

The publication dates ranged from 1951 to 2007.

The service descriptions reported practice in the USA, the UK and Denmark.

There was general agreement that donors should be advised to stop donating in certain circumstances, but there was less agreement on the exact detail of when donors should be advised to stop, either temporarily (for example, if a donor has a raised temperature) or permanently (for example, if a donor stops breastfeeding her own baby).

2.9.3 Evidence statements

2.9.3.1 *One milk bank advised donors who supplied contaminated milk to stop donating milk⁴³.*

2.9.3.2 *One milk bank advised donors who supplied milk with a low protein content to stop donating milk⁴⁴.*

2.9.3.3 *One milk bank advised donors who supplied small amounts of milk (less than 2 ounces daily after a week's trial) to stop donating milk⁴⁵.*

2.9.3.4 *In one study, donors abstaining from donating milk because they were taking medication (50/56 [89.3%] treatments were for infections) were advised to wait for five half-lives of the drug after*

⁴³ Based on 1 service description (Arnold 1999).

⁴⁴ Based on 1 service description (Arnold 1999).

⁴⁵ Based on 1 service description (Kimball et al. 1955).

the last ingested dose before they resumed collecting milk; in most cases, a washout period of 1 day was sufficient⁴⁶.

- 2.9.3.5 *One milk bank advised donors who had herpetic lesions to stop collecting milk while the lesions were present⁴⁷.*
- 2.9.3.6 *One milk bank advised donors to stop collecting milk for 3 weeks after rubella vaccination⁴⁸.*
- 2.9.3.7 *Two milk banks advised donors whose babies became ill to stop donating milk⁴⁹.*
- 2.9.3.8 *Two milk banks advised donors who became ill to stop donating milk⁵⁰.*
- 2.9.3.9 *One milk bank advised donors who were taking prescription drugs that they could continue to express and any milk that contained contraindicated drugs should be labelled and would be saved for research projects⁵¹.*

2.9.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Advice to donors about stopping donation relates closely to the staged screening process described above. Donors are required to inform the milk bank of any changes to their situation; this includes any medical treatment, or any prescribed or over-the-counter drugs, or any herbal supplements. The decision to advise donors to suspend or stop donating milk should then be taken by the milk bank.

⁴⁶ Based on 1 primary study (Hoppu et al. 1994).

⁴⁷ Based on 1 service description (Asquith et al. 1987).

⁴⁸ Based on 1 service description (Asquith et al. 1987).

⁴⁹ Based on 2 service descriptions (Balmer and Wharton 1992; Cash and Giacoia 1981).

⁵⁰ Based on 2 service descriptions (Cash and Giacoia 1981; McEnery and Chattopadhyay 1978).

⁵¹ Based on 1 service description (Langerak and Arnold 1991).

There are many reference sources on drugs and breastfeeding; for example, the 'British national formulary for children' (BNF-C). However, any decision on whether a donor should suspend donation needs to be taken based on the anticipated recipient; for example, although one drug may be safe for a full-term healthy baby, a milk bank may decide not to accept milk from a donor taking the same drug if the milk will be used for a pre-term baby with significant health problems. Because of this, the GDG decided that it was not possible to make detailed recommendations on advising donors to suspend or stop donation when they start taking drugs or herbal supplements; the donor informing the milk bank of any new drug or supplement they are taking is therefore paramount.

The same issues apply for any other changes in the donor's circumstances (for example, a significant change in diet), and it is imperative that she contacts the milk bank for a full discussion.

Milk banks sometimes advise donors to stop donating when their own baby reaches a certain age, such as 12 months. This is because changes in the composition of breast milk are known to occur with time from birth. However, it is not possible to know either the recipient of the donor milk or the effect of receiving 'age-inappropriate' milk. The GDG therefore recommended that each milk bank should advise donors when to stop donating based on their local requirements; this could include, for example, the milk banks' anticipated recipient population or the current stock levels.

2.9.5 Recommendations

Recommendation 1.2.24

While a donor continues to donate, ask regularly about her general health and the exclusion criteria detailed in recommendations 1.2.12 to 1.2.13. Advise her that if her status or circumstances change in relation to these, she should contact the milk bank immediately.

Recommendation 1.2.25

Do not routinely repeat serological tests while the donor is donating milk.

Recommendation 1.2.30

Consider no longer accepting breast milk from donors who, despite support, consistently supply:

- breast milk that does not meet the microbiological criteria (see recommendation 1.2.58)
- small amounts of breast milk.

Recommendation 1.2.31

Advise donors to contact the milk bank to discuss suspending or stopping their breast milk donation if they develop a fever or have contact with a viral exanthematous disease.

Recommendation 1.2.32

Advise donors who begin taking any medication that they should contact the milk bank to discuss suspending or stopping their breast milk donation. Use appropriate reference sources⁵².

Recommendation 1.2.33

Advise donors to contact the milk bank to discuss suspending or stopping their breast milk donation if they develop lesions or infections of the breast (including mastitis or herpes).

Recommendation 1.2.34

Provide donors who are stopping their breast milk donations with as much advice and support as needed.

Recommendation 1.2.35

Take into account the size of the recipient population and the milk bank's stock levels when discussing how long a woman can donate milk.

⁵² See the British national formulary for children, the Drugs and Lactation Database LactMed (www.toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?LACT) or the UK Drugs in Lactation Advisory Service (see www.ukmicentral.nhs.uk/drugpreg/guide.htm).

2.10 *Expressing milk at home for donation*

2.10.1 Review question

What are the best (safest) methods for collecting, storing and handling donor breast milk?

- How should donor milk be expressed?

2.10.2 Evidence review

Thirty-nine of the 202 studies included in the review provided 65 evidence records. The studies contained:

- 20 service descriptions
- 8 narrative reviews
- 8 primary studies
- 3 position statements.

The publication dates ranged from 1951 to 2007.

The service descriptions reported practice in the UK, the USA, Denmark, China, Australia, Sweden, South Africa, India, Canada and Venezuela.

Practice differed between milk banks, and there was some limited evidence comparing expression techniques or process with the level of bacterial contamination in donor milk. No direct reference to costs was made.

2.10.3 Evidence statements

2.10.3.1 There is no consensus on whether drip milk should be accepted for use. However, there is general agreement that drip milk is lower in fat (and therefore energy) than expressed milk⁵³.

⁵³ Based on 3 narrative reviews (Arnold 1997; Davies 1982; Williams and Pittard, III 1981), 3 primary studies (Almeida and Dórea 2006; Gibbs et al. 1977; Lucas and Roberts 1978) and 5 service descriptions (Balmer and Wharton 1992; Baum 1982; McEnery and Chattopadhyay 1978; Morley-Peet 1983; Tomalin 1983).

- 2.10.3.2 *When drip milk is collected and combined with expressed milk, a considerable increase in energy and fat content is seen compared with drip milk alone⁵⁴.*
- 2.10.3.3 *Many milk banks recommend that donors discard the first 10 ml of expressed milk because this is likely to have a higher level of bacterial contamination. However, one primary study concluded that donors should not discard the first few millilitres of milk because this would result in smaller quantities of milk and would offer no advantage in terms of bacterial contamination (Carroll et al. 1980)⁵⁵.*
- 2.10.3.4 *Higher rates of bacterial contamination and lower energy and total fat content have been seen in milk expressed using pumps compared with milk expressed manually. Many milk banks therefore recommend that donors express milk manually⁵⁶.*
- 2.10.3.5 *However, some milk banks make no specific recommendation on how donor milk should be expressed. It is therefore assumed that the preference of the donor is taken into account. For example, one milk bank provides donors with a hand breast pump because although they note that manual expression is the 'cleanest method' of expression, most women prefer to use a hand breast pump (Balmer and Wharton 1992)⁵⁷.*
- 2.10.3.6 *One study noted a specific need to support donors when they stop expressing milk if their own baby has died⁵⁸.*

2.10.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using

⁵⁴ Based on 1 narrative review (Davies 1982) and 1 primary study (Stocks et al. 1983).

⁵⁵ Based on 3 narrative reviews (Kinsey 1984; Roy and Lescop 1979; Williams and Pittard, III 1981), 1 position statement (Anon 1980), 3 primary studies (Asquith and Harrod 1979; Carroll et al. 1980; West et al. 1979) and 5 service descriptions (Asquith et al. 1987; Beal et al. 1978; Dempster 1982; Greenwood Wilson 1951; Pedersen 1982).

⁵⁶ Based on 2 narrative reviews (Kinsey 1984; Williams and Pittard, III 1981), 1 position statement (Anon 1980), 4 primary studies (Almeida and Dórea 2006; Boutte et al. 1985; Liebhaber et al. 1978; Tyson et al. 1982) and 4 service descriptions (Asquith et al. 1987; Beal et al. 1978; Cash and Giacoia 1981; Langerak and Arnold 1991).

formal consensus techniques.

All breastfeeding mothers should be given clear information on how to express milk for their own babies. The GDG therefore made recommendations about expressing milk only where techniques or practice are different for donated milk.

It is accepted that different expression techniques (for example, the use of pumps) affect the composition of the milk. The aim of recommending hand expression, and not 'drip milk', was to ensure the optimal levels of nutritional components, such as fat, with minimal bacterial contamination. However, the GDG recognised that manual expression may not be preferred by all donors.

2.10.5 Recommendations

Recommendation 1.2.36

Advise donors to collect expressed milk rather than 'drip' milk (milk that is passively collected from one breast while the baby feeds at the other) for donation.

Recommendation 1.2.37

Actively encourage donors to hand express milk; however, accept pump-expressed milk if donors prefer this method.

2.11 Handling milk at home

2.11.1 Review question

What are the best (safest) methods for collecting, storing and handling donor breast milk?

- How, and for how long, should donor milk be stored at home, including refrigeration and freezing?

⁵⁷ Based on 8 service descriptions (Arnold 1996; Arnold 1999; Asquith et al. 1987; Balmer and Wharton 1992; Bjorksten et al. 1980; Hoey et al. 1980; Kimball et al. 1955; Sauve et al. 1984).

⁵⁸ Based on 1 narrative review (Woo and Spatz 2007).

2.11.2 Evidence review

Twenty-six of the 202 studies included in the review provided 43 evidence records. The studies contained:

- 19 service descriptions
- 3 position statements
- 2 narrative reviews
- 1 case report
- 1 primary study.

The publication dates ranged from 1951 to 2007.

The service descriptions reported practice in the UK, the USA, Denmark, Australia, Brazil, Sweden, South Africa, Canada and Germany.

The milk banks differed in their instructions to donors on how milk should be handled in the home. However, there was general agreement that milk banks should give guidance on the handling of milk in a donor's home. No direct reference to costs was made.

See also the evidence review on milk handling in general below.

2.11.3 Evidence statements

2.11.3.1 Milk banks differ in their instructions to donors on how milk should be handled in the home. However, there is general agreement that milk banks should give guidance on the handling of milk in a donor's home⁵⁹.

2.11.3.2 Good hygiene is important for all aspects of milk handling in a donor's home⁶⁰.

2.11.3.3 Most milk banks provide donors with instructions on how milk should be stored before collection, and most recommend that milk

⁵⁹ Based on many references; a specific example is from 1 service description (Pedersen 1982).

⁶⁰ Based on 1 narrative review (Davies 1982), 1 primary study (Minder et al. 1982) and 1 service description (Cash and Giacoia 1981).

should be stored in a freezer. Some milk banks allow storage in a refrigerator if milk is being collected on a daily basis (or as soon as possible)⁶¹.

2.11.3.4 One milk bank reported a marked reduction in bacterial contamination before pasteurisation when donors were advised to store milk in home freezers rather than in the refrigerator⁶².

2.11.3.5 One milk bank instructed donors that any expressed milk should not be left uncovered or allowed to reach room temperature after collection had been completed. After an outbreak of infection caused by contaminated milk, the milk bank also recommended that milk should be refrigerated immediately after collection had been completed⁶³.

2.11.3.6 Brazilian milk banks advised donors that milk should be stored in the freezer for no longer than 5 days or in the refrigerator (at 5°C) for no longer than 24 hours before being transported to the milk bank⁶⁴.

2.11.3.7 One milk bank advised donors that milk should be stored in the freezer for no longer than 7 days before being transported to the milk bank⁶⁵.

2.11.3.8 One primary study reported that safe, unpasteurised milk could be collected from donors if a 'careful aseptic collection technique under adequate microbiological control' is used. Two milk banks also reported that by following agreed procedures, milk was collected that showed no bacterial growth⁶⁶.

⁶¹ Based on 1 narrative review (Kinsey 1984), 1 position statement (Anon 1985) and 12 service descriptions (Arnold 1999; Balmer and Wharton 1992; Baum 1982; Beal et al. 1978; Bjorksten et al. 1980; Cash and Giacoia 1981; Davidson et al. 1979; Hoey et al. 1980; Kimball et al. 1955; Sauve et al. 1984; Springer 1997; Tomalin 1983).

⁶² Based on 1 service description (Lucas et al. 1979).

⁶³ Based on 1 service description (Beal et al. 1978) and 1 case report (Ryder et al. 1977).

⁶⁴ Based on 1 position statement (Gutierrez and de Almeida 1998).

⁶⁵ Based on 1 service description (Cash and Giacoia 1981).

⁶⁶ Based on 1 primary study (Murphy et al. 1982) and 2 service descriptions (Asquith et al. 1987; Pedersen 1982).

2.11.3.9 *There is no consensus on the type of container that donors should use to collect expressed milk. Examples of containers provided by milk banks include aluminium jugs, milk jars, and glass or rigid plastic containers. Such containers are often supplied by the milk bank. However, there is general agreement that any container used should be sterilised (for example, by washing in a sterilisation solution)⁶⁷.*

2.11.3.10 *Some milk banks do not allow donors to use containers other than those provided⁶⁸.*

2.11.3.11 *Some milk banks instruct donors to pool milk collected over 24 hours⁶⁹.*

2.11.3.12 *One milk bank instructed donors to express only once into autoclaved bottles, which were then stored in the refrigerator until collection⁷⁰.*

2.11.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

The recommendations on handling milk at home were also based on the evidence and considerations on handling milk at the milk bank.

Overall, the GDG considered the safety of the milk (that is, the level of bacterial contamination) to be paramount. Although refrigerated milk is safe for maternal use, as recommended in ‘Improving the nutrition of pregnant and breastfeeding mothers and children in low-income households’ (NICE public health guidance 11; available from www.nice.org.uk/guidance/PH11), because of transportation to the milk bank and the use of donor milk for babies who

⁶⁷ Based on 1 position statement (Anon 1985), 2 primary studies (Lloyd-Jones et al. 1979; Minder et al. 1982) and 8 service descriptions (Beal et al. 1978; Bjorksten et al. 1980; Cash and Giacoia 1981; Greenwood Wilson 1951; Hartmann et al. 2007; Kimball et al. 1955; Tully 2000; Tully 2001).

⁶⁸ Based on 3 service descriptions (Cash and Giacoia 1981; Dempster 1982; Hartmann et al. 2007).

⁶⁹ Based on 3 service descriptions (Bjorksten et al. 1980; Radcliffe 1989; Tomalin 1983).

⁷⁰ Based on 1 service description (McEnery and Chattopadhyay 1978).

may be pre-term and may have significant health problems, freezing milk at the donor's home was recommended. Recommendations were made about length of storage. 'Improving the nutrition of pregnant and breastfeeding mothers and children in low-income households' (NICE public health guidance 11; available from www.nice.org.uk/guidance/PH11) recommended that breast milk for use with the mother's own baby can be frozen for up to 2 weeks in the freezer compartment of a fridge or for up to 6 months in a domestic freezer at -18°C or lower. The recommended storage times for donated milk were modified to ensure that milk received at the donor milk bank is of the highest nutritional and immunological quality and to reflect the time needed at the milk bank to process the donated milk. There were also concerns about the efficient performance of domestic freezers; again supporting the need to transport the donor milk to the donor milk bank as soon as possible.

2.11.5 Recommendations

Recommendation 1.2.38

Advise donors that expressed milk collected for donation should be frozen as soon as possible to maintain the nutritional and microbiological quality of the milk. If this is not possible (for example, because of storage capacity), advise donors to refrigerate samples collected over 24 hours, and then freeze the batch.

Recommendation 1.2.39

Advise donors that expressed milk for donation should remain frozen during storage at home, and if they have any concerns about storage conditions or freezer temperatures, they should discuss these with the milk bank.

Recommendation 1.2.40

Advise donors that frozen expressed milk should be transported to the milk bank as soon as possible. However, if necessary, expressed milk for donation can be stored before transport to the milk bank for up to 3 months in a domestic freezer, at -18°C or lower. If a donor does not have access to a domestic freezer at her home, she may be able to access freezers for milk storage at local donor milk depots or children's centres.

Recommendation 1.2.41

Advise donors that expressed milk can only be accepted by the milk bank if it has been collected and stored in milk collection containers provided by, or acceptable to, the milk bank.

Recommendation 1.2.42

Advise donors that collection containers for expressed milk should be used according to instructions provided by the milk bank.

Recommendation 1.2.43

Ensure that donors can check and document their freezer temperature every day; this may include providing a thermometer.

2.12 *Transporting milk to the milk bank***2.12.1 Review question**

What are the best (safest) methods for collecting, storing and handling donor breast milk?

- How, and for how long, should donor milk be stored during transportation?

2.12.2 Evidence review

Twenty-seven of the 202 studies included in the review provided 47 evidence records. The studies contained:

- 23 service descriptions
- 2 position statements
- 2 narrative reviews.

The publication dates ranged from 1951 to 2003.

The service descriptions reported practice in the UK, the USA, Germany, Brazil, Sweden, South Africa, Canada, Australia, India, Denmark and Finland.

Practice differed between milk banks, but few details were reported. No direct reference to costs was made.

2.12.3 Evidence statements

- 2.12.3.1 *Details of how milk should be handled during transport were reported only rarely.*
- 2.12.3.2 *When reported, most milk banks transported frozen milk from the donors' homes to the milk banks. Although some milk banks reported collecting milk that was refrigerated⁷¹.*
- 2.12.3.3 *Milk banks transported milk from the donors' homes to the milk banks by air, bus, taxi, milk bank vehicle, hand delivery, collection by the milk bank nurses, community midwives, 'milk man' or volunteers, the American Red Cross, a system using grocery stores as exchange points, or firemen⁷².*
- 2.12.3.4 *Milk banks transported milk from the donors' homes to the milk banks using a variety of containers, including Styrofoam containers with 'blue ice' lids labelled 'perishable, frozen, human milk', bottles packed into cooler boxes, polystyrene foam cooler with an ice brick, polystyrene cool boxes, bottles in a tin bucket, or boxes insulated with crumpled newspaper or packing beads, with dry ice if needed⁷³.*
- 2.12.3.5 *One milk bank stored collected milk at an intermediary, local depository before transporting it in bulk to the milk bank every 2 weeks⁷⁴.*
- 2.12.3.6 *Periods between collections from donors differed; for example, one milk bank collected milk every 10 days (Balmer and Wharton 1992),*

⁷¹ Based on 1 narrative review (Wight 2001) and 9 service descriptions (Asquith et al. 1987; Balmer and Wharton 1992; Baum 1982; Bjorksten et al. 1980; Hoey et al. 1980; Kimball et al. 1955; Langerak and Arnold 1991; Springer 1997; Tully 2001).

⁷² Based on 11 service descriptions (Arnold 1999; Asquith et al. 1987; Balmer and Wharton 1992; Cash and Giacoia 1981; Davidson et al. 1979; Greenwood Wilson 1951; McEnery and Chattopadhyay 1978; Murray 1953; Siimes and Hallman 1979; Springer 1997; Tully 2002).

⁷³ Based on 11 service descriptions (Asquith et al. 1987; Balmer and Wharton 1992; Beal et al. 1978; Davidson et al. 1979; Dempster 1982; Greenwood Wilson 1951; Gutierrez and de Almeida 1998; Kimball et al. 1955; Langerak and Arnold 1991; McEnery and Chattopadhyay 1978; Tully 2000).

⁷⁴ Based on 1 service description (Baum 1982).

one once a week or at least within one month (Bjorksten et al. 1980), and one twice weekly (Connor 1982)⁷⁵.

2.12.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Milk collected from a donor's home should be frozen and remain frozen during transport to the milk bank. The GDG made recommendations to ensure that the milk remains frozen and that quality assurance processes were followed. When appropriate, guidance was based on European Union directives related to the transportation of blood and tissue (available from www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:294:0032:0050:EN:P DF and www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:256:0041:0048:EN:P DF).

2.12.5 Recommendations

Recommendation 1.2.44

Define critical conditions for transport, including temperature and time limit, to ensure that donor milk remains frozen during transport.

Recommendation 1.2.45

Transport donor milk in secure, tamper-evident containers and packaging.

Recommendation 1.2.46

If donor milk is transported to the milk bank by a contracted third party, ensure that a documented agreement is in place to maintain the conditions needed.

Recommendation 1.2.47

Define in writing the milk bank's procedures for transporting and storing donor milk. Ensure that these procedures maintain the quality of the donor milk and allow accurate identification of samples. Keep records of inventory and distribution (see also recommendations 1.2.68 to 1.2.75 on tracking and

⁷⁵ Based on 4 service descriptions (Balmer and Wharton 1992; Bjorksten et al. 1980; Connor 1982; Davidson et al. 1979).

tracing).

Recommendation 1.2.48

Collect expressed milk from the donors, preferably using an agreed transport provider (ideally a medical courier) or a member of staff from the milk bank. In some instances, donors may be required or may wish to deliver their own milk to the milk bank or depot, in which case they should also follow the milk bank's requirements for transport as outlined. In all cases, use consistent monitoring processes, including recording the journey time.

Recommendation 1.2.49

Collect expressed milk from either the donor's home (see recommendations 1.2.38 to 1.2.43) or from donor milk depots that have practices for monitoring freezers and maintaining standards for quality control, storage and security. Ensure that similar processes are in place in any location where the donor milk is stored.

2.13 *Milk handling in general*

2.13.1 Review question

What are the best (safest) methods for collecting, storing and handling donor breast milk?

- How, and for how long, should donor milk be stored at the milk bank, including refrigeration and freezing?

2.13.2 Evidence review

Thirty-three of the 202 included studies provided 48 evidence records. The studies contained:

- 14 primary studies
- 9 narrative reviews
- 7 service descriptions
- 2 opinion pieces
- 1 position statement.

Publication dates ranged from 1953 to 2007.

Service descriptions reported practice in the USA, the UK, Sweden and Germany.

It is known that the composition of milk is affected by storage processes, but it is not clear how important these changes are, or which specific processing method has the least detrimental effect on the nutritional and immunological properties of breast milk.

2.13.3 Evidence statements

2.13.3.1 The composition of milk is affected by storage processes.

Therefore, the balance of benefits from raw, or minimally treated, milk and harms from contaminated, or heavily processed, milk needs to be considered⁷⁶.

2.13.3.2 Because all storage processes affect the nutritional and immunological qualities of milk, any processing should be the minimum required to achieve the required safety⁷⁷.

2.13.3.3 Refrigerating milk:

- *inhibits bacterial growth in non-contaminated milk compared with freezing*
- *does not affect lactose concentrations*
- *has no effect on immunological factors, such as IgA*
- *decreases lipid concentrations*
- *decreases vitamin C concentrations*
- *decreases lysine concentrations*
- *does not denature proteins*
- *retains bactericidal activity (but this decreases after 72 hours)*
- *reduces the antioxidant activity of milk (but less so than freeze-thawing)*

⁷⁶ Based on many references: specific examples include 6 narrative reviews (Baum 1979; Bromberger 1982; Kinsey 1984; Lawrence 1999; Ogundele 2000; Roy and Lescop 1979) and 2 opinion pieces (Lucas 1982; Williams et al. 2007).

⁷⁷ Based on 1 narrative review (Narayanan 1989).

- *increases levels of free fatty acids*
- *retains creatinocrit values*
- *destroys or reduces viable cells, such as macrophages and neutrophils, over time or these cells may adhere to the walls of the container*
- *reduces glutathione peroxidase activity*
- *increases malondialdehyde*
- *has no effect on lymphocyte concentration*⁷⁸.

2.13.3.4 Freezing milk:

- *affects the rate of lipolysis (and therefore levels of free fatty acids)*
- *destroys viable cells, such as leukocytes*
- *does not affect lactose concentrations*
- *decreases lipid concentrations*
- *decreases vitamin C concentrations*
- *decreases lysine concentrations*
- *retains creatinocrit values*
- *reduces the glutathione content (and therefore the antioxidant activity)*
- *has no effect on malondialdehyde*
- *has an effect on the bactericidal and bacteriostatic activity on the milk, but study results are inconsistent*
- *has no effect on immunological factors, such as IgA, IgM and IgG (although one narrative review states that IgG and IgM are destroyed)*
- *does not inhibit bacterial growth in milk compared with refrigeration*
- *increases bile salt-independent esterase activity*
- *increases lipase activity*

⁷⁸ Based on 2 narrative reviews (Bromberger 1982; Ogundele 2000) and 9 primary studies (Buss et al. 2001; Hanna et al. 2004; Martinez-Costa et al. 2007; Miranda et al. 2004; Pardou et al. 1994; Pittard, III and Bill 1981; Silprasert et al. 1987; Silvestre et al. 2006a; Williamson and Murti 1996)

- *destroys, or markedly reduces, CMV*
- *does not destroy HIV*
- *does not destroy Semliki Forest virus*
- *does not destroy herpes simplex virus type 1*
- *does not destroy coxsackie virus*⁷⁹.

*However, the effects of freezing are not accepted universally; for example, one meeting report advised that frozen milk can be stored for extended periods with no appreciable change in composition, and one narrative review concluded that there is no effect on the nutritional or 'anti-infective' quality of the milk*⁸⁰.

2.13.3.5 *Hydrolysis of triglycerides occurs in milk frozen at –20°C, but not at –70°C*⁸¹.

2.13.3.6 *Freeze-thawing milk:*

- *denatures HTLV I*
- *increases cell loss*
- *has no effect on vitamin A levels*
- *decreases levels of vitamin C*
- *increases concentrations of free fatty acids*
- *reduces creatinocrit values*
- *activates lipolysis, and therefore the levels of free fatty acids and glycerides*
- *does not cause unacceptable levels of bacterial growth in milk that had not been pasteurised*
- *has no effect on lipoprotein lipase or bile salt-stimulated lipase*
- *reduces bacteriostatic activity.*

⁷⁹ Based on 16 primary studies (Ankrah et al. 2000; Buss et al. 2001; Clark et al. 1984a; Clark et al. 1984b; Curtis et al. 2005; Friis and Andersen 1982; Hamprecht et al. 2004; Hernandez et al. 1979; Lavine and Clark 1987; Miranda et al. 2004; Pardou et al. 1994; Reynolds et al. 1982; Silprasert et al. 1987; Silvestre et al. 2006a; Silvestre et al. 2006b; Welsh et al. 1979) and 3 narrative reviews (Bromberger 1982; Ogundele 2000; Oxtoby 1988).

⁸⁰ Based on 1 meeting report (Silverman 1971) and 2 narrative reviews (Wight 2001; Williams and Pittard, III 1981).

⁸¹ Based on 2 primary studies (Berkow et al. 1984; Bitman et al. 1983).

However, fast freeze-thawing may preserve more of the antibacterial and nutritional components of the milk, but may also require more effort and equipment⁸².

2.13.3.7 Microwaving milk decreases 'anti-infective' properties⁸³.

2.13.3.8 Lyophilising (freeze-drying) milk preserves bacteriostatic activity⁸⁴.

2.13.3.9 A proposed solution to address concerns about leukocytes, trace minerals and fats adhering to the storage container is to thoroughly agitate and mix any stored milk before feeding⁸⁵.

2.13.3.10 Tocopherols appear to be stable when milk is stored after heating or freezing⁸⁶.

2.13.3.11 One primary study examining the effect of milk banking processes (including refrigeration at home and freezing at the milk bank, but not pasteurisation) on levels of fatty acids in milk concluded that banked milk, even after processing, is a good source of long-chain polyunsaturated fatty acids⁸⁷.

2.13.3.12 One primary study examining the effect of milk banking processes (including Holder pasteurisation and freezing for up to 90 days) on fat and L-lactate content and on lipid composition found that the treatment reduced fats and L-lactate, and induced triglyceride hydrolysis. However, the study also noted that different results had been seen in similar analyses⁸⁸.

⁸² Based on 1 narrative review (Van de et al. 1992) and 8 primary studies (Berkow et al. 1984; Friend et al. 1983; Honour and Dolby 1979; Morera et al. 1998; Rechtman et al. 2006; Reynolds et al. 1982; Silprasert et al. 1987; Wardell et al. 1981).

⁸³ Based on 1 narrative review (Wight 2001).

⁸⁴ Based on 1 primary study (Honour and Dolby 1979).

⁸⁵ Based on 1 narrative review (Williams and Pittard, III 1981).

⁸⁶ Based on 1 primary study (Moffatt et al. 1987).

⁸⁷ Based on 1 primary study (Luukkainen et al. 1995).

⁸⁸ Based on 1 primary study (Lepri et al. 1997).

2.13.3.13 *One primary study examining the effect of different storage processes on esterolytic activity concluded that storage in the freezer was the preferred method⁸⁹.*

2.13.3.14 *One primary study examining the effect of different storage processes on pH and antibacterial activities found that freezing maintained up to two-thirds of the bactericidal activity compared with refrigeration, but the loss of bactericidal activity with refrigeration was compensated for by enhanced bacteria sequestration⁹⁰.*

2.13.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

2.13.5 Recommendations

Recommendations related to milk handling are covered both here and in the specific sections for handling in the donor's home and at the milk bank.

Recommendation 1.2.38

Advise donors that expressed milk collected for donation should be frozen as soon as possible to maintain the nutritional and microbiological quality of the milk. If this is not possible (for example, because of storage capacity), advise donors to refrigerate samples collected over 24 hours, and then freeze the batch.

Recommendation 1.2.39

Advise donors that expressed milk for donation should remain frozen during storage at home, and if they have any concerns about storage conditions or freezer temperatures, they should discuss these with the milk bank.

Recommendation 1.2.40

Advise donors that frozen expressed milk should be transported to the milk bank as soon as possible. However, if necessary, expressed milk for donation

⁸⁹ Based on 1 primary study (O'Connor and Walde 1985).

⁹⁰ Based on 1 primary study (Hegde and Vikyath 2007).

can be stored before transport to the milk bank for up to 3 months in a domestic freezer, at -18°C or lower. If a donor does not have access to a domestic freezer at her home, she may be able to access freezers for milk storage at local donor milk depots or children's centres.

Recommendation 1.2.41

Advise donors that expressed milk can only be accepted by the milk bank if it has been collected and stored in milk collection containers provided by, or acceptable to, the milk bank.

Recommendation 1.2.42

Advise donors that collection containers for expressed milk should be used according to instructions provided by the milk bank.

Recommendation 1.2.43

Ensure that donors can check and document their freezer temperature every day; this may include providing a thermometer.

Recommendation 1.2.50

Process all donated milk under hygienic conditions (a sterile environment is not necessary). Practise good hand hygiene at all times, and wear gloves whenever handling donor milk.

Recommendation 1.2.51

Check that donated milk arriving at the milk bank:

- is labelled correctly with the donor's name and the date of expression **and**
- has remained frozen **and**
- has not been tampered with.

Transfer all donated milk immediately to the freezer.

Recommendation 1.2.52

Store pasteurised and unpasteurised donor milk in separate freezers and refrigerators.

Recommendation 1.2.53

Store donor milk awaiting pasteurisation in the freezer at the milk bank (at –20°C) for no longer than 3 months from the date of expression.

Recommendation 1.2.54

Discard breast milk from donors who do not meet the selection criteria detailed in recommendations 1.2.12, 1.2.13 and 1.2.17.

Recommendation 1.2.55

Before testing and pasteurising, thoroughly thaw the donor milk, and keep in the refrigerator for no longer than 24 hours. Prevent the donor milk from reaching 8°C while thawing.

Recommendation 1.2.63

Do not open the lid of batches of pasteurised donor milk until the milk is to be used, unless it is to test the milk. If the milk is tested, discard the opened bottle.

Recommendation 1.2.66

Keep all donor milk in containers made of food grade materials.

Recommendation 1.2.67

Staff at the milk bank should not be responsible for adding anything to the donated milk.

2.14 *Handling donor milk at the milk bank***2.14.1 Review question**

What are the best (safest) methods for collecting, storing and handling donor breast milk at the milk bank?

2.14.2 Evidence review

Forty-eight of the 202 included studies provided 105 evidence records. The studies contained:

- 27 service descriptions

- 10 primary studies
- 6 narrative reviews
- 3 position statements
- 1 meeting report
- 1 case report.

Publication dates ranged from 1951 to 2007.

Service descriptions reported practice in the UK, the USA, Sweden, Australia, China, India, South Africa, Germany, Finland, Venezuela, Poland and Denmark.

Reports of milk banking practice showed that milk banks differ in their handling of donor milk. However, there is general agreement that each milk bank should have agreed documented procedures to ensure the safe handling of donor milk. There is no high-quality evidence on exactly what these procedures should be or their impact on the safety of the donor milk.

2.14.3 Evidence statements

2.14.3.1 Milk banks differ in their procedures for handling donor milk. But there is general agreement that each milk bank should have agreed documented procedures to ensure the safe handling of donor milk⁹¹.

2.14.3.2 Freezing is the most common method of storing pasteurised donor milk, although some milk banks refrigerate milk⁹².

2.14.3.3 One milk bank refrigerates milk rather than freezes it to minimise the effects of pasteurisation and freezing (see the evidence statements on milk handling in general in section 2.12.2)⁹³.

⁹¹ Based on many references: specific examples include 1 narrative review (Baum 1979), 1 position statement (Anon 1985), 1 service description (Tully 2000) and 1 opinion piece (Williams et al. 2007).

⁹² Based on 1 narrative review (Oxtoby 1988) and 23 service descriptions (Asquith et al. 1987; Balmer and Wharton 1992; Baum 1982; Beal et al. 1978; Bjorksten et al. 1980; Cash and Giacoia 1981; Davidson et al. 1979; Dempster 1982; Fernandez et al. 1993; Greenwood Wilson 1951; Hartmann et al. 2007; Hoey et al. 1980; Ikonen et al. 1982; Langerak and Arnold 1991; McEnery and Chattopadhyay 1978; Morley-Peet 1983; Murray 1953; Pedersen 1982; Penc 1996; Reid 1988; Tomalin 1983; Tully 2001; Wight 2001).

- 2.14.3.4 *A meeting report stated that, after thawing, milk should not be refrozen⁹⁴.*
- 2.14.3.5 *In general, because of the need to culture all donated samples to test for bacteriological and viral contamination, two complete cycles of freezing and thawing are required⁹⁵.*
- 2.14.3.6 *There is variation in the length of time milk is stored at the milk bank (with an upper limit of 12 months). For example, in the UK the recommended period for storing frozen milk is 3 months post-pasteurisation⁹⁶.*
- 2.14.3.7 *One narrative review stated that most milk banks limit storage to 3–4 months at below -7°C ⁹⁷.*
- 2.14.3.8 *Brazilian milk banks follow recommendations to store pasteurised milk in the refrigerator for up to 24 hours, in the freezer for up to 6 months, and after lyophilisation (freeze-drying) for up to 12 months⁹⁸.*
- 2.14.3.9 *One milk bank recommends that freezers should not be self-defrosting, and should be monitored with a recording thermometer or a thermometer with an alarm⁹⁹.*
- 2.14.3.10 *Pasteurisation is the most common method of treating donor milk, although some milk banks use 'raw' donor milk (unpasteurised, unfrozen) when possible¹⁰⁰.*

⁹³ Based on 1 case report (Ryder et al. 1977).

⁹⁴ Based on 1 meeting report (Silverman 1971).

⁹⁵ Based on 1 narrative review (Roy and Lescop 1979).

⁹⁶ Based on 1 narrative review (Van de et al. 1992) and 9 service descriptions (Arnold 1999; Balmer and Wharton 1992; Dempster 1982; Greenwood Wilson 1951; Hartmann et al. 2007; Hoey et al. 1980; Murray 1953; Reid 1988; Tomalin 1983).

⁹⁷ Based on 1 narrative review (Williams and Pittard, III 1981).

⁹⁸ Based on 1 position statement (Gutierrez and de Almeida 1998).

⁹⁹ Based on 1 service description (Tully 2000).

¹⁰⁰ Based on 8 service descriptions (Asquith et al. 1987; Bjorksten et al. 1980; Davidson et al. 1979; Dempster 1982; Fernandez et al. 1993; Hartmann et al. 2007; Ikonen et al. 1982; Tomalin 1983).

- 2.14.3.11 *Milk banks differ in their procedures for cooling donor milk after pasteurisation; different cooling temperatures, times, and methods of cooling are used.*¹⁰¹
- 2.14.3.12 *One milk bank specifies that raw donor milk is used within 72 hours of collection*¹⁰².
- 2.14.3.13 *One milk bank stores milk by freeze-drying large volumes of donor milk*¹⁰³.
- 2.14.3.14 *In the USA, milk for pre-term babies is processed separately*¹⁰⁴.
- 2.14.3.15 *Two milk banks examine each container for appearance, taste, colour or odour, which could indicate spoilage or flavouring from the mother's diet and may affect safety or taste*¹⁰⁵.
- 2.14.3.16 *One primary study found that there was a link between the presence of off-flavour milk and higher rates of microorganisms*¹⁰⁶.
- 2.14.3.17 *Similar to handling milk in the home, there was no consensus on the most suitable containers to be used when handling milk at the milk bank. Examples reported include plastic containers made of food grade material, polypropylene pots with a screw lid, 40 ml plastic specimen bottles, and stainless steel containers. However, one narrative review concluded that glass is the least destructive container. This was supported by a primary study that showed more viable cells were retained on storage in glass compared with steel*¹⁰⁷.

¹⁰¹ Based on 1 opinion piece (Baum 1980), 4 primary studies (Bertino et al. 2008; Brown et al. 2000; Gibbs et al. 1977; Minder et al. 1982), and 4 service descriptions (Balmer and Wharton 1992; Baum 1982; Kimball et al. 1955; Morley-Peet 1983).

¹⁰² Based on 1 service description (Springer 1997).

¹⁰³ Based on 1 service description (Springer 1997).

¹⁰⁴ Based on 1 narrative review (Wight 2001).

¹⁰⁵ Based on 2 service descriptions (Asquith et al. 1987; Pedersen 1982).

¹⁰⁶ Based on 1 service description (Novak et al. 2008).

¹⁰⁷ Based on 1 narrative review (Lawrence 1999), 1 meeting report (Silverman 1971), 4 service descriptions (Asquith et al. 1987; Connor 1982; Dempster 1982; Fernandez et al. 1993) and 1 primary study (Williamson and Murti 1996).

- 2.14.3.18 *One milk bank uses milk in rotation, with the oldest milk being used first¹⁰⁸.*
- 2.14.3.19 *Handling of the milk at some milk banks is minimised to prevent contamination and procedures are carried out under sterile conditions or using sterilised equipment¹⁰⁹.*
- 2.14.3.20 *One milk bank handles (pools and samples) all milk in a laminar flow cabinet using aseptic technique and all containers are commercially sterile¹¹⁰.*
- 2.14.3.21 *One milk bank transfers milk from breast pumps to reusable, non-sterile bottles, which are cleaned between uses in a dishwasher. Other milk banks also report using dishwashers to clean equipment¹¹¹.*
- 2.14.3.22 *One milk bank works in an open system because they are not aiming for a sterile product¹¹².*
- 2.14.3.23 *In the USA (in 1995), health and safety regulations did not require milk bank staff to wear gloves for the routine handling of milk, but the American Academy of Pediatrics recommended that when exposure to expressed human milk was frequent or prolonged (as in donor milk banks), staff should wear gloves¹¹³.*

2.14.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Overall, the GDG considered the safety of the milk (that is, the level of bacterial contamination) to be paramount. However, the evidence is not clear about which storage methods are the least damaging to the nutritional and

¹⁰⁸ Based on 1 service description (Beal et al. 1978).

¹⁰⁹ Based on 3 service descriptions (Asquith et al. 1987; Kimball et al. 1955; Penc 1996).

¹¹⁰ Based on 1 service description (Hartmann et al. 2007).

¹¹¹ Based on 3 service descriptions (Arnold 1999; Balmer and Wharton 1992; Tully 2000).

¹¹² Based on 1 service description (Arnold 1999).

¹¹³ Based on 1 position statement (Anon 1995).

immunological components of donor milk. The GDG therefore recommended a pragmatic combination of refrigeration and freezing, noting that freezing can also destroy some viral contamination (such as CMV).

As with milk at the donor's home, recommendations about length of storage were based on 'Improving the nutrition of pregnant and breastfeeding mothers and children in low-income households' (NICE public health guidance 11; available from www.nice.org.uk/guidance/PH11), but were modified to reflect the time needed at the milk bank to process the donated milk.

The GDG considered that donor milk should be processed in a hygienic environment, but that this need not necessarily be sterile. However, processing in a non-sterile environment increases the importance of good handling techniques and processes; the principles are described more fully in the sections on staff training and quality assurance.

There was much discussion about the process of cooling milk after pasteurisation. In 1981, guidance on the collection and storage of human milk (Committee on Medical Aspects of Food Policy 1981) suggested that 'the mixed milk temperature should be reduced to 25°C within 10 minutes'. No references were cited to support this, and although, more recently, milk banks have described that cooling is required after pasteurising, very few details were reported. The GDG therefore recommended rapid cooling of milk to 4°C¹¹⁴ after pasteurisation. In the absence of evidence on specific cooling protocols and their comparative effectiveness, no further details were specified.

2.14.5 Recommendations

Recommendation 1.2.50

Process all donated milk under hygienic conditions (a sterile environment is not necessary). Practise good hand hygiene at all times, and wear gloves whenever handling donor milk.

¹¹⁴ Temperature recommended to be consistent with "Improving the nutrition of pregnant and breastfeeding mothers and children in low-income households." NICE public health guidance 11 (2008). Available from www.nice.org.uk/PH11

Recommendation 1.2.51

Check that donated milk arriving at the milk bank:

- is labelled correctly with the donor's name and the date of expression **and**
- has remained frozen **and**
- has not been tampered with.

Transfer all donated milk immediately to the freezer.

Recommendation 1.2.52

Store pasteurised and unpasteurised donor milk in separate freezers and refrigerators.

Recommendation 1.2.53

Store donor milk awaiting pasteurisation in the freezer at the milk bank (at –20°C) for no longer than 3 months from the date of expression.

Recommendation 1.2.54

Discard breast milk from donors who do not meet the selection criteria detailed in recommendations 1.2.12, 1.2.13 and 1.2.17.

Recommendation 1.2.55

Before testing and pasteurising, thoroughly thaw the donor milk, and keep in the refrigerator for no longer than 24 hours. Prevent the donor milk from reaching 8°C while thawing.

Recommendation 1.2.63

Do not open the lid of batches of pasteurised donor milk until the milk is to be used, unless it is to test the milk. If the milk is tested, discard the opened bottle.

Recommendation 1.2.66

Keep all donor milk in containers made of food grade materials.

Recommendation 1.2.67

Staff at the milk bank should not be responsible for adding anything to the donated milk.

2.15 *Pooling donor milk*

2.15.1 Review question

Should donor milk be pooled?

2.15.2 Evidence review

Thirty-eight of the 202 included studies provided 49 evidence records. Studies included:

- 20 service descriptions
- 6 narrative reviews
- 6 primary studies
- 3 position statements
- 2 opinion pieces
- 1 meeting report.

Publication dates ranged from 1951 to 2007.

Service descriptions reported practice in the UK, the USA, South Africa, Germany, Finland, Australia, Poland, Denmark and Canada.

Although many studies used the term ‘pooling’, it was often not clear whether this meant pooling of donations from different donors or pooling of separate donations from individual donors. There were reported differences in practice, and there was some support and benefits found for pooling between different donors although the evidence on this was not consistent.

2.15.3 Evidence statements

See also evidence statements on how donors are advised to pool milk at home before transport to the milk bank (section 2.10.2).

2.15.3.1 *Advantages of pooling pasteurised, frozen milk from different donors include:*

- *dilution of any undesirable compounds*
- *uniformity of composition*

- *making milk pools to a specific composition (for example, a high protein pool)*
- *simplification of procedures*
- *more efficient handling because of larger volumes.*

Pooling of donations from different donors is used by some milk banks and recommended¹¹⁵.

2.15.3.2 When milk from different donors is pooled, there is variation in the number of different donors contributing to the pool; ranging from 2 to 25 donors¹¹⁶.

2.15.3.3 One meeting report recommended that pooling raw milk from different donors should not be done because the risk of bacterial contamination, even with careful surveillance of donors, was too great¹¹⁷.

2.15.3.4 One milk bank reported pooling all milk, although raw and pasteurised donations were pooled separately¹¹⁸.

2.15.3.5 There was also concern about the pooling of milk from different donors, particularly if the milk is not pasteurised. Pooling of separate donations from individual donors was favoured because it allows for control of the stage of lactation, it may limit contamination, and it allows donors with consistently high levels of contamination to be identified. However, it was also noted that this

¹¹⁵ Based on 1 meeting report (Silverman 1971), 2 position statements (Anon 1980; Anon 1985), 3 narrative reviews (Bromberger 1982; Williams and Pittard, III 1981; Woo and Spatz 2007), 2 primary studies (Michaelsen et al. 1990; Smith et al. 1984) and 6 service descriptions (Arnold 1999; Asquith et al. 1987; Baum 1982; Siimes and Hallman 1979; Tully 2000; Wilson-Clay 2006).

¹¹⁶ Based on 1 meeting report (Silverman 1971), 3 primary studies (Lucas and Roberts 1978; Michaelsen et al. 1990; Smith et al. 1984) and 3 service descriptions (Asquith et al. 1987; Morley-Peet 1983; Tully 2000).

¹¹⁷ Based on 1 meeting report (Silverman 1971).

¹¹⁸ Based on 1 service description (Tomalin 1983).

may increase the risk of concentration of toxic substances excreted in the milk¹¹⁹.

2.15.3.6 In the UK, donor milk from different donors is not pooled. Pooled milk is prepared from separate donations of individual donors and is stored in aliquots before use¹²⁰.

2.15.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Although there was some evidence and logic for pooling milk from different donors, there was clear consensus in the GDG that donor milk should not be pooled in this way. The primary reason for this was the theoretical, unknown risk of CJD transmission via donor milk. If new evidence shows that vertical transmission of CJD can be ruled out or if a reliable test becomes available, this could be re-evaluated in any update of this guideline.

2.15.5 Recommendations

Recommendation 1.2.56

Only pool pre-pasteurised breast milk from the same donor.

Recommendation 1.2.57

Do not pool:

- breast milk from different donors,
- or**
- batches of pasteurised breast milk from the same donor.

¹¹⁹ Based on 2 narrative reviews (Roy and Lescop 1979; Van de et al. 1992), 1 opinion piece (Braune 1982), 2 position statements (Anon 1980; Anon 1985), 1 primary study (Stocks et al. 1983) and 6 service descriptions (Davidson et al. 1979; Dempster 1982; Hartmann et al. 2007; McEnery and Chattopadhyay 1978; Penc 1996; Springer 1997).

¹²⁰ Based on 1 opinion piece (Modi 2006).

2.16 *Testing donor milk*

2.16.1 Review question

How should donor milk be tested?

2.16.2 Evidence review

Fifty-eight of the 202 included studies provided 109 evidence records. Studies included:

- 29 service descriptions
- 11 primary studies
- 10 narrative reviews
- 4 position statements
- 2 case reports
- 1 meeting report
- 1 opinion piece.

Publication dates ranged from 1951 to 2009.

Service descriptions reported practice in the UK, the USA, Sweden, Finland, Australia, Denmark, India, South Africa, Germany, Canada and Poland.

Different milk banks reported the use of different testing processes, including different testing schedules and acceptance criteria. Although reports of neonatal infection from donor breast milk were extremely rare, there was an overall acceptance that milk should be tested and treated, if appropriate, before use.

2.16.3 Evidence statements

2.16.3.1 Different milk banks use different testing processes, including different testing schedules and acceptance criteria. Although reports of neonatal infection from donor breast milk are extremely

rare, there is a general acceptance that milk should be tested and treated, if appropriate, before use¹²¹.

2.16.3.2 Although adequate pasteurisation destroys HIV in milk, most milk banks adopt a dual approach of pasteurisation and screening of donors to prevent any transmission of HIV through donor milk. Some may rely on pasteurisation only¹²².

2.16.3.3 One case report describes the postnatal transmission of HIV via pooled, raw donor milk from different donors. The case occurred in an area of high prevalence of HIV (8–15% of pregnant women were HIV positive)¹²³.

2.16.3.4 Testing schedules may differ because of:

- *local disease prevalence*
- *local levels of specific contaminants*
- *storage procedures used*
- *costs, time and availability of tests¹²⁴.*

2.16.3.5 Milk banks test for a variety of contaminants. These include:

- *dichlorodiphenyltrichloroethane (DDT) concentrations*
- *levels of bacteria*
- *CMV*
- *methicillin-resistant S. aureus (MRSA)*
- *enteric pathogens*
- *indicator organisms*
- *heat-resistant Bacillus species that can form spores*

¹²¹ Based on many references: specific examples include 3 narrative reviews (Baum 1979; Oxtoby 1988; Williams and Pittard, III 1981) 1 opinion piece (Williams et al. 2007), 2 position statements (Anon 1980; Anon 1985) and 2 primary studies (Carrol et al. 1978; Law et al. 1989).

¹²² Based on 1 opinion piece (Morley and Lucas 1993) and 2 narrative reviews (Oxtoby 1988; Van de et al. 1992).

¹²³ Based on 1 case report (Nduati et al. 1994).

¹²⁴ Based on 1 narrative review (Narayanan 1989) and 2 position statements (Anon 1980; Penc 1996).

- *dilution with water or cows' milk (especially when donors receive payment)*¹²⁵.

2.16.3.6 *Some milk banks test for specific contaminants if the donor has a diagnosed infection, such as mastitis*¹²⁶.

2.16.3.7 *When testing, milk banks test using different schedules. These include:*

- *testing of pooled samples*
- *testing of some individual samples*
- *testing of all individual samples*
- *monitoring samples regularly (for example, at weekly intervals or twice a month)*
- *spot checks (that is, randomly)*¹²⁷.

2.16.3.8 *One case report describes an outbreak of Salmonella kottbus traced to contaminated donor milk from a single donor*¹²⁸.

2.16.3.9 *Milk banks test using different criteria of bacterial contamination to accept or reject milk. These include:*

- *rejection of raw milk that*
 - *contains organisms other than normal breast flora or commensal skin flora*
 - *shows growth of Gram-negative bacteria and colony counts of more than 10,000 organisms/ml of Staphylococcus epidermis and/or more than 4000 organisms/ml of S. aureus*
 - *exceeds 10⁴ colony-forming units (CFU)/ml of normal skin flora*

¹²⁵ Based on 1 meeting report (Silverman 1971), 2 primary studies (Lindemann et al. 2004; Novak et al. 2000) and 4 service descriptions (Greenwood Wilson 1951; Sauve et al. 1984; Siimes and Hallman 1979; Wilson-Clay 2006).

¹²⁶ Based on 2 service descriptions (Asquith et al. 1987; Omarsdottir et al. 2008).

¹²⁷ Based on 1 meeting report (Silverman 1971), 3 narrative reviews (Oxtoby 1988; Roy and Lescop 1979; Williams and Pittard, III 1981), 1 position statement (Anon 1980) and 7 service descriptions (Arnold 1999; Balmer and Wharton 1992; Cash and Giacoia 1981; Fernandez et al. 1993; Greenwood Wilson 1951; Kimball et al. 1955; Morley-Peet 1983).

¹²⁸ Based on 1 case report (Ryder et al. 1977).

- contains pathogens or coliform bacteria
- rejection of pasteurised milk that
 - contains any measurable levels of bacteria
 - contains pathogenic bacteria
 - contains more than 10^5 CFU/ml of saprophytic bacteria
 - exceeds 25 CFU.

There is a recognition however, that such standards are empiric and unproven, and are often determined by the microbiologist responsible for the milk bank¹²⁹.

2.16.3.10 It is not clear what effect different organisms and different levels of contamination have on the recipient baby, and whether this differs according to the recipient group¹³⁰.

2.16.3.11 One milk bank defined the microbiological criteria for accepting milk for pasteurisation as:

- *milk with bacterial contamination of less than 10^3 CFU/ml is used regardless of the organisms present*
- *milk with bacterial contamination of more than 10^5 CFU/ml is not used*
- *milk with bacterial contamination between 10^3 and 10^5 CFU/ml is only used if the organisms are skin commensals (for example, *S. epidermis*, *Streptococcus viridans* and diphtheroids)*
- *milk is not used if it has more than 10^3 CFU/ml of *S. aureus*, any Gram-negative rod (lactose-fermenting and *Pseudomonas* species), beta-haemolytic streptococci or *Streptococcus faecalis*¹³¹.*

¹²⁹ Based on 2 narrative reviews (Arnold 1997; Wight 2001), 1 position statement (Anon 1985), and 6 service descriptions (Arnold 1999; Balmer and Wharton 1992; Beal et al. 1978; Cash and Giacoia 1981; Dempster 1982; Langerak and Arnold 1991).

¹³⁰ Based on many references: specific examples include 1 narrative review (Narayanan 1989) and 1 opinion piece (Arnold et al. 1997).

¹³¹ Based on 1 service description (Balmer and Wharton 1992).

2.16.3.12 *One milk bank defined ‘arbitrary’ microbiological criteria for using and treating milk.*

- *Milk with a quantitative count of less than 2500 organisms/ml (consisting of, for example, micrococci, Staphylococcus albus, ‘viridans type’ streptococci or diphtheroids, which were considered to be contaminants probably derived from skin flora but unlikely to be pathogenic) was used unheated.*
- *No donation was used unheated or pasteurised if the pilot sample gave either a total count of more than 5000 organisms/ml or any detectable potential pathogen. On an arbitrary basis the potential pathogens were defined as S. aureus, beta-haemolytic streptococci, Pseudomonas species, Proteus species, S. faecalis, and any other organism from a potential enteric or water-borne source (here defined as ‘coliforms’ for convenience).*
- *No donated milk with a total bacterial count of 2500–5000 organisms/ml was used unheated. If the pilot sample had a bacterial count in this range, but none of the organisms listed above, the donated milk was pasteurised at 63°C for 30 minutes in a water bath and then subjected to the same bacteriological screening, plus the alkaline phosphatase test. (Alkaline phosphatase is destroyed within 30 minutes at 63°C and is used as evidence of adequate pasteurisation of cows’ milk). Provided effective pasteurisation was established by no detectable growth on culture and a satisfactory phosphatase test, the milk was issued for use.*

The milk bank discarded 45% of samples from home collection based on these criteria¹³².

2.16.3.13 *One milk bank used criteria that, in general, the pilot sample must contain no potential pathogens capable of producing heat-stable*

¹³² Based on 1 service description (Davidson et al. 1979).

enterotoxins, no Enterobacteriaceae or enterococci, and no confluent growth of organisms indicating a total count exceeding 10^5 CFU/ml. Any bacterial growth in the sample post-pasteurisation is unacceptable¹³³.

2.16.3.14 One milk bank used criteria as follows.

- If the sample contains less than 2.5×10^6 non-pathogenic organisms/l, then that aliquot of milk will be given to a baby without further processing.*
- If there are between 2.5×10^6 and 1×10^9 non-pathogenic organisms/l, the milk samples are placed individually in a sterile jug within boiling water for 10 minutes (milk temperature 63–65°C) shortly before being fed to babies.*
- All milk that contains more than 1×10^9 organisms/l and grows *S. aureus*, *Pseudomonas*, *Klebsiella* or *Proteus* species, or other enteropathogenic organisms is not fed to babies¹³⁴.*

2.16.3.15 One milk bank used criteria as follows.

- Bacteriological tests are done on all donated milk and milk must meet the following standards to be used.*
 - Total bacteria count must not exceed 10^5 CFU/ml.*
 - The presence of pathogenic bacteria (for example, *S. aureus*, *Escherichia coli*, *Klebsiella* species, *Pseudomonas aeruginosa*, or alpha- and beta-streptococci) is not acceptable.*
 - Batches of non-pathogenic cutaneous microflora of 10^3 to 10^4 CFU/ml are preferable.*
 - No bacteriological growth should be observed in pasteurised milk; conditional growth of 1–2 CFU/ml is acceptable¹³⁵.*

2.16.3.16 One milk bank used criteria as follows.

¹³³ Based on 1 service description (Hartmann et al. 2007).

¹³⁴ Based on 1 service description (McEnery and Chattopadhyay 1978).

¹³⁵ Based on 1 service description (Penc 1996).

- *A bacterial count of less than 10^4 /ml (or less than 10^7 /l) organisms and no demonstrable pathogens is taken as evidence that the milk, at the time of sampling, is safe to use.*

Using this standard, bacterial cultures at one milk bank during the past 5 years showed that when significant bacterial growth occurred in post-pasteurisation samples, pasteuriser malfunction was detected and the samples were repasteurised before use¹³⁶.

2.16.3.17 One primary study assessed the link between bacterial contamination and clinical suspicion of infection in recipient babies. The study found that feeding milk containing more than 10^3 Gram-negative bacilli/ml is associated with increased feeding intolerance and higher levels of 10^6 /ml are associated with suspected sepsis¹³⁷.

2.16.3.18 Milk banks also test:

- *the fat, protein or lactose content*
- *the carbohydrate or caloric content*
- *the acidity*
- *the sodium levels*
- *for evidence that procedures are being followed (for example, by testing after pasteurisation to ensure effective treatment)*
- *to identify donors with consistently high rates of contamination*
- *to determine if samples should be used raw¹³⁸.*

2.16.3.19 Not all milk banks routinely test for bacterial contamination both before and after pasteurisation. For example, one milk bank

¹³⁶ Based on 1 service description (Sauve et al. 1984).

¹³⁷ Based on 1 primary study (Botsford et al. 1986).

¹³⁸ Based on 2 narrative reviews (Davies 1982; Williams and Pittard, III 1981), 3 position statements (Anon 1985; Fernandez et al. 1990; Gutierrez and de Almeida 1998), 5 primary studies (Almeida and Dórea 2006; Lindemann et al. 2004; Spencer and Hull 1981; Wojcik et al. 2009; Wright and Feeney 1998) and 11 service descriptions (Arnold 1999; Bjorksten et al. 1980; Davidson et al. 1979; Dempster 1982; Fernandez et al. 1993; Greenwood Wilson 1951; Ikonen et al. 1982; Omarsdottir et al. 2008; Pedersen 1982; Sauve et al. 1984; Wilson-Clay 2006).

reported testing samples after pasteurisation four times a year, and one tests 1 in 40 bottles after pasteurisation¹³⁹.

2.16.3.20 Not all milk banks routinely test for bacterial contamination and, in one survey, seven milk banks were reported to use no defined standards or to test routinely¹⁴⁰.

2.16.3.21 Not all milk banks routinely test all samples from donors. For example, one milk bank reported testing only the first batch received from a donor and one reported testing only the first three donations¹⁴¹.

2.16.3.22 One milk bank does not routinely test milk donated in the hospital because this milk is collected in autoclaved shells or bottles. However, for 1 day every 3 months, all samples and all equipment are screened for bacterial contamination¹⁴².

2.16.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Questions addressed by the GDG focused on the following areas.

- Why should milk banks test donor milk before pasteurisation and what should it be tested for?
- Why should milk banks test donor milk after pasteurisation and what should it be tested for?

The GDG recognised that, although raw milk may be used in rare circumstances and only under the supervision of the prescribing physician, in general milk banks would not be providing raw milk. Recommendations were therefore made only for milk to be pasteurised.

¹³⁹ Based on 2 service descriptions (Arnold 1999; Tomalin 1983).

¹⁴⁰ Based on 1 survey of services (Sauve et al. 1984).

¹⁴¹ Based on 2 service descriptions (Arnold 1999; Bjorksten et al. 1980).

¹⁴² Based on 1 service description (Bjorksten et al. 1980).

The GDG discussed the importance of avoiding any duplication of tests and debated the usefulness of each test at each stage. If tests do not have an added benefit in identifying contaminated donated breast milk and therefore minimising any impact on infant outcomes, testing at that stage will not be cost effective and will displace scarce health resources for other NHS patients.

The GDG reconsidered the recommendations on donor screening and remained in agreement that the donor screening processes were adequate and in line with other national donor programmes. In the absence of evidence that pasteurisation completely destroys all viral contaminants of concern, a precautionary approach was adopted and a recommendation made that any woman who tests positive, or who has previously tested positive, on any of the recommended tests should be excluded from donating milk.

For other viral contaminants, such as CMV, although there is documented evidence on the risk of transmission, there is also evidence that pasteurisation and other processing techniques, including freezing, destroys the contamination. The point therefore at which the risk is controlled is through adequate pasteurisation and storage, not through the screening of potential donors for CMV. Screening of potential donors for CMV is not recommended, but adequate storing and pasteurisation at 62.5°C for 30 minutes in a human milk pasteuriser is vital.

Regarding bacterial contamination: two groups of bacteria are present in breast milk. These are low virulence skin commensals, such as coagulase-negative staphylococci, and bacteria with greater virulence, such as *S. aureus* and *E. coli*, which may originate from skin or other sources. High levels of either type of bacteria are more likely to be associated with the expression, storage or handling of the milk rather than any significant health problem in the donor.

Adequate pasteurisation (recommended in this guideline as 62.5°C for 30 minutes in a human milk pasteuriser) will reduce normal levels of bacterial contamination to minimal levels that pose no risk to the recipient. But any milk

with very high levels should be discarded because pasteurisation may not reduce the levels to acceptable amounts, and may not destroy any bacterial toxins.

The GDG recommended criteria for the levels of bacterial contamination above which donor milk should be rejected, and these were based on the expert knowledge of the GDG and reference to criteria used in the food industry. However, any such levels are arbitrary (that is, there is no evidence on which to base such criteria). Therefore, as with other recommendations, a precautionary approach was taken. It was agreed that some maternal milk will inevitably be contaminated with bacteria and that this is acceptable, and in some circumstances preferable, but contamination is much more difficult to justify if the milk comes from a milk bank. The recommended *S. aureus* limit is consistent with that for ready-to-eat foods and cows' milk for human consumption. A combination of total bacterial count and a count of those pathogens that are recognised as problematic in food-borne illness was agreed to be appropriate (because this would then reflect significant contamination rather than the effects, alone, of poor processing).

In the GDG's view, this combination of criteria for rejecting donated milk before pasteurisation appropriately balances the necessity to ensure safety for the recipient and the need to use donor breast milk from screened donors effectively and efficiently.

Pasteurisation is effective as long as the procedure is followed correctly; therefore, the most crucial element of the testing process is that the correct quality control and monitoring processes are followed.

There was a lot of discussion about the testing schedule and how any failure in process (for example, if a pasteuriser breaks down) would have an impact on the amount of tracking back required. The importance of regular and ongoing calibration and checking of critical equipment was stressed, as was staff training.

It was understood that testing after every cycle of pasteurisation promotes confidence in the safety of the milk. However, this may be false reassurance

because not all bottles undergoing pasteurisation are tested and there is also a risk of introducing contamination during testing, unless this is done under strict conditions. Testing after pasteurisation only rarely identifies contamination (if the pasteuriser is working correctly – that is, at the correct temperature for the recommended time); testing carries a risk of introducing contamination (if not conducted in appropriate conditions) and is unlikely to positively change recipient outcomes and thus unlikely to be worth the additional cost.

The GDG agreed the following principles.

- Testing post-pasteurisation should be kept to the minimum required to achieve maximum confidence in the treated milk.
- Testing every sample was not appropriate or necessary because the risk of introducing contamination was high (unless under strict conditions).
- Testing every batch would not have a significant cost impact (so the decision to reduce post-pasteurisation testing was not made on a cost-saving assumption).
- Any bottle from which milk is taken for testing should be discarded.
- Any testing should be part of a defined quality control and monitoring process.
- The timing of testing should be based on the volume and throughput of donor milk.

The GDG agreed recommendations to reflect these principles. It was recognised that the recommendations should specify the requirements of testing; however, in some circumstances milk banks could exceed this if this was indicated, for example by the recipient population.

Concern was expressed that low levels of *Bacillus* species may be present in donor milk, and it is known that such spores are not destroyed by pasteurisation. However, this type of contamination can be controlled by proper storage and handling after pasteurisation, which should prevent any *Bacillus* species that are present from growing.

2.16.5 Recommendations

Recommendation 1.2.58

Before pasteurisation, test a sample from each batch of pooled donor milk for microbial contamination and discard if samples exceed a count of:

- 10^5 colony-forming units (CFU)/ml for total viable microorganisms **or**
- 10^4 CFU/ml for Enterobacteriaceae **or**
- 10^4 CFU/ml for *Staphylococcus aureus*.

Recommendation 1.2.59

Ensure that laboratories communicate the results of microbial testing clearly and that they provide appropriate interpretive comments.

Recommendation 1.2.60

Seek help from microbiological laboratories to identify and investigate instances of significant or unusual contamination (for example, by undertaking further microbial tests).

Recommendation 1.2.63

Do not open the lid of batches of pasteurised donor milk until the milk is to be used, unless it is to test the milk. If the milk is tested, discard the opened bottle.

Recommendation 1.2.64

Regularly test pasteurised donor milk for microbial contamination. Base the testing schedule on the volume and throughput of milk. Test:

- either at least once a month or every 10 cycles, depending on which comes first,
and
- on an ad-hoc basis if any new processes, equipment or staff are introduced, or if there are concerns about any part of the process.

Recommendation 1.2.65

Discard pasteurised donor milk that has a total viable microbial count of 10 CFU/ml or more.

2.17 *Treating donor milk*

2.17.1 Review question

How should donor milk be tested?

2.17.2 Evidence review

Ninety-six of the 202 included studies provided 156 evidence records. Studies included:

- 44 primary studies
- 25 service descriptions
- 17 narrative reviews
- 5 opinion pieces
- 3 position statements
- 1 case report
- 1 meeting report.

Publication dates ranged from 1951 to 2008.

Service descriptions reported practice in the UK, the USA, Denmark, Sweden, India, South Africa, Germany, Canada, Australia, Finland and Poland.

Different milk banks reported the use of different treatment processes. Although reports of neonatal infection from donor breast milk were extremely rare, there was an overall acceptance that milk should be tested and treated before use.

It is known that treatment can destroy or inactivate viral and bacterial contaminants, but there is no treatment process that can destroy the agent of CJD. It is not clear which treatment process is the most effective and the least detrimental to the nutritional and immunological components of breast milk. Nor is it clear what levels of pre-pasteurisation contamination are safe for donor milk.

2.17.3 Evidence statements

- 2.17.3.1 *There are many methods of treating milk with heat, usually with the aim of pasteurisation. As with the storage of milk, the balance of benefits from raw or minimally treated milk, with harm from contaminated or heavily processed milk, need to be considered¹⁴³.*
- 2.17.3.2 *The majority of reviews recommend the use of Holder pasteurisation rather than sterilisation, and most milk banks support and follow this recommendation¹⁴⁴.*
- 2.17.3.3 *There are several studies comparing different heat treatments; these are primarily laboratory studies and as such may not reflect effects in practice. However, there is some indication that high-temperature, short-time processing may have some benefits, although most authors conclude that further research is needed. For example, one primary study showed that high-temperature, short-time pasteurisation eliminated key bacteria and viruses, and may also preserve more of the important milk protein than Holder pasteurisation; however, it is extremely expensive¹⁴⁵.*

Although some studies evaluated the effects of some of the processes of milk banking, no studies compared different processing arrangements (the complete processing from expression through to post-storage) directly.

2.17.3.4 Storing milk at 23°C (room temperature):

- *has no effect on vitamin A levels*
- *reduces levels of vitamin C¹⁴⁶.*

¹⁴³ Based on many references: specific examples include 4 narrative reviews (Baum 1979; Boyes 1987; Lawrence 1999; Roy and Lescop 1979) and 2 opinion pieces (Lucas 1982; Williams et al. 2007).

¹⁴⁴ Based on many references: specific examples include 7 narrative reviews (Bromberger 1982; Davies 1982; Kinsey 1984; Oxtoby 1988; Roy and Lescop 1979; Tully et al. 2001; Wight 2001), 1 position statement (Anon 1980), and 1 primary study (Lucas and Roberts 1979).

¹⁴⁵ Based on 11 primary studies (Donnelly-Vanderloo et al. 1994; Fidler et al. 1998; Ford et al. 1977; Gaffin et al. 1983; Hamprecht et al. 2004; Silvestre et al. 2006a; Silvestre et al. 2008; Terpstra et al. 2007; Viazis et al. 2007; Viazis et al. 2008; Wills et al. 1982).

¹⁴⁶ Based on 2 primary studies (Honour and Dolby 1979; Rechtman et al. 2006).

2.17.3.5 *Heating milk to 56–57.5°C for 30–33 minutes:*

- *has no effect on IgG, IgA or IgM*
- *destroys HIV*
- *destroys HTLV-I-infected lymphocytes*
- *has no effect on gangliosides or glycoconjugates*
- *destroys complement*
- *reduces lysozyme and lactoperoxidase levels*
- *reduces levels of bacteria such as E. coli, S. aureus and group B beta-haemolytic streptococci*
- *tends to preserve higher levels of IgA, lactoferrin and lysozyme (than Holder pasteurisation)¹⁴⁷.*

2.17.3.6 *Heating milk to 62.5–63°C for 30 minutes:*

- *reduces bacterial growth inhibitory properties*
- *decreases lysine concentrations*
- *reduces levels of vitamin A*
- *destroys HIV*
- *destroys CMV*
- *does not destroy hepatitis B or C*
- *has no effect on lactose content*
- *has no effect on total and specific oligosaccharides*
- *kills Listeria innocua*
- *has little effect on lysozyme activity (although it is affected by an increase in temperature)*
- *has little effect on insulin-like growth factors and insulin-like growth factor binding proteins*
- *causes some loss of IgG, IgA and IgM*
- *has no effect on gangliosides or glycoconjugates*
- *reduces lactoferrin*
- *reduces C3 complement*

¹⁴⁷ Based on 2 narrative reviews (Eglin and Wilkinson 1987; Ogundele 2000) and 2 primary studies (Wills et al. 1982; Yamato et al. 1986).

- *destroys milk cells*
- *destroys bacteria such as E. coli, S. aureus and group B beta-haemolytic streptococci*
- *inactivates human milk lipases*
- *has little effect on long-chain polyunsaturated fatty acids (LC-PUFA) proportions but does reduce levels of total triglycerides*
- *destroys enzymes and the activity of alkaline phosphatase*
- *reduces levels of glutathione peroxidase*
- *does not destroy Semliki Forest virus*
- *does not destroy herpes simplex virus type 1*
- *does not destroy coxsackie virus¹⁴⁸.*

2.17.3.7 *Heating milk to above 65°C causes a progressive loss of bacteriostatic activity¹⁴⁹.*

2.17.3.8 *Heating milk to 72°C for 10 seconds destroys CMV¹⁵⁰.*

2.17.3.9 *Heating milk to 75°C for 15 seconds:*

- *decreases lysine concentrations*
- *kills L. innocua*
- *destroys CMV*
- *decreases levels of glutathione peroxidase*
- *reduces bactericidal activity¹⁵¹.*

2.17.3.10 *Heating milk to 90°C for 10 minutes destroys HTLV I¹⁵².*

2.17.3.11 *Other pasteurisation methods include heat treatment at 56°C, 62°C, 65.6°C or 65°C, and for different times (most commonly*

¹⁴⁸ Based on 4 narrative reviews (Chen and Allen 2001; Ogundele 2000; Simmer 2000; Tully et al. 2001), 18 primary studies (Bertino et al. 2008; Chen and Allen 2001; Donovan et al. 1991; Dworsky et al. 1982; Evans et al. 1978; Ford et al. 1977; Friis and Andersen 1982; Henderson et al. 1998; Orloff et al. 1993; Rees 1987; Ribeiro et al. 2005; Roberts and Severn 1978; Silvestre et al. 2006a; Silvestre et al. 2008; Wardell et al. 1984; Welsh et al. 1979; Wills et al. 1982; Yamato et al. 1986) and 1 opinion piece (Morley and Lucas 1993).

¹⁴⁹ Based on 1 primary study (Honour and Dolby 1979).

¹⁵⁰ Based on 1 narrative review (Stagno 2002).

¹⁵¹ Based on 5 primary studies (Chen and Allen 2001; Hamprecht et al. 2004; Silvestre et al. 2006a; Silvestre et al. 2008; Terpstra et al. 2007).

¹⁵² Based on 1 primary study (Yamato et al. 1986).

30 minutes). For example, one primary study reported over 90% destruction of the inoculated bacteria after heating the milk at 62.5°C for only 5 minutes¹⁵³.

2.17.3.12 Sterilising milk:

- destroys IgA, IgG and IgM
- has no effect on gangliosides or glycoconjugates, or bifidobacterium growth factor
- destroys lactoferrin
- destroys lysozyme and lactoperoxidase
- has no effect on lipid levels
- reduces fat content¹⁵⁴.

2.17.3.13 One milk bank reported autoclaving milk at 100°C for 5 minutes¹⁵⁵.

2.17.3.14 One primary study showed that heating to 105°C, then freezing and thawing, reduces rates of:

- IgA and IgG
- lactoferrin and alpha-1 trypsin¹⁵⁶.

2.17.3.15 One primary study showed that pasteurisation followed by freezing caused redistribution of zinc, but did not affect other nutrients¹⁵⁷.

2.17.3.16 One primary study showed that high-pressure processing retained higher levels of IgA and lysozyme compared with Holder pasteurisation¹⁵⁸.

¹⁵³ Based on 3 service descriptions (Arnold 1996; Asquith et al. 1987; Balmer and Wharton 1992) and 1 primary study (Lloyd-Jones et al. 1979).

¹⁵⁴ Based on 1 narrative review (Ogundele 2000) and 2 primary studies (Fidler et al. 1998; Raptopoulou-Gigi et al. 1977).

¹⁵⁵ Based on 1 service description (Langerak and Arnold 1991).

¹⁵⁶ Based on 1 primary study (Raptopoulou-Gigi et al. 1977).

¹⁵⁷ Based on 1 primary study (Goes et al. 2002).

¹⁵⁸ Based on 1 primary study (Viazis et al. 2007).

2.17.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Any recommended pasteurisation method needs to balance safety with any destruction or reduction in the nutritional and immunological components of donor milk.

The recommended pasteurisation process is one that is currently used by most, if not all, milk banks in the UK. Although there is no direct evidence of the effect on health outcomes of reducing specific nutritional components through a higher temperature (62.5°C) – and no certainty that all microorganisms will be destroyed even at 62.5°C – the GDG considered this to be the most appropriate level for pasteurisation.

NICE clinical guidelines generally do not make specific recommendations about the exact equipment that should be used. Instead, a general recommendation was made that all equipment should be fit for purpose (as outlined in section 2.4) and a recommendation was made on the conditions needed for pasteurisation; it was assumed that milk quality would be controlled if these recommendations are followed.

As before, any equipment used for treating should be part of a quality control system that has both mechanisms for critical incident reporting and defined systems for monitoring and documenting.

2.17.5 Recommendations

Recommendation 1.2.61

Pasteurise donated milk at 62.5°C for 30 minutes in a human milk pasteuriser. Rapidly cool the milk to a temperature of 4°C or lower. Remove one bottle for testing if appropriate, then move the remainder of the batch to the freezer.

2.18 *Fortifying donor milk*

2.18.1 Review question

Fortifying donor milk was reviewed as part of the evidence review on handling milk in general – see section 2.13.

2.18.2 Evidence review

Ten of the 202 included studies provided 13 evidence records. The studies contained:

- 3 service descriptions
- 2 narrative reviews
- 2 primary studies
- 2 opinion pieces
- 1 position statement.

Publication dates ranged from 1982 to 2008.

Service descriptions reported practice in the USA, Sweden and Denmark.

There was very limited evidence and few descriptions of the process of milk fortification in milk banking; the GDG specifically excluded evidence related to the provision of donor milk to recipients, because this was not considered to be a core task of a donor milk bank.

2.18.3 Evidence statements

Very few included studies referred to the process of milk fortification.

- 2.18.3.1 *The aim of fortification was generally understood to be a match of the nutritional content of the milk to the recipient baby¹⁵⁹.*
- 2.18.3.2 *Some safety concerns about the effects of fortification, specifically on the osmolality of the milk and on host defence properties, were expressed¹⁶⁰.*
- 2.18.3.3 *There was general agreement that, if milk was to be fortified, this should only be undertaken after an analysis of the donor milk composition, because this varies considerably¹⁶¹.*
- 2.18.3.4 *One milk bank reported routine supplementation, but no further details were reported¹⁶².*
- 2.18.3.5 *A survey of milk banks indicated that all neonatal units enriched donor milk, either based on nutritional analysis or blindly¹⁶³.*
- 2.18.3.6 *One author noted that milk banks in the UK do not determine the nutritional content of breast milk¹⁶⁴.*

2.18.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

The GDG wanted to clarify that although some milk banks may fortify milk, this was not a key function of a milk bank and the recommendation therefore emphasises this.

¹⁵⁹ Based on 1 narrative review (Anon 1987) and 1 service description (Arnold 1999).

¹⁶⁰ Based on 1 opinion piece (Braune 1982), 1 position statement (Anon 1985) and 1 primary study (Santiago et al. 2005).

¹⁶¹ Based on 1 narrative review (Anon 1987) and 2 opinion pieces (Braune 1982; Modi 2006).

¹⁶² Based on 1 service description (Langerak and Arnold 1991).

¹⁶³ Based on 1 service description (Omarsdottir et al. 2008).

¹⁶⁴ Based on 1 opinion piece (Modi 2006).

2.18.5 Recommendations

Recommendation 1.2.67

Staff at the milk bank should not be responsible for adding anything to the donated milk.

2.19 Disposing of donor milk

2.19.1 Review question

How should donor milk samples be disposed of?

2.19.2 Evidence review

Eight service descriptions from the 202 included studies provided 12 evidence records. Publication dates ranged from 1978 to 2007.

Service descriptions reported practice in the UK, Australia, the USA, Finland and South Africa.

2.19.3 Evidence statements

2.19.3.1 *There was general agreement about disposing of contaminated milk (as measured by agreed criteria) and samples arousing any safety concerns. However, no details of any specific method of disposal were described¹⁶⁵.*

2.19.3.2 *One milk bank reported that contaminated milk (as measured by agreed criteria) was retained for use in research¹⁶⁶.*

2.19.3.3 *Three milk banks reported discarding stored milk after a specific period. However, the time period ranged from 3 (two milk banks) to 6 months (one milk bank)¹⁶⁷.*

¹⁶⁵ Based on 6 service descriptions (Asquith et al. 1987; Balmer and Wharton 1992; Beal et al. 1978; Dempster 1982; Hartmann et al. 2007; Ikonen et al. 1982).

¹⁶⁶ Based on 1 service description (Asquith et al. 1987).

¹⁶⁷ Based on 3 service descriptions (Beal et al. 1978; Connor 1982; Hartmann et al. 2007).

2.19.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Donor milk should be disposed of in the same way as any other clinical waste, so local waste disposal policies should be followed (see www.dh.gov.uk for information on disposal of clinical and other waste).

2.19.5 Recommendations

No specific recommendations were made on how donor milk should be disposed of.

2.20 *Tracking and tracing*

2.20.1 Review question

How should donor breast milk samples be tracked and traced?

- How should donor milk samples be archived?

2.20.2 Evidence review

Forty-six of the 202 included studies provided 139 evidence records. The studies contained:

- 28 service descriptions
- 9 narrative reviews
- 3 opinion pieces
- 2 position statements
- 2 primary studies
- 1 meeting report
- 1 case report.

Publication dates ranged from 1951 to 2008.

Service descriptions reported practice in the UK, the USA, Denmark, Australia, Sweden, India, Germany, Finland, Poland and Brazil.

Only some of these studies specifically mentioned tracking and tracing, but all referred to the need to have proper administrative procedures, many of which would facilitate tracking and tracing.

2.20.3 Evidence statements

2.20.3.1 There was general agreement that a system of administration of milk samples, including tracking and tracing, was needed. However, different milk banks used different systems¹⁶⁸.

2.20.3.2 No evidence on the most effective and efficient tracking and tracing system was identified.

2.20.3.3 Even where administration systems were in place, procedures were not always followed¹⁶⁹.

2.20.3.4 When reported, components of administration systems used in milk banks included:

- a registry of 'raw' milk donors*
- labelling or record of each sample*
- donor identity*
- details of any prescription drugs*
- date of expression*
- date of collection*
- date of deposit*
- nutritional content*
- date of clearance (bacteriologic)*
- expiry date*
- labelling of each pool, both between and within donors*
- bacteriological results*
- pasteurisation log*

¹⁶⁸ Based on many references: specific examples include 1 narrative review (Van de et al. 1992), 1 position statement (Gutierrez and de Almeida 1998) and 3 service descriptions (Asquith et al. 1987; Hartmann et al. 2007; Morley-Peet 1983).

¹⁶⁹ Based on 1 case report (Ryder et al. 1977).

- *record of recipient use, either individual baby or other organisation¹⁷⁰.*

2.20.3.5 It is generally accepted that, whichever system is used, adequate resources (for example, money, staff and equipment) are needed to implement an effective and efficient administration system¹⁷¹.

2.20.3.6 A report from a meeting recommended that contingency samples should be frozen before treatment and archived for 'investigational purposes which may arise'¹⁷².

2.20.3.7 Although no explicit link was made in the literature, it could be speculated that, as there are significant barriers to the use of donor milk because of safety concerns, the implementation of an effective tracking and tracing system could address some of these, and thereby increase the use of donor milk¹⁷³.

2.20.3.8 A position statement on the running of milk banks in Brazil states that:

- *all human milk banks are responsible for clinical and quality control*
- *every procedure should be recorded*
- *all records of procedures should be available to the health inspection laboratories*
- *periodic reports of donations, quality control test results, total volume of milk collected, and total number of recipients should be sent to the local health authorities*

¹⁷⁰ Based on 1 meeting report (Silverman 1971) and 8 service descriptions (Arnold 1999; Asquith et al. 1987; Balmer and Wharton 1992; Beal et al. 1978; Cash and Giacoia 1981; Hartmann et al. 2007; McEnery and Chattopadhyay 1978; Tully 2000).

¹⁷¹ Based on 3 narrative reviews (Bromberger 1982; Lording 2006; Weaver 2001) and 1 service description (Tully 2000).

¹⁷² Based on 1 meeting report (Silverman 1971).

¹⁷³ Barriers based on 1 narrative review (Lording 2006).

- *all milk samples should be marked with the name, date and time of collection¹⁷⁴.*

2.20.3.9 *One milk bank stated, as an operational objective, their commitment to ‘ensuring full traceability from individual donation to recipient and maintaining a record of all storage and processing conditions’. To achieve this, the following databases and records were maintained:*

- *donor record*
- *medical record number*
- *consent*
- *medical history questionnaire*
- *pathology results*
- *specimen database*
- *specimen ID*
- *processing information*
- *batch record*
- *specimens pooled*
- *pasteurisation log*
- *microbiological screening results*
- *recipient record*
- *consent*
- *product used¹⁷⁵.*

2.20.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

Tracking and tracing of milk samples was considered to be the most important function of any administration system used in a milk bank, and the GDG was keen to make detailed recommendations on the principles to follow and the information to be collected.

¹⁷⁴ Based on 1 position statement (Gutierrez and de Almeida 1998).

¹⁷⁵ Based on 1 service description (Hartmann et al. 2007).

No guidelines on the archiving of donor milk samples or critical information were found. Although the GDG initially wished to make recommendations on the archiving of milk samples; based on stakeholder comments, the GDG accepted that there was no evidence to support this and no existing guidance that could be cited. Therefore, the GDG changed the recommendation to refer to archiving of blood samples only and referred to the Royal College of Pathologists' guidelines (see www.rcpath.org/resources/pdf/g031retentionstorageaugust09.pdf), which give recommendations on the retention and storage of pathological records and specimens, including blood.

2.20.5 Recommendations

Recommendation 1.2.68

Track donated milk from the donor through to the recipient hospital.

Recommendation 1.2.69

Tracking and monitoring of donor milk processing should include freezer temperatures, pasteurisation processes and stock control.

Recommendation 1.2.70

At all stages, donor milk containers should be labelled clearly for identification. Clearly identify milk that is ready to be used.

Recommendation 1.2.71

For each donor milk batch, keep the following records.

- About the donor:
 - NHS number/donor ID
 - consent
 - relevant medical history
 - results of serological tests.
- About each container before pasteurisation:
 - donor ID
 - a testing log, including the tests undertaken and their results.
- For each pasteurised container:

- samples making up the batch
- the batch number
- a testing log, including the tests undertaken and their results
- pasteurisation details, including date of the pasteurisation.
- The hospital or neonatal unit that receives the donated milk, or the disposal date of the donated milk, as appropriate.

Recommendation 1.2.72

Label each container of pasteurised donor milk with the following information.

- A unique identification number.
- Confirmation that it contains pasteurised donor breast milk.
- Instructions to keep frozen, and use within 24 hours if defrosted.
- An expiry date (no later than 6 months from expression).

Recommendation 1.2.73

Only supply donor milk to hospitals or neonatal units that agree to comply with the tracking procedures for milk outlined by the milk bank.

Recommendation 1.2.74

The receiving hospital or neonatal unit should keep a record of how the donor milk is used. It should document for each bottle of donor milk:

- the baby's name, NHS number and date of birth, and the date administered
- the batch number and the date the donor milk was used in the patient record of each baby
- the condition of the donor milk on arrival following transport
- the storage conditions.

Recommendation 1.2.75

Ensure that all records (including raw data) that are critical to the safety and quality of the donor milk are kept for at least 30 years after expiry date, use or disposal. These records should be confidential.

2.21 Staff training

2.21.1 Review question

What training and competencies should the following have?

- Milk bank staff.
- Staff working with mothers and babies who may benefit from, or who are receiving, donor breast milk.
- Staff working with potential donors.

In discussion with the GDG, it was agreed that training for staff working with the recipients was not relevant to this guideline; but they should understand the process of donor milk banking.

2.21.2 Evidence review

Ten of the 202 included studies provided 16 evidence records. The studies contained:

- 4 service descriptions
- 4 narrative reviews
- 2 opinion pieces.

Publication dates ranged from 1981 to 2007.

Service descriptions reported practice in the USA, Brazil and Poland.

2.21.3 Evidence statements

2.21.3.1 There was general support for education of all staff involved in milk donation and use, and specifically on the benefits and processes.

2.21.3.2 Two narrative reviews stated that healthcare professionals did not have a full understanding of the benefits of milk donation or the process of milk banking¹⁷⁶.

¹⁷⁶ Based on 2 narrative reviews (Bar-Yam 2003; Woo and Spatz 2007) and 3 service descriptions (Nommsen-Rivers 1997; Penc 1996; Williams et al. 2007).

2.21.3.3 *Some milk banks reported specific components of training packages they delivered. These included:*

- *hygiene*
- *quality control*
- *collection and storage procedures*
- *an update on research on the role of breast milk for the neonate¹⁷⁷.*

2.21.3.4 *One milk banking system required milk bank staff to be certified following a training course, and federal law required all milk bank directors to be certified¹⁷⁸.*

2.21.4 Evidence to recommendations

See also appendix 3 for the development of the recommendations using formal consensus techniques.

The GDG recognised that staff training is key to the safety of donor milk. It therefore recommended changes in practice in the expectation that all staff involved in milk banking would be adequately and appropriately trained.

2.21.5 Recommendations

Recommendation 1.2.5

All milk bank staff should have ongoing training that is relevant to their job and is recorded. Training should cover good practice and should ensure that each staff member:

- is competent in performing their job
- understands the technical processes relevant to their job
- understands how the milk bank is organised and how its health and safety and quality systems work
- understands the regulatory, legal and ethical aspects of their work.

¹⁷⁷ Based on 2 service descriptions (Asquith et al. 1987; Cash and Giacoia 1981).

¹⁷⁸ Based on 1 service description (Tully 2001).

Recommendation 1.2.6

Train milk bank staff in HACCP principles, food hygiene and pasteurisation, and provide ongoing support so that practices reflect these principles.

3 Research recommendations

We have made the following recommendations for research, based on our review of evidence, to improve NICE guidance in the future.

Although it was not part of the scope of this guideline, it is known that there is limited high-quality evidence on the benefits of donor breast milk. The aim of this guideline is to provide guidance on the operation of donor milk banks; however, our expectation is that, once any risks of donor milk banking are minimised, further research can be undertaken to evaluate the benefits of donor milk, and to identify the recipient babies who would benefit most.

The research recommendations below relate to the process of donor milk banking. Where appropriate, they also recommend evaluating outcomes in the recipient population.

3.1 *The process of handling donor milk*

What is the effect of the process of milk banking on the nutritional and immunological components of donor milk?

Why this is important

The handling of donor milk includes a range of processes – including transport, storage and heat treatment – and is known to affect various biological, nutritional and immunological properties of breast milk. In addition, new methods of processing, such as heat or pressure treatment, are now being used in the food industry. However, there is very little comparative evidence on the different effects of the processes and how changes in the detailed process (for example, a change in temperature of 1°C) may affect the biological, nutritional and immunological properties of the milk. There is also no direct evidence of how these changes affect outcomes for recipients.

Further research is needed on the comparative effects of all milk handling processes on nutritional and immunological components, and, where possible, the impact of these on health outcomes for the recipients and on resource use during milk banking and following supply to recipients.

3.2 *Nutritional assessment of donor milk*

How and when should the nutritional components of donor breast milk be assessed?

Why this is important

It is known that the process of donor milk banking (for example, storage and heat treatment) affects the nutritional composition of milk. It is not clear how such changes affect health outcomes for recipients. Currently, in the UK, nutritional assessment of donor breast milk is not common practice.

Further research is needed to define clinically important changes and to determine the most useful methods and timing of measuring these in UK milk banking practice.

3.3 *Milk donors*

What are the attitudes and behaviours (including lifestyle factors such as diet) of milk donors, and can they affect the quality of donor milk?

Why this is important

There is very limited evidence on the attitudes and behaviours of milk donors, including the reason why they choose to donate. There is no evidence on how these factors (for example, ongoing donation or a one-off donation or dietary behaviours) may be associated with the quality of donated milk.

Further research is needed to understand the link between donor attitudes or behaviours and the quality of milk.

4 Other versions of this guideline

This is the full guideline. It contains details of the methods and evidence used to develop the guideline. It is available from our website (www.nice.org.uk/guidance/CG93/Guidance).

Quick reference guide

A quick reference guide for healthcare professionals is available from www.nice.org.uk/guidance/CG93/QuickRefGuide

For printed copies, phone NICE publications on 0845 003 7783 or email publications@nice.org.uk (quote reference number N2094).

'Understanding NICE guidance'

A summary for patients and carers ('Understanding NICE guidance') is available from www.nice.org.uk/guidance/CG93/PublicInfo

For printed copies, phone NICE publications on 0845 003 7783 or email publications@nice.org.uk (quote reference number N2095).

We encourage NHS and voluntary sector organisations to use text from this booklet in their own information about milk donation.

5 Related NICE guidance

Published

- Maternal and child nutrition. NICE public health guidance 11 (2008). Available from www.nice.org.uk/guidance/PH11
- Postnatal care. NICE clinical guideline 37 (2006). Available from www.nice.org.uk/guidance/CG37

6 Updating the guideline

NICE clinical guidelines are updated so that recommendations take into account important new information. New evidence is checked 3 years after publication, and healthcare professionals and patients are asked for their views; we use this information to decide whether all or part of a guideline

needs updating. If important new evidence is published at other times, we may decide to do a more rapid update of some recommendations.

7 References, glossary and abbreviations

7.1 References

See also Appendix 2 for a full list of included studies

Anon (1980) American Academy of Pediatrics. Committee on Nutrition. Human milk banking. *Pediatrics* 65: 854–7.

Anon (1985) Statement on human milk banking. Nutrition Committee, Canadian Paediatric Society. *Canadian Medical Association Journal* 132: 750–2.

Anon (1987) Banked milk is low in immunologically protective proteins. *Nutrition Reviews* 45: 44–6.

Anon (1995) Human milk, breastfeeding, and transmission of human immunodeficiency virus in the United States. American Academy of Pediatrics Committee on Pediatric AIDS. *Pediatrics* 96: 977–9.

Anon (2003). Guidelines for the establishment and operation of human milk banks in the UK. Third edition. (www.ukamb.org).

Almeida SG, Dórea JG (2006) Quality control of banked milk in Brasília, Brazil. *Journal of Human Lactation* 22: 335–9.

Ankrah N-A, Appiah-Opong R, Dzokoto C (2000) Human breastmilk storage and the glutathione content. *Journal of Tropical Pediatrics* 46: 111–3.

Arnold L, Thompson N, Pickler RH et al. (1997) Contamination in expressed breast milk: a non-issue... 'Contamination in expressed milk following breast cleansing' in the June 1997 issue. *Journal of Human Lactation* 13: 273–4.

Arnold LDW (1996) Currents in human milk banking: donor milk banking in China: the ultimate step in becoming baby friendly. *Journal of Human Lactation* 12: 319–21.

Arnold LDW (1997) Currents in human milk banking: a brief look at drip milk and its relation to donor human milk banking. *Journal of Human Lactation* 13: 323–4.

Arnold LDW (1999) Currents in human milk banking: donor milk banking in Scandinavia. *Journal of Human Lactation* 15: 55–9.

Asquith MT, Harrod JR (1979) Reduction of bacterial contamination in banked human milk. *Journal of Pediatrics* 95: 993–4.

Asquith MT, Pedrotti PW, Stevenson DK et al. (1987) Clinical uses, collection, and banking of human milk. *Clinics in Perinatology* 14: 173–85.

Azema E, Callahan S (2003) Breast milk donors in France: a portrait of the typical donor and the utility of milk banking in the French breastfeeding context. *Journal of Human Lactation* 19: 199–202.

Balmer SE, Wharton BA (1992) Human milk banking at Sorrento Maternity Hospital, Birmingham. *Archives of Disease in Childhood* 67: 556–9.

Bar-Yam NB (2003) Political issues. An introduction to human milk banking. *International Journal of Childbirth Education* 18: 22.

Bar-Yam NB (2005) Political issues. Helping others in our loss: organ, tissue, and milk donation. *International Journal of Childbirth Education* 20: 14–7.

Baum D (1979) Development of human milk banks. *Midwife, Health Visitor & Community Nurse* 15: 126–31.

Baum D (1980) Collecting and banking human milk: to heat or not to heat. *British Medical Journal* 281: 1066–7.

Baum JD (1982) Donor breast milk. *Acta Paediatrica Scandinavica – Supplement* 299: 51–7.

- Beal D, Ashdown LR, Mackay M (1978) The organization of a human milk bank in a North Queensland hospital. *Medical Journal of Australia* 1: 8–10.
- Berkow SE, Freed LM, Hamosh M et al. (1984) Lipases and lipids in human milk: effect of freeze-thawing and storage. *Pediatric Research* 18: 1257–62.
- Bertino E, Coppa GV, Giuliani F et al. (2008) Effects of Holder pasteurization on human milk oligosaccharides. *International Journal of Immunopathology & Pharmacology* 21: 381–5.
- Bitman J, Wood DL, Mehta NR et al. (1983) Lipolysis of triglycerides of human milk during storage at low temperatures: a note of caution. *Journal of Pediatric Gastroenterology & Nutrition* 2: 521–4.
- Bjorksten B, Burman LG, De Chateau P et al. (1980) Collecting and banking human milk: to heat or not to heat? *British Medical Journal* 281: 765–9.
- Botsford KB, Weinstein RA, Boyer KM (1986) Gram-negative bacilli in human milk feedings: quantitation and clinical consequences for premature infants. *Journal of Pediatrics* 109: 707–10.
- Boutte CA, Garza C, Fraley JK et al. (1985) Comparison of hand- and electric-operated breast pumps. *Human Nutrition – Applied Nutrition* 39: 426–30.
- Boyes SM (1987) AIDS virus in breast milk: a new threat to neonates and donor breast milk banks. *Neonatal Network – Journal of Neonatal Nursing* 5: 37–9.
- Braune K (1982) Breast milk bank. *Journal of Obstetric, Gynecologic & Neonatal Nursing* 11: 194–5.
- Bromberger PI (1982) Premature infants' nutritional needs. Breast milk banking... part 2. *Perinatology Neonatology* 6: 35.
- Brook RH (1994) The RAND/UCLA appropriateness method. In: McCormick KA, Moore SR, Siegel RA, editors. *Clinical practice guidelines development*:

methodology perspectives. Rockville, MD: US Department of Health and Human Services.

Brown NM, Arbon J, Redpath C (2000) Contamination of milk-bank samples with *Pseudomonas aeruginosa* during pasteurization by penetration of organisms through the screw lid during cooling. *Journal of Hospital Infection* 46: 321–2.

Buss IH, McGill F, Darlow BA et al. (2001) Vitamin C is reduced in human milk after storage. *Acta Paediatrica* 90: 813–5.

Carroll L, Osman M, Davies DP (1980) Does discarding the first few millilitres of breast milk improve the bacteriological quality of bank breast milk? *Archives of Disease in Childhood* 55: 898–9.

Carroll L, Osman M, Davies DP et al. (1978) Raw donor breast milk for newborn babies. *British Medical Journal* 2: 1711.

Cash JK, Giacoia GP (1981) Organization and operation of a human breast milk bank. *Journal of Obstetric, Gynecologic & Neonatal Nursing* 10: 434–8.

Chen H-Y, Allen JC (2001) Human milk antibacterial factors: The effect of temperature on defense systems. *Advances in Experimental Medicine & Biology* 501: 341–8.

Clark RM, Hundrieser KE, Brown PB (1984a) The effect of temperature and length of storage on bile salt-stimulated lipase and esterase in human milk. *Nutrition Research* 4: 957–60.

Clark RM, Hundrieser KH, Ross S et al. (1984b) Effect of temperature and length of storage on serum-stimulated and serum-independent lipolytic activities in human milk. *Journal of Pediatric Gastroenterology & Nutrition* 3: 567–70.

Committee on Medical Aspects of Food Policy. (1981) The collection and storage of human milk. Report of a Working Party on Human Milk Banks, Panel on Child Nutrition. *Reports on Health & Social Subjects* 22: 1–3.

Connor I (1982) A check on a milk bank: a safer method of storing human milk. *Nursing Times* 78: 1–4.

Curtis N, Chau L, Garland S et al. (2005) Cytomegalovirus remains viable in naturally infected breast milk despite being frozen for 10 days. *Archives of Disease in Childhood – Fetal & Neonatal Edition* 90: F529–30.

Davidson DC, Poll RA, Roberts C (1979) Bacteriological monitoring of unheated human milk. *Archives of Disease in Childhood* 54: 760–4.

Davies DP (1982) Human milk banking. *Archives of Disease in Childhood* 57: 3–5.

Dempster ER (1982) The establishment of a breast-milk bank in Durban. *South African Medical Journal Suid-Afrikaanse*: 951–4.

Donnelly-Vanderloo M, O'Connor DL, Shoukri M (1994) Impact of pasteurization and procedures commonly used to rethermalize stored human milk on folate content. *Nutrition Research* 14: 1305–16.

Donovan SM, Hintz RL, Rosenfeld RG (1991) Insulin-like growth factors I and II and their binding proteins in human milk: effect of heat treatment on IGF and IGF binding protein stability. *Journal of Pediatric Gastroenterology & Nutrition* 13: 242–53.

Dworsky M, Stagno S, Pass RF et al. (1982) Persistence of cytomegalovirus in human milk after storage. *Journal of Pediatrics* 101: 440–3.

Eglin RP, Wilkinson AR (1987) HIV infection and pasteurisation of breast milk. *Lancet* 1: 1093.

Egri-Okwaji MTC, Bamisaiye A, Ahmed I (1984) Setting up a breast milk bank: some socio-psychological and organisational considerations. *Nigerian Journal of Paediatrics* 11: 23–7.

Evans TJ, Ryley HC, Neale LM et al. (1978) Effect of storage and heat on antimicrobial proteins in human milk. *Archives of Disease in Childhood* 53: 239–41.

Fernandez A, Mondkar J, Nanavati R (1993) The establishment of a human milk bank in India. *Journal of Human Lactation* 9: 189–90.

Fernandez A, Mondkar J, Vaz C (1990) International workshop on human milk banking in developing countries. *Indian Journal of Pediatrics* 57: 381–4.

Fidler N, Sauerwald TU, Koletzko B et al. (1998) Effects of human milk pasteurization and sterilization on available fat content and fatty acid composition. *Journal of Pediatric Gastroenterology & Nutrition* 27: 317–22.

Ford JE, Law BA, Marshall VM et al. (1977) Influence of the heat treatment of human milk on some of its protective constituents. *Journal of Pediatrics* 90: 29–35.

Friend BA, Shahani KM, Long CA et al. (1983) The effect of processing and storage on key enzymes, B vitamins, and lipids of mature human milk. I. Evaluation of fresh samples and effects of freezing and frozen storage. *Pediatric Research* 17: 61–4.

Friis H, Andersen HK (1982) Rate of inactivation of cytomegalovirus in raw banked milk during storage at -20°C and pasteurisation. *British Medical Journal* 285: 1604–5.

Gaffin SL, Coovadia HM, Adhikari M et al. (1983) Effect of heat treatment of human breast milk on its anti-endotoxin antibody activities. *South African Medical Journal Suid-Afrikaanse*: 1014–5.

Gibbs JH, Fisher C, Bhattacharya S et al. (1977) Drip breast milk: it's composition, collection and pasteurization. *Early Human Development* 1: 227–45.

Goes HC, Torres AG, Donangelo CM et al. (2002) Nutrient composition of banked human milk in Brazil and influence of processing on zinc distribution in milk fractions. *Nutrition* 18: 590–4.

Greenwood Wilson J (1951) Random reflections on a human milk bank. *Archives of Disease in Childhood* 26: 452–6.

Gutierrez D, de Almeida JAG (1998) Currents in human milk banking: human milk banks in Brazil. *Journal of Human Lactation* 14: 333–5.

Hamprecht K, Maschmann J, Muller D et al. (2004) Cytomegalovirus (CMV) inactivation in breast milk: reassessment of pasteurization and freeze-thawing. *Pediatric Research* 56: 529–35.

Hanna N, Ahmed K, Anwar M et al. (2004) Effect of storage on breast milk antioxidant activity. *Archives of Disease in Childhood – Fetal & Neonatal Edition* 89: F518–20.

Hartmann BT, Pang WW, Keil AD et al. (2007) Best practice guidelines for the operation of a donor human milk bank in an Australian NICU. *Early Human Development* 83: 667–73.

Hegde AM, Vikyath R (2007) Cariogenic potential of stored human milk – an in-vitro study. *Journal of Clinical Pediatric Dentistry* 32: 27–32.

Henderson TR, Fay TN, Hamosh M (1998) Effect of pasteurization on long chain polyunsaturated fatty acid levels and enzyme activities of human milk. *Journal of Pediatrics* 132: 876–8.

Hernandez J, Lemons P, Lemons J et al. (1979) Effect of storage processes on the bacterial growth-inhibiting activity of human breast milk. *Pediatrics* 63: 597–601.

Hoey H, Hopper PK, Laurance BM (1980) Collecting and banking human milk. *British Medical Journal* 281: 1350.

Holland R (2006) Donor human milk – part 2: cultural and political perspectives. MIDIRS Midwifery Digest 16: 109–12.

Honour P, Dolby JM (1979) Bacteriostasis of *Escherichia coli* by milk. III. The activity and stability of early, transitional and mature human milk collected locally. Journal of Hygiene 83: 243–54.

Hoppu K, Kettunen K, Remes R (1994) Maternal drug treatment and human milk banking. International Journal of Clinical Pharmacology & Therapeutics 32: 488–90.

Ighogboja IS, Olarewaju RS, Odumodu CU et al. (1995) Mothers' attitudes towards donated breastmilk in Jos, Nigeria. Journal of Human Lactation 11: 93–6.

Ikonen RS, Miettinen A, Gronroos P (1982) Bacteriological quality control in a human milk bank. Klinische Padiatrie 194: 295–7.

Kimball ER, Jones E, Lewis ME et al. (1955) The breast milk bank as a community project. Pediatrics 16: 264–9.

Kinsey K (1984) Collection and storage of breast milk: current considerations. Neonatal Network – Journal of Neonatal Nursing 3: 41–7.

Langerak ER, Arnold LDW (1991) The Mothers' Milk Bank of Wilmington, Delaware: history and highlights. Journal of Human Lactation 7: 197–8.

Lavine M, Clark RM (1987) Changing patterns of free fatty acids in breast milk during storage. Journal of Pediatric Gastroenterology & Nutrition 6: 769–74.

Law BJ, Urias BA, Lertzman J et al. (1989) Is ingestion of milk-associated bacteria by premature infants fed raw human milk controlled by routine bacteriologic screening? Journal of Clinical Microbiology 27: 1560–6.

Lawrence RA (1999) Storage of human milk and the influence of procedures on immunological components of human milk. Acta Paediatrica Supplement 88: 14–8.

Lepri L, Del Bubba M, Maggini R et al. (1997) Effect of pasteurization and storage on some components of pooled human milk. *Journal of Chromatography B*, 1–10.

Liebhaber M, Lewiston NJ, Asquith MT et al. (1978) Comparison of bacterial contamination with two methods of human milk collection. *Journal of Pediatrics* 92: 236–7.

Lindemann PC, Foshaugen I, Lindemann R (2004) Characteristics of breast milk and serology of women donating breast milk to a milk bank. *Archives of Disease in Childhood – Fetal & Neonatal Edition* 89: F440–1.

Lloyd-Jones C, Jennison RF, D’Souza SW (1979) Bacterial contamination of expressed breast milk. *British Medical Journal* 2: 1320–2.

Lording RJ (2006) A review of human milk banking in public health policy in Australia. *Breastfeeding Review* 14: 21–30.

Lucas A (1982) Human milk banks. *Lancet* 1: 103.

Lucas A (1987) AIDS and human milk bank closures. *Lancet* 1: 1092–3.

Lucas A, Roberts CD (1978) Group B streptococci in pooled human milk. *British Medical Journal* 1: 919–20.

Lucas A, Roberts CD (1979) Bacteriological quality control in human milk-banking. *British Medical Journal* 1: 80–2.

Lucas A, Smith A, Baum JD et al. (1979) Human milk banking. *British Medical Journal* 1: 343.

Luukkainen P, Salo MK, Nikkari T (1995) The fatty acid composition of banked human milk and infant formulas: the choices of milk for feeding preterm infants. *European Journal of Pediatrics* 154: 316–9.

Martinez-Costa C, Silvestre MD, Lopez MC et al. (2007) Effects of refrigeration on the bactericidal activity of human milk: a preliminary study. *Journal of Pediatric Gastroenterology & Nutrition* 45: 275–7.

McEnery G, Chattopadhyay B (1978) Human milk bank in a district general hospital. *British Medical Journal* 2: 794–6.

Michaelsen KF, Skafté L, Badsberg JH et al. (1990) Variation in macronutrients in human bank milk: influencing factors and implications for human milk banking. *Journal of Pediatric Gastroenterology & Nutrition* 11: 229–39.

Minder W, Roten H, Zurbrugg RP et al. (1982) Quality of breast milk: its control and preservation. *Helvetica Paediatrica Acta* 37: 115–37.

Miranda M, Muriach M, Almansa I et al. (2004) Oxidative status of human milk and its variations during cold storage. *Biofactors* 20: 129–37.

Modi N (2006) Donor breast milk banking. *British Medical Journal* 333: 1133–4.

Moffatt PA, Lammi-Keefe CJ, Ferris AM et al. (1987) Alpha and gamma tocopherols in pooled mature human milk after storage. *Journal of Pediatric Gastroenterology & Nutrition* 6: 225–7.

Morera PS, Castellote Bargallo AI, Lopez Sabater MC (1998) Evaluation by high-performance liquid chromatography of the hydrolysis of human milk triacylglycerides during storage at low temperatures. *Journal of Chromatography A* 823: 467–74.

Morley R, Lucas A (1993) AIDS and human milk banking. *Clinical Nutrition* 12: 69.

Morley-Peet P (1983) Enteropathogenic *Escherichia coli*. *Nursing Times* 79: 24–7.

Mortimer PP, Cooke EM, Tedder RS (1988) HIV infection, breastfeeding, and human milk banking. *Lancet* 2: 452–3.

- Murphy JF, Lewarne VM, Lowe GH et al. (1982) The provision of safe unpasteurized breast milk using a simple aseptic technique. *Journal of Infection* 5: 133–7.
- Murray HA (1953) The mother's milk bank of Essex County. *Journal of the Medical Society of New Jersey* 50: 401–3.
- Narayanan I (1989) Human milk for low birthweight infants: immunology, nutrition and newer practical technologies. *Acta Paediatrica Japonica* 31: 455–61.
- Nduati RW, John GC, Kreiss J (1994) Postnatal transmission of HIV-1 through pooled breast milk. *Lancet* 344: 1432.
- Nommsen-Rivers L (1997) Universal precautions are not needed for health care workers handling breast milk. *Journal of Human Lactation* 13: 267–8.
- Novak FR, Da Silva AV, Hagler AN et al. (2000) Contamination of expressed human breast milk with an epidemic multiresistant *Staphylococcus aureus* clone. *Journal of Medical Microbiology* 49: 1109–17.
- Novak FR, Junqueira AR, Dias MS et al. (2008) Sensorial analysis of expressed human milk and its microbial load. *Jornal de Pediatria* 84: 181–4.
- O'Connor CJ, Walde P (1985) Esterolytic activity during storage of human milk. *New Zealand Medical Journal* 98: 114–5.
- Ogundele MO (2000) Techniques for the storage of human breast milk: implications for anti-microbial functions and safety of stored milk. *European Journal of Pediatrics* 159: 793–7.
- Omarsdottir S, Casper C, Akerman A et al. (2008) Breastmilk handling routines for preterm infants in Sweden: a national cross-sectional study. *Breastfeeding Medicine: The Official Journal of the Academy of Breastfeeding Medicine* 3: 165–70.

Orloff SL, Wallingford JC, McDougal JS (1993) Inactivation of human immunodeficiency virus type I in human milk: effects of intrinsic factors in human milk and of pasteurization. *Journal of Human Lactation* 9: 13–7.

Oxtoby MJ (1988) Human immunodeficiency virus and other viruses in human milk: placing the issues in broader perspective. *Pediatric Infectious Disease Journal* 7: 825–35.

Pardou A, Serruys E, Mascart-Lemone F et al. (1994) Human milk banking: influence of storage processes and of bacterial contamination on some milk constituents. *Biology of the Neonate* 65: 302–9.

Pedersen JK (1982) The woman milk bank at Fuglebakken Children's Hospital. *Danish Medical Bulletin* 29: 300–5.

Penc B (1996) Currents in human milk banking: organization and activity of a human milk bank in Poland. *Journal of Human Lactation* 12: 243–6.

Pittard WB, III, Bill K (1981) Human milk banking. Effect of refrigeration on cellular components. *Clinical Pediatrics* 20: 31–3.

Pronczuk J, Akre J, Moy G et al. (2002) Global perspectives in breast milk contamination: infectious and toxic hazards. *Environmental Health Perspectives* 110: A349–51.

Radcliffe A (1989) Setting up a nursing mother's room. *Journal of Human Lactation* 5: 21–2.

Raptopoulou-Gigi M, Marwick K, McClelland DB (1977) Antimicrobial proteins in sterilised human milk. *British Medical Journal* 1: 12–4.

Rechtman DJ, Lee ML, Berg H (2006) Effect of environmental conditions on unpasteurized donor human milk. *Breastfeeding Medicine: The Official Journal of the Academy of Breastfeeding Medicine* 1: 24–6.

Rees E (1987) Human breast milk: Laboratory detection of enzymes, and their use as markers for control of the pasteurisation process. *Medical Laboratory Sciences* 44: 345–9.

Reid E (1988) Breast milk banks and HIV. *Midwife, Health Visitor & Community Nurse* 24: 287.

Renfrew MJ, Craig D, Dyson L et al. (2009) Breastfeeding promotion for infants in neonatal units: a systematic review and economic analysis. *Health Technol.Assess.* 13: 1–iv.

Reynolds GJ, Lewis-Jones DI, Isherwood DM et al. (1982) A simplified system of human milk banking. *Early Human Development* 7: 281–92.

Ribeiro KDS, Melo ILP, Prito AZO et al. (2005) The effect of processing on the vitamin A content of human milk. *Jornal de Pediatria* 81: 61–4.

Roberts SA, Severn M (1978) Bacterial growth in raw and pasteurised human milk. *British Medical Journal* 2: 1196.

Roy CC, Lescop J (1979) Human milk banking: high rate of interest for a still uncertain credit balance. *American Journal of Diseases of Children* 133: 255–6.

Ryder RW, Crosby-Ritchie A, McDonough B et al. (1977) Human milk contaminated with *Salmonella kottbus*. A cause of nosocomial illness in infants. *JAMA* 238: 1533–4.

Santiago MS, Codipilly CN, Potak DC et al. (2005) Effect of human milk fortifiers on bacterial growth in human milk. *Journal of Perinatology* 25: 647–9.

Sauve R, Buchan K, Clyne A et al. (1984) Mothers' milk banking: microbiologic aspects. *Canadian Journal of Public Health* 75: 133–6.

Siimes MA, Hallman N (1979) A perspective on human milk banking, 1978. *Journal of Pediatrics* 94: 173–4.

- Silprasert A, Dejsarai W, Keawwichit R et al. (1987) Effect of storage on the creatinocrit and total energy content of human milk. *Human Nutrition – Clinical Nutrition* 41: 31–6.
- Silverman WA (1971) Human milk banking practices. *Pediatrics* 47: 456–9.
- Silvestre D, Ferrer E, Gaya J et al. (2006a) Available lysine content in human milk: stability during manipulation prior to ingestion. *Biofactors* 26: 71–9.
- Silvestre D, Lopez MC, March L et al. (2006b) Bactericidal activity of human milk: stability during storage. *British Journal of Biomedical Science* 63: 59–62.
- Silvestre D, Miranda M, Muriach M et al. (2008) Antioxidant capacity of human milk: effect of thermal conditions for the pasteurization. *Acta Paediatrica* 97: 1070–4.
- Simmer K (2000) Human milk banks and evidence-based medicine. *Journal of Paediatrics & Child Health* 36: 182–3.
- Smith L, Harkes A, D’Souza SW (1984) Fat content and fatty acid composition of pooled banked milk. *British Medical Journal* 288: 283.
- Spencer SA, Hull D (1981) Fat content of expressed breast milk: a case for quality control. *British Medical Journal* 282: 99–100.
- Springer S (1997) Currents in human blood banking: human milk banking in Germany. *Journal of Human Lactation* 13: 65–8.
- Stagno S (2002) Breastfeeding and the transmission of cytomegalovirus infections. *Italian Journal of Pediatrics* 28: 275–80.
- Stocks RJ, Davies DP, Carroll LP et al. (1983) A simple method to improve the energy value of bank human milk. *Early Human Development* 8: 175–8.
- Terpstra FG, Rechtman DJ, Lee ML et al. (2007) Antimicrobial and antiviral effect of high-temperature short-time (HTST) pasteurization applied to human milk. *Breastfeeding Medicine: The Official Journal of the Academy of Breastfeeding Medicine* 2: 27–33.

Tomalin C (1983) Is breast always best?... for premature babies... human milk banks. *Health & Social Service Journal* 93: 82–3.

Tully DB, Jones F, Tully MR (2001) Donor milk: what's in it and what's not. *Journal of Human Lactation* 17: 152–5.

Tully MR (1999) Currents in human milk banking: donating human milk as part of the grieving process. *Journal of Human Lactation* 15: 149–51.

Tully MR (2000) Currents in human milk banking: cost of establishing and operating a donor human milk bank. *Journal of Human Lactation* 16: 57–9.

Tully MR (2001) Currents in human milk banking: Excelencia em Bancos de Leite Humano: Uma Visao do Futuro – The First International Congress on Human Milk Banking. *Journal of Human Lactation* 17: 51–3.

Tully MR (2002) Currents in human milk banking: recipient prioritization and use of human milk in the hospital setting. *Journal of Human Lactation* 18: 393–6.

Tyson JE, Edwards WH, Rosenfeld AM et al. (1982) Collection methods and contamination of bank milk. *Archives of Disease in Childhood* 57: 396–8.

Van de PP, Lepage P, Homsy J et al. (1992) Mother-to-infant transmission of human immunodeficiency virus by breast milk: presumed innocent or presumed guilty? *Clinical Infectious Diseases* 15: 502–7.

Viazis S, Farkas BE, Allen JC (2007) Effects of high-pressure processing on immunoglobulin A and lysozyme activity in human milk. *Journal of Human Lactation* 23: 253–61.

Viazis S, Farkas BE, Jaykus LA (2008) Inactivation of bacterial pathogens in human milk by high-pressure processing. *Journal of Food Protection* 71: 109–18.

Wardell JM, Hill CM, D'Souza SW (1981) Effect of pasteurization and of freezing and thawing human milk on its triglyceride content. *Acta Paediatrica Scandinavica* 70: 467–71.

Wardell JM, Wright AJ, Bardsley WG et al. (1984) Bile salt-stimulated lipase and esterase activity in human milk after collection, storage, and heating: nutritional implications. *Pediatric Research* 18: 382–6.

Weaver G (2001) Human milk banking: the case for a national strategy. *MIDIRS Midwifery Digest* 11: 381–3.

Welsh JK, Arsenakis M, Coelen RJ et al. (1979) Effect of antiviral lipids, heat, and freezing on the activity of viruses in human milk. *Journal of Infectious Diseases* 140: 322–8.

West PA, Hewitt JH, Murphy OM (1979) Influence of methods of collection and storage on the bacteriology of human milk. *Journal of Applied Bacteriology* 46: 269–77.

Wight NE (2001) Donor human milk for preterm infants. *Journal of Perinatology* 21: 249–54.

Williams AF, Kingdon CC, Weaver G (2007) Banking for the future: investing in human milk. *Archives of Disease in Childhood – Fetal & Neonatal Edition* 92: F158–9.

Williams FH, Pittard WB III (1981) Human milk banking: practical concerns for feeding premature infants. *Journal of the American Dietetic Association* 79: 565–8.

Williamson MT, Murti PK (1996) Effects of storage, time, temperature, and composition of containers on biologic components of human milk. *Journal of Human Lactation* 12: 31–5.

Wills ME, Han VE, Harris DA et al. (1982) Short-time low-temperature pasteurisation of human milk. *Early Human Development* 7: 71–80.

Wilson-Clay B (2006) The milk of human kindness: the story of the Mothers Milk Bank at Austin. *International Breastfeeding Journal* 1: 6.

Wojcik KY, Rechtman DJ, Lee ML et al. (2009) Macronutrient analysis of a nationwide sample of donor breast milk. *Journal of the American Dietetic Association* 109: 137–40.

Woo K, Spatz D (2007) Human milk donation: what do you know about it? *MCN: The American Journal of Maternal Child Nursing* 32: 150–5.

Wright KC, Feeney AM (1998) The bacteriological screening of donated human milk: laboratory experience of British Paediatric Association's published guidelines. *Journal of Infection* 36: 23–7.

Yamato K, Taguchi H, Yoshimoto S et al. (1986) Inactivation of lymphocyte-transforming activity of human T-cell leukemia virus type I by heat. *Japanese Journal of Cancer Research* 77: 13–5.

7.2 Glossary

Donor breast milk Breast milk expressed by a mother that is then processed by a donor milk bank for use by a recipient that is not the mother's own baby. Payment for the donated milk is not given.

Donor milk depot Any storage facility where donor milk can be stored before transfer. The depot can be run by the milk bank (for example, where donors are from wide geographic areas) or run by volunteers, who are often donors or past donors themselves.

Hazard Analysis and Critical Control Point Further information can be found on the Food Standards Agency Website www.food.gov.uk
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7.3 Abbreviations

Abbreviation	Meaning
CMV	Cytomegalovirus
CPA	Clinical pathology accreditation
HACCP	Hazard Analysis and Critical Control Point
MRSA	Methicillin-resistant <i>Staphylococcus aureus</i>
QALY	Quality-adjusted life year
VDRL	Venereal disease research laboratory

7.4 *Appendices*

Appendices 1 to 6 are filed as separate documents:

Appendix 1: Scope

Appendix 2: Key guideline questions

Appendix 3: Methods of guideline development

Appendix 4: Survey of donor milk banks

Appendix 5: Evidence reports part 1

Appendix 6: Evidence reports part 2

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A short clinical guidelines technical team was responsible for this guideline throughout its development. It prepared information for the Guideline Development Group, drafted the guideline and responded to consultation comments. The following NICE employees made up the technical team for this guideline.

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8.3 *The Guideline Review Panel*

The Guideline Review Panel is an independent panel that oversees the development of the guideline and takes responsibility for monitoring adherence to NICE guideline development processes. In particular, the panel ensures that stakeholder comments have been adequately considered and responded to. The panel includes members from the following perspectives: primary care, secondary care, lay, public health and industry.

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8.4 *Declarations of interest*

A full list of all declarations of interest made by this Guideline Development Group is available on the NICE website (www.nice.org.uk).

8.5 *Authorship and citation*

Authorship of this document is attributed to the NICE Short Clinical Guidelines Technical Team and members of the Guideline Development Group under group authorship.

The guideline should be cited as:

National Institute for Health and Clinical Excellence (2010) Donor breast milk banks: the operation of donor breast milk bank services. London: National Institute for Health and Clinical Excellence. Available from: www.nice.org.uk/guidance/CG93