Reference List
(1)  Barness LA, Mauer AM, Holliday MA, Et al. Commentary on breast feeding and infant formulas, including
(2)  Drewett MS, Burge DM. Recurrent neonatal gastro-intestinal problems after spontaneous intestinal
obstruction in formula-fed premature infants given high doses of calcium. J Pediatr Gastroenterol Nutr
(3)  Kuschel CA, Harding JE. Multicomponent fortified human milk for promoting growth in preterm infants.
(5)  Srinivasan L, Bokiniec R, King C, Weaver G, Edwards AD. Increased osmolality of breast milk with
(6)  Telang S, Bersell L, Ferguson PW, Kinder JM, DeRoin M, Petschow BW. Fortifying fresh human milk with
commercial powdered human milk fortifiers does not affect bacterial growth during 6 hours at room
(8)  Lucas A, Fewtrell MS, Morley R. Randomised outcome trial of human milk fortification and developmental
(9)  Chappell JE, Clandinin MT, Kearney VC, Reichman B, Swyer PW. Fatty acid balance studies in premature
milk and are insufficient for preterm babies, the exception being energy. Energy content in expressed
human milk is lower than in mature term levels after two-three weeks. At this stage, intakes beyond the tolerance of preterm babies would
necessarily reflect the views of Bliss.

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Introduction
Human milk is considered the optimal feed for premature babies for both nutritional and immunological reasons. The use of fortified human milk
has, however, been associated with poorer rates of growth and bone mineralisation; particularly with very preterm babies. This has lead to the
development of Breast Milk Fortifiers (BMF) BMF has been available in the UK and Ireland since the early 1990s; however, clear guidance on its use in the context of NEC and/or milk curd bolus obstruction has not been fully explored. BMF is currently removed completely from the breast milk the resulting energy density can be <60kcal/100mL similar to premature
milk. This is due to the higher fat content of milk curd which is removed towards the end of an expression as the breast is emptied.

Outcomes
Many studies have shown that a diet of fortified BMF is associated with short term improvement in growth, indicators of bone mineralization, and nitrogen retention compared to unfortified BMF.

Concerns
However there have been concerns around the use of BMF which has led to widely differing approaches to its use. It is important to review the evidence, as completely as possible, to avoid restricting use where this is not necessary for more careful use in at-risk groups. The following is an attempt to look at all the available data.

Feed Intolerance
A systematic review of randomized controlled trials (RCTs) found there was no significant problem with feed tolerance in babies on fortified breast milk Most studies have not found BMF to affect gastric emptying14. While there is some evidence that in more immature infants it can be slower than with unfortified BMF. One study found that babies had higher stools on fortified BMF but had no other signs of feed intolerance15. The feed intolerance was higher in calcium than those commonly used in the UK today, which may have predisposition to the formation of insoluble calcium/cholesterol stones in the gut16.

Milk curd bolus
Rare examples of obstruction with milk curd bolus in babies fed fortified BMF have been described17. In one case, a 14 month old baby had had gut surgery prior to developing the milk bolus; this led to an increased risk for milk bolus obstruction18. Further to this an infant was also fed goat feed which this was thought to be lactobezoar19.

For further information on other aspects of neonatal nutrition please see http://www.bapm.org/nutrition/
Osmolality

It has been recommended that the osmolality of enteral feeds be kept below 450 mOsm/kg as higher levels were found to be associated with an increased risk of necrotising enterocolitis (NEC). In this paper the term osmolarity was used and a level below 400 mOsm/l recommended. This is equivalent to an osmolality of approximately 450 mOsm/kg. This figure on an arbitrary upper limit based on criteria of NEC. Recommendations for use of elemental formula with osmality of around 650 mOsm/kg. Thus the upper limits chosen are not based on direct experimental evidence.

In the majority of studies, addition of BMF to EBM causes an early rise in osmolarity but it remains below the recommended 400 mOsm/l that is below the limit after storage for 24 hours.19,20,21

Warming previously formulised EBM will cause an additional rise in osmolality, storing them in a warming tray. However this has also been shown to remain below the recommended upper limit.22

The osmolality of all enteral supplements must be taken into account as simple drips of same can be far higher than the osmolarity plus BMF plus BMF (e.g. sodium chloride, iron, vitamin D).

Necrotising enterocolitis

A systematic review and a randomised study published since the review found no difference in risk between fortified and unfortified BMF.22 However as NEC is a relatively rare complication, a study with much larger numbers would be needed to establish a higher level of confidence. A recent study looked at babies randomised to a bovine based or human milk based BMF. If mother’s milk was not available the bovine BMF group was supplied with human milk. The bovine based BMF group showed significantly less NEC and this was also shown when the study was conducted in a smaller group with donor milk. The bovine based BMF group developed NEC significantly more frequently than the other group. During the course of the study the bovine BMF group received only 20 per cent of their feeds as preterm formula. There is no information on the distribution of NEC cases between those who remained on all mother’s milk and those who had to have supplements of preterm formula, thus it is impossible to say whether the increased risk of NEC was due to the bovine or the formula.

Bacterial growth in human milk

Many papers have tested both fresh and previously frozen BMF and found no significant difference in bacterial growth between either milks with or without BMF. Likewise, inhibition of bacterial growth was preserved.23,24 Levels of TGFalpha and IgA have been found to be unchanged in fortified compared to unfortified EBM.25,17

Criteria for starting fortification

• Babies >1.5kg birth weight and <34 weeks
• Able to fully demand breast feed
• If growth not satisfactory carry on BMF until <25 per cent total feeds EBM
• Give iron supplement between four to six weeks
• Weekly serum urea < 4mmol/l and falling
• Weekly weight, length and head circumference
• Fortify the minimum volume possible, and use before fortifying more
• Mix well but avoid vigorous shaking
• Use manufacturers’ instructions
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Criteria for stopping fortification

• At discharge together with satisfactory growth
• Able to fully demand breast feed
• If growth not satisfactory carry on BMF until <25 per cent total feeds EBM
• Give iron supplement between four to six weeks
• Weekly serum urea < 4mmol/l and falling
• Weekly weight, length and head circumference
• Fortify the minimum volume possible, and use before fortifying more
• Mix well but avoid vigorous shaking
• Use manufacturers’ instructions
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Suggested guidelines

The following guidelines are based on available evidence and current practice within the UK and Ireland. As there is insufficient evidence as yet for the development of a national protocol it is recommended that local guidelines are developed for the use of breast milk fortifiers using these parameters.

What to add

• Commerically available fortifier following dose according to manufacturer’s instructions
• Use manufacturers’ instructions
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Fecalibra and Lactobacillus have been found to be unchanged in fortified compared to unfortified BMF.26

Addition of formula to EBM has been found to reduce lyzosyme content by ~40-70 per cent whereas BMF has a trend to improved neurodevelopmental outcome). In another no difference in rates of sepsis between the bovine BMF group and bovine protein based fortifier.24

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It is practice in some units to add fortifier before full enteral feeds has been achieved to prevent falling growth. However, due to the high levels and variability of early human milk protein levels, early empirical fortification could lead to intake of high levels of protein and may reach 6g/kg/day. These levels are not likely to aid growth and there is the small risk of adverse side effects associated with excessive protein intake.

Contro indications

Current BMFs are not suitable for term babies as they have nutrient profiles designed for the unique needs of the preterm infant. Breast milk fortifier should never be mixed with infant formula as this practice would increase the calcium content of the milk which could be redissolved in the bowel and lead to calcium/milk curd obstruction. It is advisable to use BMF instead of preterm formula for 24 hours. Fortification of breast milk could formation may also be reduced by the avoidance of BMF and a head Thrivecorer together in the same feed. If feeding fortified human milk by a continuous infusion there is the risk of incomplete delivery of some minerals and complete fat digestion. This risk can be minimised by gently swabbing the container before and during selling and plugging the nozzle of the syringe upwards to allow delivery of the fat-rich milk first.

Conclusion

Fortification of human milk is an effective intervention in the drive to optimise the nutritional status and growth of premature babies, and may have long term benefits which are beyond the scope of this review to discuss. There are many more benefits which are beyond the scope of this review to discuss. There are many more benefits which are beyond the scope of this review to discuss.

It is hoped that a more extensive version of this document will be published in the medical literature in the near future.