Crozier K, Sinclair M, Kernohan WG, Porter S. (2006) Birth technology competence: a concept analysis. *Evidence Based Midwifery* **4**(3): 96-100

Birth technology competence: a concept analysis

Kenda Crozier[1] *PhD, RM, RN. Marlene Sinclair*[2] *PhD, MEd, BSc, DASE, RNT, RM, RN. W George Kernohan*[3] *PhD, CPhys, CMath, FIMA, BSc. Sam Porter*[4] *PhD, BSSc, DipN.*

1 Lecturer in midwifery, School of Nursing and Midwifery, University of East Anglia, Earlham Road, Norwich NR4 7TJ England. Email: k.crozier@uea.ac.uk
2 Professor of midwifery research, Institute of Nursing Research, University of Ulster at Jordanstown, Newtownabbey BT37 0QB Northern Ireland. Email: m.sinclair1@ulster.ac.uk
3 Professor of health research, Institute of Nursing Research, University of Ulster at Jordanstown, Newtownabbey BT37 0QB Northern Ireland. Email: wg.kernohan@ulster.ac.uk
4 Professor of nursing research, School of Nursing and Midwifery, Queen's University Belfast, 21 Stranmillis Road, Belfast BT9 5AF Northern Ireland. Email: s.porter@qub.ac.uk

This doctoral research was funded by an All Ireland Research Fellowship awarded jointly by National Board for Northern Ireland and An Bord Altranais, Republic of Ireland.

Abstract

Aim. To identify birth technology competencies used by midwives to support women during the birthing process and to explore the concept of birth technology competence in midwifery practice in order to inform both education and practice.
Objective. To define attributes of birth technology competence.
Method. The Chinn and Kramer framework for concept analysis was used to examine sources including popular and professional literature, government reports and statutory regulation. The model allows for the exploration of three areas of experience, which interact to form the meaning of an idea or concept – feelings, values and attitudes associated with the concept, the symbolic label for the concept and the concept itself.
Results. Exploration of the literature led to the development of exemplar cases that illuminate tentative attributes of the concept, contained within three domains – interpersonal skills, professional knowledge and clinical proficiency.
Implications. Following testing in midwifery practice to ensure its transferability into the clinical context, the theoretical perspective developed here will provide a basis to inform education and practice in relation to the use of technology.

Key words: Midwifery theory, concept analysis, birth technology competence, midwifery practice, clinical competence

Introduction

At its most simple, birth technology refers to machinery and tools devised to be used in midwifery and the care of a woman in childbearing. It can be extended to include the skills, and knowledge required to operate the machinery, maintain it, use it safely and interpret its signals and outputs. It also includes the use of electronic systems for managing data, ordering tests and results. The work of a midwife in relation to technology has been explored previously by Sinclair (2001), who theorises that technology is invisible to the expert user and identifies the need for midwives to be 'ready' and competent to support women in birth with or without technology.

However, her research concluded that the meaning of birth technology competence had not yet been defined or articulated by midwives, and that this was an area for future midwifery research. Since then, midwifery researchers have articulated the meaning of caseload midwifery (Henty, 2004; Kirkham, 2003) and midwife-led birth centres (Kirkham, 2003), but there is a distinct lack of theory development for technological birth. It is important that models of a discipline are developed from within the profession, but this cannot be done by academics acting alone (Whittington and Boore, 1988). Theory development is therefore important to the development of the profession with a unique body of knowledge, distinct from obstetrics. In terms of birth technology, there seems to be a gap between practice, where midwives use technology on a daily basis, and theory, which tends to concentrate on the role of the midwife in 'normal ' or low-technology birth.

Meleis (2005) asserts that an integrated approach to theory development using the relationship between theory, practice and research is the most effective way forward. Defining the meaning of birth technology competence in midwifery will allow the development of means to assess it, and enable midwives to understand the development of the necessary competencies to ensure appropriate usage.

Aim

This philosophical analysis aims to answer two questions:

- What is birth technology competence?
- What are the key skills required by midwives to enable them to function competently and effectively in their technological role?

Methodology

In exploring and defining a concept, the researcher must accept that there is no single 'right answer' (Avant, 2000). However, the researcher must seek to answer the right question. Concept analysis is a process that enables the attributes or characteristics of a concept to be examined in depth (Walker and Avant, 1988). The Walker and Avant framework is a formal linguistic exercise, which distinguishes between those attributes that define the concept and others that may be irrelevant.

Theoretical phase

A literature search strategy followed four pathways (birth, clinical competence/competence, midwifery technology, philosophy) using MetaLib to cross-search MEDLINE, CINAHL, EMBASE and Cochrane, as well as a manual and electronic searches of government documents and guidelines. Popular literature was identified by manual library searches. According to Chinn and Kramer (1999: 54), a concept is a 'complex mental formulation of experience'. They assert there are three sources of experience that interact to form the meaning of an idea or concept:

- Values, attitudes and beliefs associated with the concept
- The symbolic label of the concept
- The concept or object itself.

The Chinn and Kramer model was chosen because it provides the opportunity to explore a complex concept using a variety of different sources of evidence. It was important to create a definition for the concept, grounded in the reality of midwifery practice that was meaningful to those in practice and also to those who educate midwives.

Discussion of findings

Values, attitudes and beliefs

Much discourse surrounding technology in the health professions centres on nursing rather than midwifery. Barnard (1997) claims that nurses accept technology because they regard it as neutral in the sense that it does not make decisions and thus they believe that they can master it. He states that nursing has unquestioningly accepted technology with little regard to how it dominates nursing practice. For many years, observations and record-keeping have involved medical devices and computers and this has led, in Barnard's (1997) view, to the deskilling of nurses. Purnell (1998: 15) argues that technology may be said to 'embody human values, actions and interactions with self, others and with the environment'. Yet, Barnard (1997) is sceptical of nurses' ability to display an attitude of caring and humanity when dealing with an increasingly complex array of machinery. The relationship between nursing and technology particularly with reference to the intensive care setting has been the subject of much discourse (Barnard, 1999; Sandelowski, 1999; Little, 2000). Golonka (1986) describes how nurses are expected to manage technology by regulating, monitoring and reporting malfunctions in the equipment within the patient's environment. However, the role of midwives and nurses in using technology is rather more than mechanical and the link between caring and technical skills has been examined (Locsin, 2001; Sinclair, 2001). Locsin and Sinclair both argue that the appropriate use of technology can enhance care when the care is client-centred rather than machine-centred. A World Health Organization (1985) declaration on the appropriate use of technology set limits for technological interventions such as induction of labour. Wagner (1994, 2000) identifies the appropriate use of various technologies including continuous electronic fetal monitoring, induction of labour and caesarean section.

Sandelowski (1999) considered the long-term links that nursing has had with technology through the physical manifestation of tools for nursing practice. Ranging from thermometers and stethoscopes to complex electronic surveillance and life support systems, these have fundamentally shaped and reshaped nursing practice. Some argue that technology is the master and the midwife or nurse the servant (Barnard, 1997). Others (Sandelowski, 1999; Locsin, 2001; Sinclair, 2001) contend that the midwife or nurse has become a part of the technology and thus invisible rather than having a separate identity and role as decision-makers.

The symbolic label

Lawrence-Beech (1997) describes the experience of women wishing to have a normal birth, concluding that the high volume of technological equipment in use leaves many maternity units incapable of providing this. She believes that the hospital view of a 'normal birth' is of one largely controlled by medical intervention and technology. Davis-Floyd (2003) describes the technological birth experience of the majority of American women. She views the US medical system as a technocratic model because it emphasises science, technology, patriarchy and institutions. She chooses the term 'technocratic' because it implies a hierarchy and includes elements of political power. She claims that the obstetric profession considered the natural process of birth to be untrustworthy and the female body as a defective machine. Therefore, their aim was to design interventions to control birth. Davis-Floyd (2003) associates the rise in technological intervention with the demise of the midwife's role in the birth process in the US. She puts forward a comparative model of technocratic and holistic birth – two extremes of the care continuum with a masculine perspective with the woman as object at one end and a feminine perspective with the woman as subject at the other.

The doctor in the comparative model is regarded as controlling while the midwife is benign and nurturing. Yet in technological birth, for example in induction of labour, the midwife controls the rate of infusion of the drug, which will augment contractions. Therefore, midwives who are working in a highly technologised birth environment will be responsible for taking control of the technology and the decisions that arise from that position. The midwife is stepping out of the nurturing role and working within the technocratic model.

The concept itself

Defining birth technology competence in relation to clinical practice is necessary in that it is an attribute of the profession that details explicit professional knowledge. In many countries, midwives practise under rules laid down in government legislation such as the Nurses, Midwives and Health Visitors Act 1997 and Nursing and Midwifery Order 2001 in the UK and the Nurses Act 1985 in the Republic of Ireland.

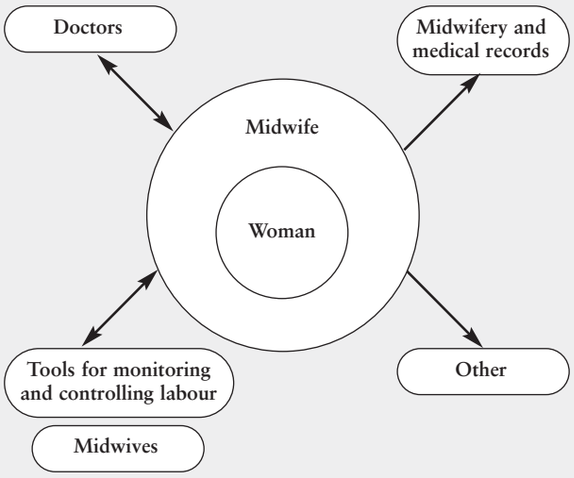
The general public expect healthcare professionals to have undergone a statutory period of training and education and to have qualified with the requisite knowledge and skills to practise safely. Competence is a 'complex multidisciplinary phenomenon' according to the Irish regulatory board An Bord Altranais (2005). The UKCC, since replaced by the NMC, described competence as 'the skills and ability to practise safely and effectively without the need for direct supervision. This concept of competence is fundamental to the autonomy and accountability of the individual practitioner' (UKCC, 1999: 35). An Bord Altranais (2005: 12) places competence within a framework of:

- Professional and ethical practice
- Holistic approaches to care and integration of knowledge
- Interpersonal relationships
- Organisational and management of care
- Personal and professional development.

NMC standards for proficiency for pre-registration midwifery education (2004b: 30) are based on:

- A woman-centred approach to care based on partnership, which respects the individuality of the woman and her family

Figure 1. Model of communication for a midwife in a delivery suite



- Ethical and non-discriminatory practices
- Quality of care through the setting and maintenance of appropriate standards
- Lifelong learning, encompassing key skills including communication and teamwork
- The changing nature and context of midwifery practice
- Practice based on the best available evidence.

The technologically skilled role of the professional is poorly defined in all these documents. There is little acknowledgement of the growing use of a range of technology in health care in general. Training and acquisition of skills has to alter to accommodate changes both in society and technology. In *Fitness for practice* (1999), the UKCC described the complexity of paradoxes affecting the professions in relation to changes in society. For example, there is a growing awareness and demand for high technology medicine and treatment, but also growing demand for complementary approaches such as homeopathy and acupuncture. There is an expectation to have a workforce that possesses high technical competence and 'scientific rationality' (Schön, 1983), but also a need for caring approaches and the time to use these bedside skills. All professions have a recognised set of knowledge and skills, but to develop and progress the competencies must change (Rawson, 1994).

Box 1. Tentative criteria for birth technology competence

Knowledge of the tools and machinery – how to set it up, switch it on and test that it is working safely

Knowledge of the normal mechanism of labour

Knowledge of sound evidence on which practice is based

Knowledge of how drugs affect normal physiological processes

Ability to communicate with the woman

Ability to use the machinery safely and effectively

Ability to interpret readings from the machinery

Ability to make clinical decisions based on interpretation of findings

Ability to identify faults in machinery and take appropriate action

Ability to communicate with colleagues

Ability to document clearly the actions of the midwife, woman and machinery in the relevant records

Demonstration of a caring approach to the woman and her partner

Demonstration of a sensitive approach to the wishes and needs of the woman and her partner in the delivery suite environment

Demonstration of respect for the privacy of the woman and her partner in labour

The International Confederation of Midwives (ICM) defined a list of essential competencies for midwives following a global survey (Fullerton et al, 2003). Competencies from the disciplines of social sciences, public health, ethics and professional conduct are included. One particular item that dealt with monitoring the fetal heart with a Doppler or Sonicaid device caused concern with some respondents who deemed it not to be an essential component. However, this may have been due to lack of availability of the device in some areas, or may be considered a non-essential skill for a midwife. There was widespread agreement about the importance of midwives retaining skills to use less technological devices such as Pinard stethoscope for monitoring the fetal heart rate (Fullerton et al, 2003).

The ICM competencies largely ignore skills required by midwives working in the high technology environment that exists in many hospitals in developed countries. In the delivery suite, it seems self-evident that the midwife must communicate with the machinery, effectively using the tools to guide her practice, and also with women, their partners, doctors and other midwives. In defining competence in midwives' use of birth technology, the nature of midwifery work needs to be examined closely and 'traditional' skills of palpation and interpersonal communication need to be considered alongside the more highly technical skills of intensive monitoring and other appropriate technology-based intervention.

The NMC proficiencies are divided into four domains – effective midwifery practice, professional and ethical practice, developing self and others and achieving quality through evaluation and research. Examples are given to illustrate types of outcomes expected, which include only two references to technology. The first, within the domain of effective midwifery practice, refers to the use of appropriate technical skill in monitoring the mother and fetus and in providing pain relief. The second, in the area of achieving quality through evaluation and research, considers the use of appropriate information technology systems for recording practice and analysing data from practice. The lack of any specific technological skills outcomes leaves midwifery educators to decide for themselves how much emphasis needs to be placed on the 'machine skills' required of the midwife. Given the assumption that midwives are being educated to provide care for women in normal childbirth, it is not surprising that Fraser et al (1998) and Sinclair (1999) discovered that newly-qualified midwives were not prepared to meet the 'high tech' requirements of providing care in a modern birthing environment.

It is important that education takes into account the growing use of technology in everyday midwifery practice, which reflects the growing dependence that society has upon technology. Page (2003) emphasises that 'normal birth' involves ensuring that women are cared for on a one-to-one basis, and the support

provided will reduce the need for epidural analgesia and electronic monitoring. Even when normal birth occurs, midwives require technical skills in order to maintain the electronic records required within the health service.

This examination of the literature helped to identify the broad parameters of the concept and its defining attributes. The next step is the development of illustrative cases.

Exemplar case

The midwife sites an intravenous cannula in the woman's arm and starts an intravenous infusion containing Syntocinon to augment a labour that is not progressing. This follows a discussion including the woman, her partner and the obstetrician and midwife. The rate of the infusion is controlled with an electronic infusion pump, which the midwife programmes to deliver the regime according to the unit standing order. The midwife talks to the woman and her partner throughout the procedure, explaining everything that is happening and answering the questions asked. An electronic fetal monitor is used to monitor the uterine contractions and the fetal heart rate. The machines are placed so that the woman and partner can see the readouts. The midwife touches the woman gently in a reassuring manner and makes the connection between the technology, the baby and the environment of care. The midwife uses the technology to monitor the outcomes from the interventions she has undertaken. Abdominal examination to assess progress and record the contractions is performed on a regular basis. During the process, the midwife is vigilant in her observation of the woman's progress in labour as well as the equipment. The woman's temperature is recorded using an electronic thermometer. The midwife controls the process by increasing the Syntocinon infusion rate.

Inevitably, the woman requests pain relief and after discussion chooses an epidural. The midwife assists the anaesthetist with this procedure and the woman has another intravenous cannula inserted and an infusion of Hartmanns solution started. An electronic blood pressure machine is used to monitor her blood pressure and the analgesia is maintained by regular bolus doses administered by the midwife, so that the woman can remain relatively mobile. The woman progresses to a vaginal birth and two midwives are present.

Discussion of exemplar case

An exemplar case can illustrate the attributes of the concept. It is a means of showing what is meant by the concept of 'birth technology competence'. Cases have been constructed from the experience of the authors and from the process of critically reviewing the literature. The exemplar details the care given by the midwife, but the rationale for the care decisions is beyond the scope of this paper.

The midwife should be able to interpret the findings, assess progress and make decisions about whether or not to increase the rate of infusion. She must communicate with the woman having established a relationship of trust with her. She also has a statutory professional obligation to record contemporaneously the events of the labour and birth. All communication between machinery, other professionals, the clients and the medical or midwifery records is conducted through the midwife (see Figure 1). Communication must take place between the machinery or tools, the midwife and the woman. The midwife observes the machines and translates the findings for the woman and her birthing partner, and is often responsible for relaying or translating information from doctors to clients (Kirkham, 1989). The midwife is also responsible for acting as an advocate for the client in order to relay the woman's wishes about treatment or action to other healthcare professionals. The midwife is required to discuss the care of the woman with other midwives – for example, at handover of a shift. At other times, the midwife may have to report on the progress of the woman because the doctors are conducting a 'ward round', or the midwife in charge may require this information to plan for the care of other women in the delivery suite. The midwife is also responsible for recording all observations, care activities and outcomes in the midwifery case notes, Partogram and on the computer database. The woman is central to the process, but all communication is carried out via the midwife who acts as a buffer around the woman. Tentative attributes of birth technology competence that are demonstrated in this exemplar can be identified (see Box 1).

Contrary case

The delivery suite is busy and the midwife is looking after a woman who had been admitted with pre-eclampsia. A regime of magnesium sulphate has been started, delivered by a syringe driver. The fetus is being monitored by external cardiotocography (CTG) and the mother's vital signs are being monitored using an electronic blood pressure machine that also measures pulse and mean arterial pressure. The midwife has taken over from another, who had given her a brief handover in the room in the presence of the mother. The first midwife had stated that all was well – she had just started the syringe infusion of magnesium sulphate and was monitoring the woman's blood pressure every 15 minutes according to the unit protocol. Once her colleague had left the room, the midwife began to carry out the observations. She attached the syringe driver to a pole at the side of the bed, placing it at a height where she could see it while standing up, above the level of the woman's head.

The midwife leaves the room to check on another woman for whom she is caring next door. When she returns after 30 minutes, the woman is feeling unwell. The midwife checks the CTG and the blood pressure readings on the printout. The fetal heart rate shows decelerations and decreasing variability, which indicate that the fetus may be compromised. The midwife summons the senior sister on duty to get a second opinion on the CTG reading. The sister looks at the syringe driver and finds it empty. The woman is displaying signs of magnesium toxicity. The sister summons the obstetric consultant and the anaesthetist who arrange immediate transfer to theatre for caesarean section.

Discussion of contrary case

In the same way that health can be described as an absence of disease, so it may be possible to eliminate attributes that do not illustrate the concept of birth technology competence (Chinn and Kramer, 1999).

Both mother and baby survived the episode described. The midwife placed the syringe driver above the level of the woman,

creating a siphoning effect with potentially disastrous results. The wings of the syringe were not properly secured in the driver. This had not been noticed by either midwife. The second midwife was unfamiliar with using a syringe driver, but did not seek help, possibly because the area was so busy. She was relying on the machinery to monitor the condition of mother and fetus while she was out of the room, but she could not be alerted to the deterioration in the woman's condition unless she was in the room to observe both the woman and machinery.

It is common practice in busy birthing environments to leave a woman unattended while connected to a monitor. The generally-held belief is that this is safer than leaving her unattended with no monitor. The flaw in this logic is that action can only be taken in response to monitor readings if someone is present to see the changes and relate them to what is happening to the woman. This inappropriate use of technology is common where the birthing environment cannot provide one midwife for each woman in labour. Even though the baby may have been born in good condition, the care would not be considered competent if the relationship and communication between midwife, woman, technology and medical staff was not satisfactory.

Attributes of birth technology competence

According to Chinn and Kramer (1999), creating conceptual meaning produces tentative criteria for determining whether the concept under investigation exists in a given situation. The various sources from which the meaning is drawn create layers of meaning. The attributes have emerged from analysis of the professional, government, educational and popular literature. Exemplar and contrary cases have been used to illustrate and clarify attributes identified in the literature.

Conclusion

The attributes identified in this way remain a theoretical exercise unless tested within the realm of midwifery practice. Accordingly, further work is needed to continue the theory development process by testing and confirming the transferability of the concept into the 'real world' of midwifery through ethnographic research.

References

An Bord Altranais. (2005) *Requirements and standards for nurse education programmes*. Stationary Office: Dublin.

Avant KC. (2000) *The Wilson method of concept analysis*: In: Rodgers BL, Knafl KA. (Eds.). *Concept development in nursing: foundations, techniques and applications (second edition)*. WB Saunders: Philadelphia.

Barnard A. (1997) A critical review of the belief that technology is a neutral object and nurse are its master. *Journal of Advanced Nursing* **26**(**1**): 126-31.

Barnard A. (1999) Nursing and the primacy of technological progress. *International Journal of Nursing Studies* **36**(**6**): 435-42.

Chinn PL, Kramer MK. (1999) *Theory and nursing: integrated knowledge development*. Mosby: London.

Davis-Floyd RE. (2003) *Birth as an American rite of passage (second edition)*. University of California Press: Berkley.

Fraser D, Murphy R, Worth-Butler M. (1998) *Preparing effective midwives: an outcome evaluation of pre-registration programmes of midwifery education*. English National Board for Nursing, Midwifery and Health Visitors: London.

Fullerton J, Severino R, Brogan K, Thompson J. (2003) The International Confederation of Midwives' study of essential competencies of midwifery practice. *Midwifery* **19**(**3**): 174-90.

Golonka L. (1986) Trends in health care and use of technology by nurses. *Medical Instrumentation* **20**(**1**): 8-10.

Henty D. (2004) Caseload midwifery and its contribution to increasing normal birth. *MIDIRS Midwifery Digest* **14**(**S1**): 25-7.

Kirkham M. (1989) *Midwives and information giving during labour*: In: Robinson S, Thompson AM. (Eds.). *Midwives research and childbearing (volume one)*. Chapman and Hall: London.

Kirkham M. (2003) *Birth centres: a social model for maternity care*. Books for Midwives: London.

Lawrence-Beech BA. (1997) Normal birth – does it exist? *AIMS Journal* **9**(**2**): 6.

Little CV. (2000) Technological competence as a fundamental structure in critical care nursing: a phenomenological study. *J Clinical Nursing* **9**(**3**): 391-9.

Locsin RC. (Ed.) (2001) *Advancing technology, caring and nursing*. Auburn House: Westport, Connecticut.

Meleis AI. (2005) *Theoretical nursing: development and progress (third edition)*. Lippincott Williams and Wilkins: Philadelphia.

NMC. (2004a) *Midwives rules and standards*. NMC: London.

NMC. (2004b) *Standards of proficiency for pre-registration midwifery education*. NMC: London

Page L. (2003) When normal birth is in the minority. *British Journal of Midwifery* **11**(**6**): 356.

Paley J. (1996) How not to clarify concepts in nursing. *Journal of Advanced Nursing* **24**(**3**): 572-8.

Purnell MJ. (1998) Who really makes the bed? Uncovering technologic dissonance in nursing. *Holistic Nursing Practice* **12**(**4**): 12-22.

Rawson D. (1994) *Models of interprofessional work: likely theories and possibilities*: In: Leathard A. (Ed.). *Going interprofessional: working together for health and welfare*. Routledge: London.

Rodgers BL, Knafl KA. (Eds.). (2000) *Concept development in nursing: foundations, techniques and applications (second edition)*. WB Saunders: Philadelphia.

Sandelowski M. (1999) Troubling distinctions: a semiotics of the nursing/technology relationship. *Nursing Enquiry* **6**(**3**): 198-207.

Schön DA. (1983) *The reflective practitioner: how professionals think in action*. Basic Books: New York.

Sinclair MK. (1999) *Midwives' readiness to use technology on labour ward. (unpublished PhD thesis)*. Queens University Belfast: Belfast.

Sinclair MK. (2001) Midwives' attitudes to the use of the cardiotocograph machine. *Journal of Advanced Nursing* **35**(**4**): 559-606.

Swartz-Barcott D, Kim HS. (2000) *An expansion and elaboration of the hybrid model of concept development*: In: Rodgers BL, Knafl KA. (Eds.). *Concept development in nursing: foundations, techniques and applications (second edition)*. WB Saunders: Philadelphia.

UKCC. (1999) *Fitness for practice: report of the Commission into Nurse Education*. UKCC: London.

Wagner M. (1994) *Pursuing the birth machine: the search for appropriate birth technology*. Ace Graphics: Camperdown, Australia.

Wagner M. (2000) Choosing caesarean section. *The Lancet* **356**(**9242**): 1677-80.

Walker LO, Avant KC. (1988) *Strategies for theory construction in nursing*. Appleton and Lange: Norwalk.

Whittington D, Boore J. (1988) *Competencies in nursing*: In: Ellis R. (Ed.). *Professional competence and quality assurance in the caring professions*. Chapman and Hall: London.

World Health Organization. (1985) Appropriate technology for birth. *The Lancet* **2**(**8542**): 436-7.