Antenatal care and maternal health: How effective is it?

A review of the evidence
Abstract

If resources are to be directed towards provision of antenatal care, it is important to identify which interventions are effective and how best to deliver them.

This report, prepared for the World Health Organization’s Maternal Health and Safe Motherhood research programme, draws together available information on how antenatal care could be used to reduce maternal mortality and serious morbidity in areas where levels are currently high.

The report concludes that strikingly little is known about the effectiveness of antenatal care for maternal health. Underlying this uncertainty is lack of information about the aetiology, pathogenesis and natural history of even some of the commoner complications of pregnancy such as hypertension; about the levels and patterns of causation of maternal mortality and morbidity in developing countries; and about the biological efficacy of treatments in current use.

Interventions in pregnancy which have been shown to be effective relate mainly to chronic conditions (anaemia, hypertensive disorders or infections) rather than acute conditions (haemorrhage or obstructed labour) which emerge close to the time of delivery.
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A review of the evidence

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EXECUTIVE SUMMARY

Maternal mortality is the health indicator which shows the greatest differential between developed and developing countries, with the lifetime risk of death related to pregnancy and childbearing estimated to be 500 times as high for women in Africa as for those in developed countries. The scope for reducing this risk through family planning and delivery services has been explored. However, the potential of antenatal care to reduce maternal mortality or serious morbidity in developing countries has not been systematically assessed, despite widespread belief that it can improve maternal health.

This review of the effectiveness of antenatal interventions in relation to poor maternal health in developing countries is the first step in a proposed programme of research to explore this potential. It starts from the major pathogenic causes of maternal mortality in developing countries and traces their antecedent morbidities and risk factors in pregnancy. Then the interventions employed to prevent, detect or treat any stage along this pathway during pregnancy are identified.

The scientific evidence from randomised controlled trials and other types of intervention or observational study on the effectiveness of these interventions is reviewed critically. The sources and quality of available data, and possible biases in their collection or interpretation are considered. As in other areas of maternal health, good quality information is scarce, and, as in many areas of health care, many interventions in current practice have not been subjected to rigorous testing.

A table of antenatal interventions of proven effectiveness in conditions which can lead to maternal mortality or serious morbidity is presented. Interventions for which there is some promising evidence, short of proof, of effectiveness are explored, and the outstanding questions formulated. These are presented in a series of tables with suggestions about the types of study needed to answer them.
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1. INTRODUCTION

1.1 Background and aims

Maternal mortality is the health indicator which shows the greatest differential between developing and industrialised countries. The lifetime risk of death as a result of pregnancy or childbirth is estimated at one in twenty-three for women in Africa, compared to about one in 10,000 for women in Northern Europe. Less reliable information exists on levels of serious morbidity related to pregnancy and childbirth, or differentials between developed and developing countries. However it is clear that those morbid conditions which can lead to maternal mortality occur much more commonly in developing countries, and/or give rise to far higher case fatality rates. The Safe Motherhood Initiative was set up to tackle these problems in a variety of ways (Mahler, 1987). The majority of maternal deaths occur around the time of delivery, and much effort has gone into identifying and providing effective and appropriate delivery care to prevent these deaths (Winikoff et al., 1987; Winikoff, 1988; Weston, 1989; Bullough et al., 1990). The potential of family planning and birth spacing to prevent maternal mortality by reducing the incidence of high risk pregnancies and the total number of pregnancies women experience has also been explored (Fortney, 1986a; Fortney et al., 1986b; Fauveau and Chakraborty, 1988). In addition, clear evidence exists that provision of legal safe abortion could reduce the considerable mortality associated with unwanted pregnancy.

Whether antenatal care can also prevent maternal mortality and serious morbidity is a difficult question to answer definitively. However, it is clearly not a trivial question and deserves urgent attention. Although systematic antenatal care was first introduced early this century in Europe and North America and is now almost universal in developed countries, questions related to its effectiveness have only begun to be tackled comparatively recently. Current knowledge, doubts and recommendations for antenatal care in industrialised countries have recently been explored in Effective Care in Pregnancy and Childbirth (Chalmers et al., 1989a) and Caring for Our Future: the Content of Prenatal Care (US DHHS, 1989). The persistent uncertainty concerning the value of many of the tests and treatments in common use is striking. Both these publications, however, relate to populations with low maternal mortality, and examine the effectiveness and potential of care in pregnancy to improve perinatal and infant mortality, and the general wellbeing of the family.

The role which pregnancy care, as distinct from delivery care, has played in the dramatic decline in maternal mortality in the developed world is not clear (Oakley, 1982; Enkin and Chalmers, 1982; Tew, 1990). Reviews looking at the potential of various options, including improving the status of women, providing family planning programmes, provision of safe abortion services, strengthening antenatal care, improving emergency obstetric services, training traditional birth attendants and community mobilisation have produced both optimistic (Lettenmaier, 1988; Walsh et al., 1989) and pessimistic (Maine, 1991) views of the potential of antenatal care to reduce maternal mortality. There is, however, a notable lack of comprehensive and critical reviews of the effectiveness of antenatal care programmes or of individual screening tests and
interventions during pregnancy to avert maternal death or severe morbidity. A recent challenge to identify aspects of routine care which actually do, or could, improve maternal survival (Renfrew and Chalmers, 1990) provoked responses from many parts of the world (Duby, 1990; Gosh, 1990; Carlson, 1990; Soetjiningsih, 1990; Minden, 1990; Rosenfield, 1990) with suggested solutions for the most pressing local problems, which included anaemia, hypertensive diseases of pregnancy and unwanted pregnancy, but no firm evidence.

There is a widespread desire to improve maternity care services and make optimum use of women’s contact with the health services. If considerable resources are to continue to be devoted to providing antenatal care, it is important to identify which interventions are effective and how best to deliver them. This report for WHO’s Maternal Health and Safe Motherhood Research Programme is the first step in one strand of an expanding programme of research (Vaughan, 1987; WHO, 1987a; WHO, 1990a) in this area being undertaken in the Division of Family Health. Its primary aims are:

a) to identify those interventions in pregnancy which appear most promising in terms of reducing major maternal morbidity and mortality;

b) to show how the effectiveness of promising but unproven interventions might best be assessed;

c) to define research priorities in antenatal care for safe motherhood.

1.2 Scope, sources and definitions

This review draws together available information on how antenatal care could be used to reduce maternal mortality and serious morbidity in areas with currently high levels. Not all care provided in pregnancy has this as its aim. In deciding which interventions to include, the review begins with the main pathogenic causes of maternal mortality. Data on maternal mortality in developing countries are generally poor and incomplete. In addition, the causes of maternal deaths are often multifactorial and involve complex interactions of several medical, obstetric and health service related factors. Attribution of deaths to a given underlying cause may be an artifact of classification when infection due to unclean delivery leads to secondary post partum haemorrhage or pre-eclampsia to placental abruption, and women do not receive needed emergency care (Campbell and Graham, 1990; Graham, 1991). Nevertheless, haemorrhage, infection, obstructed labour and hypertensive diseases of pregnancy (HDP), are estimated together to account for 68% of all maternal deaths in developing countries (Royston and Armstrong, 1989). From this basis, the review then identifies the antecedents in pregnancy, and all the tests and treatments which might be employed in their various stages to detect, treat or prevent these conditions. In addition, some other interventions unrelated to conditions which can lead to serious maternal morbidity or mortality have been included, where the case for their effectiveness in terms of other outcome measures was overwhelming or urgent. However, the treatment of malaria in pregnancy has not been dealt with in detail here, because a working group has recently been set up by WHO to tackle this important subject and its report will be available soon.
Antenatal care can be defined in many different ways. In tabulations of coverage worldwide (WHO/FHE/89.2) WHO defines antenatal care as a dichotomous variable; having had one or more visit with a trained person during the pregnancy, or none. It may be taken to mean only that care which is routinely provided for all pregnant women at primary care level, or every aspect of care from screening to intensive life support provided to any women while pregnant and up to delivery. Since what is provided at primary or secondary level varies widely even within developing countries and since effective care for one condition may involve a co-ordinated series of interventions at different levels, this review does not use primary or referral level to define antenatal care. Primary care level and first referral level are used in this report to refer to services which are or should be available to all pregnant women, and to services which are or should be provided to women referred because of complications of pregnancy. It does not attempt, however, to deal in detail with aspects of delivery or emergency care covered in the WHO recommendations for Essential Elements of Obstetric Care at First Referral Level (WHO, 1991b).

Evidence for this review was sought through searches of the published literature and from unpublished reports provided by WHO and several research groups working in the field of maternal health. Extensive searches of Medline and Popline on CD-ROM covering the past ten years were carried out using as key words all the conditions and interventions considered, as well as more inclusive terms such as "maternal health care", "prenatal care", and "maternal mortality" to identify original research studies and reviews. The reference collections on maternal health held by the Maternal and Child Epidemiology Unit at the London School of Hygiene and Tropical Medicine (LSHTM) and by the Family Health Division of the WHO, which include many unpublished or un-indexed reports, were systematically searched. Several international groups provided me with extensive reports of health care and research projects on maternal health in developing countries which they had carried out, supported or evaluated (see acknowledgements). Bibliographies and reference lists of papers from all these sources were used to identify important earlier writings. The Oxford Database of Perinatal Trials (ODPT) (Chalmers, 1992) was invaluable in identifying randomised controlled trials, and providing overviews of several interventions. It contains data from trials all over the world. As the information on trials in progress and planned, as well as those completed and published, is actively sought, this database is generally more complete than the published literature and less likely to be affected by publication bias. These overviews include pooled estimates of the effects of interventions from meta-analyses of methodologically sound trials (Chalmers, et al., 1989b; Mohide and Grant, 1989). Trials included in these overviews from the ODPT are only listed individually here when cited in support of points other than those covered by the overview.

Particular attention has been paid to studies in developing countries, but evidence from studies in developed countries has also been considered in so far as it is applicable to populations experiencing high maternal mortality. In many cases conclusions from studies in industrialised countries can be generalised to treatment of the same conditions in developing countries. For example, a drug found to be effective in controlling blood pressure in severe pre-eclampsia from trials in Europe and North America is likely to have the same effect in pre-eclampsia in Africa. Other questions may, however, have to
be addressed before treatments are transferred, such as drug safety and level of supervision required. In addition, the results may not be generalisable because of differences in health patterns. For example, the routine use of haematinics has not been shown to confer any improvement in maternal or infant outcome when given routinely to pregnant women in developed countries, who are usually well nourished, however the situation may be very different in populations with high prevalences of frank or borderline anaemia and iron deficiency (Mahomed and Hytten, 1989).

In this review, the effectiveness of each intervention is considered in terms of what it is intended to achieve. Thus for a screening test this may be defined as its ability to discriminate between those with and without the condition in question, whilst for a treatment effectiveness may be judged by its ability to cure or prevent progression of a condition or reduce case fatality. Where possible, the evidence that any type of intervention reduces mortality from a given cause is assessed. The main emphasis is on biological effectiveness or efficacy. Once the biological effectiveness is demonstrated, the effectiveness of an intervention in normal practice or as part of a programme can be explored, including operational questions of how best to deliver the treatment in the various situations encountered in developing countries. No attempt has been made at assessing the cost-effectiveness of individual interventions or programmes. Assessing measures of process, such as coverage, access, uptake, number of visits and gestation at first visit in relation to antenatal care programmes is not the purpose of this review. These measures have, however, been considered where they affect the potential of an intervention to be provided effectively, or for its effectiveness to be assessed.

The reliability of evidence on effectiveness may be ranked according to its source and particularly the rigour of the study methods used in the assessment. The "gold standard" in assessing the effectiveness of any treatment for any given condition is the double blind, randomised control trial (RCT). When properly conducted, random allocation to treatment group eliminates the possibility that differences in outcome between treatment groups are due to systematic differences in underlying risk between the groups. "Blindness" of subjects and assessors of outcome to the treatment given prevents observer bias and allows for the placebo effect. There are treatments with such dramatic and enormous benefit that their efficacy is obvious without the need for a formal trial, for example the introduction of penicillin to treat puerperal fever in the 1940s. However, most interventions in obstetrics have much smaller effects and an RCT is the only way to obtain a true unbiased estimate of their efficacy, though other study designs can suggest interventions promising enough to warrant a trial (Chalmers, 1989a). Randomised controlled trials have not, however, been done on all interventions of interest, and true "double blindness" is impossible to achieve for some. Evidence from other types of study on the effectiveness of interventions has been assessed for this review with regard to how far the research methods eliminate bias and confounding as possible explanations of any differences found or not found between treatments. The use and limitations of case control studies to assess the performance of treatments such as vaccination (Smith et al., 1984), and tests such as cervical screening (Moss, 1991) is well documented.

Though numerous assessments of various aspects of antenatal care in developing countries were identified, many of these did not provide any useful information on the
effectiveness of the care being provided. There are several reasons for this. Some studies only set out to measure the process (availability, uptake, number of visits, etc) of the services, and not health outcomes. Others measured various aspects of "quality" including the percentage of attenders who received particular tests or treatment, or were seen before a given point in their pregnancies. While this information is obviously useful for management of services, the value of those services in terms of improved health cannot be assumed until the effects of the individual interventions or the package on the outcome for mother and infant has been demonstrated. Many studies are too small and so lack the statistical power to show an effect on important outcomes. Adverse maternal outcomes are uncommon events, and results from many centres may need to be pooled to get a clear answer. This can only be done if the studies are similar in several aspects, and is best achieved by a planned multi-centre study. In many published reports there is insufficient information given to know whether data can be pooled. Unclear objectives and poor study design often mean that only part of the information needed to judge effectiveness is collected. For example, several studies of the risk approach report the percentage of women seen for antenatal care who are judged to be at high risk, or the percentage of those delivering in hospital who are high risk, but they don't give data on outcome for high and low risk groups, either in terms of process (eg percentage delivering where recommended) or health (eg percentage with obstructed labour, incidence of morbidity or mortality). Very few studies provide adequate details of the catchment population or possible biases in self or health service selection for attendance at the antenatal clinic or delivery in hospital. Large, carefully designed and executed studies with clear objectives are needed to establish the efficacy or otherwise of antenatal care. Rigorous peer-review of proposals and publications is needed to ensure the quality of future research.

2. ANTENATAL CARE PROGRAMMES

2.1 Rationale and overall effectiveness

The rationale for antenatal care is essentially that of screening a predominantly healthy population to detect early signs of, or risk factors for, disease, followed by timely intervention. As such, it should fulfill the criteria applied to assess the usefulness of any screening programme. These are (as developed from Wilson and Jungner, 1968):

a) that the outcome in question is an important public health problem in the population;

b) that there is a detectable preclinical phase or high risk state preceding this outcome;

c) that screening tests are sufficiently sensitive and specific to permit identification of those at risk;

d) that there is an effective treatment available for this early disease stage, and
e) that early intervention is more effective than waiting and treating overt disease.

Maternal mortality is undoubtedly an important public health problem in developing countries. It is possible to identify the precursors, early signs or risk factors for at least some of the major pathogenic causes of maternal death such as rising blood pressure which may proceed to eclampsia, or cephalo-pelvic disproportion leading to obstructed labour. However, evidence that antenatal interventions fulfil the remaining criteria used to assess a screening programme needs careful scrutiny. Figure 1 shows a model of the theoretical points along the road to maternal mortality at which intervention during pregnancy might act.

Antenatal care might theoretically reduce maternal morbidity and mortality directly through detection and treatment of pregnancy-related or intercurrent illness, or indirectly through detection of women at increased risk of complications of delivery and ensuring that they deliver in a suitably equipped facility. However, the realizable potential of antenatal interventions to address these problems is unclear for several reasons. Most formal investigations of the effectiveness of antenatal care programmes, whether in developed or developing countries, have concentrated on the effect of care on infant outcomes, perinatal mortality, preterm delivery and low birth weight. Analyses of historical data in England have shown that the fall in maternal mortality rates since the 1930s can be at least in part attributed to obstetric care, and particularly to improved delivery care reducing mortality from infection and haemorrhage (Loudon, 1991). Similar conclusions have been reached using data from the United States (Maine, 1991). It is more difficult to show a relationship with the introduction of antenatal clinics or particular interventions in pregnancy, even on the more chronic problems of anaemia and hypertension (Oakley, 1982; Tew, 1990). Associations between availability and use of antenatal services have been shown in various types of epidemiological study. Though the availability, content and quality of antenatal care varies enormously amongst developing countries, they are generally much lower in countries with high maternal mortality (Filippi et al., 1991). Hospital case series (Boes, 1987 a & b; Melrose, 1984) and confidential enquiries into causal pathways in maternal mortality frequently identify lack of antenatal care as a risk factor (Kwast, 1989; Walker, 1985 & 1986). Case control studies of maternal death in developing countries also show an association with lack of antenatal care (Bhatia, 1985 & 1986).

Despite the consensus from studies of different designs in favour of antenatal care, reservations about the extent of its true effectiveness must remain for several reasons. In places where antenatal care is lacking, delivery services are also likely to be poor and information systems unreliable. Confidential enquiries are intended primarily to identify deficiencies in standards, provision and utilisation of health services (Cook, 1989) which are known to be effective, such as blood transfusion. However, they generally lack control groups, as do the case series, and so cannot be used to establish the effectiveness of a given intervention or service. In developed countries, comparison of outcomes among women who did and did not receive antenatal care, or who first attended late versus early in pregnancy, have been shown to be confounded by socio-economic factors, education, wantedness of the pregnancy, maternal age and other factors which influence the outcome
of pregnancy (Strachan, 1986; Thomas et al., 1991). In developing countries there is likely to be further confounding with knowledge of, distance from, access to and utilisation of other health services including those for delivery. No studies have been identified which control adequately for these factors. Lastly, reports of programmes with no impact are less likely to be published. It appears pointless in the face of all these limitations to attempt to quantify the overall protective effect of an undefined and variable package of tests and treatments known as "antenatal care".

Despite all these caveats, however, there may be real benefit to be had from at least some of the elements of antenatal care, and the absolute scope for benefit may be greater in developing countries where morbidity and mortality are higher. In some developing countries far more women are seen by health workers during pregnancy than are delivered by a trained attendant (WHO, 1989b). This is therefore a chance to reach a larger section of the pregnant population, and it should be put to the most effective use possible. In addition, in high fertility societies, antenatal visits may afford a chance to reach a large proportion of the whole female population and an opportunity to address other health related issues. These include health education about, and awareness of services for, family planning, immunization, child health, nutrition, and sexually transmitted diseases.

Even high quality antenatal care cannot be a substitute for adequate emergency access to obstetric services. For instance, in a population attending regular antenatal clinics in Aberdeen, Scotland, it was found that there were more emergency admissions to hospital for problems occurring between visits than admissions related to abnormalities found during clinic visits (Hall et al., 1980). Antenatal surveillance can have little impact if services do not exist to manage the clinical problems identified (Maine, 1991; Bruce and Winikoff, 1990). As with all services for pregnant women the organisational problems in providing adequate care quickly for what are comparatively uncommon events in local communities, even in high maternal mortality countries, must be addressed. The balance between provision of services locally and transfer to expert district or regional centres depends on many factors, including prevalence of the disorder, availability and training of staff, distances, and transport. Effective treatment should be provided at the most peripheral or local level at which it is safe to do so, bearing in mind the necessity to train and motivate staff and the need to maintain their expertise.

2.2 The role of risk ascertainment

All antenatal care programmes throughout the world are based to some extent on risk ascertainment in that they attempt to screen the whole pregnant population and provide surveillance and treatment to individual women or groups of women according to their level of need. In the context of the low risks experienced by most women in developed countries, the rationale is to limit medical interference, and allow them informed personal choice while attempting to ensure universal access to high quality care. Though the same arguments apply to an extent in developing countries, there are important differences. The risks of childbearing are much higher for women in developing countries, to the extent that so called "low risk" groups experience higher mortality than so called "high risk " groups in Northern Europe (Briggs and Oruamabo,
1991; Campbell et al., 1991; Pearce and Chamberlain, 1991). In many developing countries formal delivery facilities are not sufficient to cover most of the population. The risk approach is an attempt to allocate existing resources according to a risk scoring system reflecting need rather than according to access or demand (Backett et al., 1986).

The effectiveness of a risk scoring system in its narrowest sense is measured by its ability to discriminate between women at high and low risk, that is by the sensitivity, specificity, and positive predictive value. However, for this strategy to be effective as a public health strategy several other conditions must be met:

a) the whole population must be included in primary screening;

b) conditions screened for must include the important causes of mortality and morbidity;

c) when increased risk is detected appropriate referral or other action must be taken;

d) adequate services must exist at the referral level;

e) women at risk must be able to reach the referral level facility and be motivated to do so.

With the data currently available, it is difficult to assess the discriminatory performance of risk scoring or identification systems. Reaching the whole population can be difficult, both because of physical distance and because those most at risk are often the least likely to use health services. There is evidence that simply identifying increased risk does not always lead to the required action, sometimes due to failure on the part of health workers to recognise the importance of the risk, but also because facilities are inadequate or inaccessible or women are unconvinced of the need to use them or of their effectiveness. The performance of programmes based on the risk approach has come under question, particularly where resources are scarcest, and there is worry that this approach may divert attention away from improving services for all women (Bruce and Winikoff, 1990).

Screening programmes all over the world face a problem sometimes referred to as the "inverse care law". It is often those at highest risk of adverse outcome who are least likely to have access to health services, particularly preventive services. Risk factors such as very young age, lack of education, and poverty are all associated with low use of health services. This was demonstrated in a recent study in India which found that women with more risk factors were less receptive to proffered antenatal supervision (Bhardwaj et al., 1991). In developing countries this may be compounded by distance from and ignorance of the existence or purpose of health services. In addition, in some areas cultural practices may prevent high risk women, such as very young primigravidae from revealing their pregnancies or seeking care (Harrison, 1985a; Hira et al., 1990).
Much of the work on risk scoring systems for use in antenatal care both in developed and developing countries has concentrated on predicting infant outcomes (Fortney and Whitehorn, 1982; Lilford and Chard, 1983; Selwyn, 1990) with maternal health risks regarded as secondary concerns. In fact, many of the risk factors for poor infant outcomes are also related to maternal risk, such as extremes of maternal age and parity, poor past obstetric history, and medical illness. This may be an advantage from the point of view of identifying all the women who need extra care in pregnancy, but risks to mother and infant may interact in complex ways, as for instance short maternal stature which is a predictor of both low birth weight and cephalo-pelvic disproportion. If interventions are undertaken to alleviate the consequences for the infant, without being aware of the maternal risk, problems for both may be increased.

Individual factors are poor predictors of risk, probably because they are only markers for groups of women at increased risk rather than direct causes of poor outcome. Attempts have been made to improve discrimination using complex scoring systems combining large numbers of variables (Fortney, 1982; Alexander and Kierse, 1989). The causation of maternal deaths is multifactorial, complex and not fully understood. The relationship with identifiable risk factors such as age, parity, or height is indirect, and shows continuous variation across their distribution. Reports on antenatal programmes referring to the risk approach lack sufficient information on maternal risk factors and outcomes to calculate the sensitivity, specificity, and positive predictive value of the factors used to identify women needing to deliver in a referral level facility, or the trade off between sensitivity and specificity. Some data is available on risk factors for particular outcomes, such as obstructed labour, and these are presented in the relevant sections of this report.

In settings as different as Java (Tanuwijaya et al., 1985), Burkina Faso (Sauerborn et al., 1989), and the United Kingdom (Chng et al., 1980; Guthrie et al., 1989) there is evidence of frequent failure to elicit important information on risk factors, particularly those based on past obstetric and medical history, and failure to take appropriate action when evidence of increased risk is elicited. In Java at least one in four women with previous stillbirths or child deaths were not noted by TBAs. In the United Kingdom, only 32% of women with a previous history of delivering infants light for gestational age, and 15% of cases of previous post-partum haemorrhage were noted by medical staff. The performance of the wide variety of check-lists and antenatal record cards designed to improve the recognition of important risk factors has rarely been evaluated. Antenatal records kept by the woman herself rather than the health worker or institution, on the other hand, can improve the transfer of information between levels and ensure that recorded information is available when it is needed. Home-based maternity records have been developed for use in many communities, in various languages and pictorial forms (Shah, 1988 & 1990; WHO, 1990d). Evidence is available that women lose their records less often than do institutions both in developed (Elbourne, 1992 in ODPT) and developing countries (Shah, 1990). An additional advantage of these records is that they have space for information on consecutive pregnancies, and intervening periods so that women and their health may be considered in full rather than as "index pregnancies".
As regards evaluations of antenatal care programmes based on the risk approach, there is also a paucity of rigorous published studies. One study of TBAs working within the health services in Fortaleza, Brazil showed that they referred 97% of 117 women in their care who had an antenatal complication (pre-eclampsia, eclampsia, haemorrhage or premature rupture of membranes). This accounted for half the total referrals, the other half being for problems arising in labour. No information is given on how many were referred for investigation or treatment before labour. There were no maternal deaths in this sample and no further information on maternal outcomes (Janowitz et al., 1985). In this setting TBAs seemed to be able to identify women at high risk of perinatal loss well, and to act appropriately. However they were working in shifts within the formal health services, in special delivery premises in their communities, visited by a nurse once a week, with an ambulance always available and not more than ninety minutes from the referral hospital. It would be difficult to achieve such a high standard in more isolated areas, with workers less closely integrated into the health services.

One study in three clinics in Maputo, Mozambique (one each urban, peri-urban and rural) found that though many women were successfully assessed, referred and cared for, less than half of those in the high risk group were actually seen at the referral centre, and from the rural clinic only 11% of women referred for delivery in hospital actually delivered there compared to 66% of those referred from the other two clinics (Jelley and Madeley, 1983). Distance appeared to be a stronger determinant of place of delivery than risk screening.

In a four year community based study of pregnancy and delivery in a rural area of Kenya (Voorhoeve, Kars and Ginneken, 1984), 84% of women attended an antenatal clinic at least once but only 27% delivered in hospital. In fact, only just over a third of women intending to deliver in hospital actually did so, and distance from the hospital town and the rainy season were shown to have a strong negative effect on the percentage of women delivering in hospital. Delivering in hospital in this study was, however, related to primiparity, height less than 150cm, history of a serious complication in a previous delivery, or of previous hospital delivery, which suggests that some degree of risk selection did occur. Of the 67 women with a previous caesarean section, 73% delivered in hospital. The only high risk factors associated with a reduced likelihood of delivering in hospital were grand multiparity and advanced age. The authors attributed this to older women’s personal experience of successful childbirth at home. The study is too small to assess any effect on maternal or perinatal mortality. Questioned while pregnant, women themselves gave safety and the availability of doctor, midwife and modern medicines as their reasons for choosing hospital delivery. Those who intended to deliver at home did so because of lack of transport or money, or because they had previous uncomplicated deliveries. One possible remedy for poor access to delivery services because of distance or transport problems is the maternity waiting home or village where women can live during the last weeks of pregnancy awaiting delivery near a hospital or clinic. By their nature, these serve isolated rural communities. Information about births and deaths in these communities is often incomplete and it is difficult to obtain data on which to assess the effectiveness of provision of waiting homes on morbidity or mortality.
There may be real scope for benefit from the risk approach when it is effectively carried out and backed up by adequate referral services. Identifying risk will not help women if the means to prevent or treat problems are not available or are inaccessible. In Senegal’s Kaolak hospital, for 80% of women referred in labour needing transfusion, this was not available, nor was anaesthesia for 64% of those needing it (Region Medicale de Kaolak, 1988). In the long run, this sort of failure of services can be very prejudicial to the implementation of the referral system. Women may refuse transfer to a distant referral centre if their experience is that women transferred have poor outcomes. This is a problem in any system based on high risk, as women referred are at higher risk of dying than those not referred, but it may be compounded where services are inadequate. The risk approach may enable health workers to identify women needing special care during labour and delivery, but this needs careful evaluation. At present it is not clear how well it works in practice in developing countries and large scale well conducted research studies with outcome data on both women and children are urgently needed.

3. INTERVENTIONS IN PREGNANCY RELATED TO MAJOR CAUSES OF MATERNAL MORBIDITY AND MORTALITY

3.1 Haemorrhage and anaemia

Obstetric haemorrhage is one of the leading causes of death related to pregnancy and childbirth throughout the world. Historically and geographically, the higher the overall level of maternal mortality, the larger the proportion of the total which is due to haemorrhage. Haemorrhage is usually an acute event, which can occur at any stage in pregnancy, delivery or the puerperium. Prevention of mortality from haemorrhage mainly depends on prompt treatment of its cause to prevent further bleeding and replacement of blood loss to maintain the circulation. These in turn depend on access to medical, surgical, intravenous fluid replacement and blood transfusion services, as outlined in Essential Elements of Obstetric Care at First Referral Level (WHO, 1991b). Post-partum haemorrhage can be prevented by active management of the third stage of labour, including prophylactic use of oxytocics (WHO, 1990c; Elbourne, 1992 in ODPT). Operational research on ways to improve third stage management by all types of birth attendant in home and institutional deliveries is needed.

The role of antenatal care in preventing or ameliorating the effects of this emergency is limited. Figure 2 shows the stages at which interventions in the antenatal period might theoretically influence the risk of death from haemorrhage. The first is by detection of those at increased risk of serious bleeding in labour and ensuring that they deliver in a facility which is adequately equipped. The second is by detection of adverse symptoms and signs developing during pregnancy and referral for prompt investigation and treatment. The third is by reduction in the prevalence of anaemia, so that women have a greater haematological reserve to withstand blood loss.
3.1.1 Risk assessment and referral

Identifying women at increased risk of haemorrhage will clearly only be of benefit if adequate delivery services, including active management of the third stage, blood transfusion and operative facilities, are available to and used by them. No direct assessment of the effectiveness of risk screening in preventing death from haemorrhage in developing countries has been identified for this review. Several risk factors for postpartum haemorrhage (PPH) are known: history of haemorrhage in a previous delivery, multiple pregnancy, and grand multiparity. A history of previous postpartum haemorrhage was found to be associated with a relative risk of 1.6 of recurrence, but only 6.3% of those with such a history suffered PPH in the index delivery (Chng et al., 1980). This study took place in Aberdeen where active management of the third stage is the rule, and the positive predictive value might be higher where this is not so. In Papua New Guinea, 49% of women with a previous third stage complication recorded antenatally went on to experience third stage complications again (Lennox, 1984). This study could, however be subject to considerable recall bias. Strikingly, clinicians in Scotland apparently only noted this risk factor in 15% of those in whom it was recorded by midwives.

Disseminated intravascular coagulation secondary to prolonged undelivered intrauterine death and clotting disorders related to pre-eclampsia or eclampsia may result in catastrophic bleeding at delivery. Women with hypertensive disorders of pregnancy (HDP) or intra-uterine fetal death should, anyway, be referred for expert care.

3.1.2 Identification and prompt treatment of symptoms and signs

The effectiveness of intervention for signs and symptoms of haemorrhage depends on immediate recognition of the seriousness of the situation, availability of first aid and knowledge of and access to definitive treatment. The potential roles of antenatal care are twofold:

a) enquiry about symptoms and signs of conditions such as placenta praevia and placental abruption, as well as the conditions which precede or predispose to them, at antenatal visits followed by appropriate action, and

b) in educating pregnant women and the community to recognise the seriousness of symptoms such as vaginal bleeding in late pregnancy themselves, and to act on them immediately.

Vaginal bleeding in late pregnancy is an alarming symptom and one expected to lead to immediate care seeking. However, it is not clear whether it is seen as dangerous in all cultures, or as a reason to seek medical help. Traditional interpretations of its significance and traditional remedies may delay women from presenting to health workers. Anthropological research is needed to clarify this. However, it is easy to attribute to cultural barriers what are often failures to provide adequate services or to make them accessible.
Many of the antenatal records developed for use in developing countries ("action oriented antenatal card") include spaces to enter information about bleeding in pregnancy, and instructions to refer the woman to the nearest health centre or hospital immediately. These are often in pictorial form, or both written and pictorial, and are used in TBA training. No studies of the effectiveness of these in reducing morbidity or mortality have been identified.

3.1.3 Prevention and treatment of anaemia

The haemoglobin concentration falls slightly in mid-pregnancy as a result of physiological haemodilution so that a larger proportion of pregnant than non-pregnant women will have a haemoglobin below any given cut off point. No untoward consequences of this relative reduction of haemoglobin on mother or fetus can be discerned in well nourished women. Indeed, failure of haemodilution and high haemoglobin throughout pregnancy is associated with poor fetal outcome, probably because it reflects a lack of physiological adaptation to pregnancy (Mahomed and Hytten, 1989). Oral iron supplements do prevent or reduce this fall in haemoglobin concentration and reduce the proportion of women whose Hb is below 10 g/dl in late pregnancy. However routine supplementation has not been shown to confer any benefit on mothers or infants in developed countries.

In areas where maternal mortality is high, the prevalence of anaemia is also much higher. It is estimated that over half of women of childbearing age in Africa have haemoglobin levels below 11g/l (WHO, 1992a). In addition to the morbidity of anaemia, it may contribute indirectly to mortality associated with haemorrhage and directly through heart failure. Most of these cases of anaemia are thought to be due to iron deficiency, and there is probably an even larger pool of women who, though not frankly anaemic, have insufficient iron stores for the needs of pregnancy, delivery and lactation (Hughes, 1990). In some areas haemoglobinopathy may be an important contributor to morbidity and mortality from anaemia. Paradoxically, as health services for children improve, more girls with homozygous haemoglobinopathy are likely to survive to adulthood and need special care during pregnancy (Tuck and White, 1991). Patterns of local prevalence will determine the need for screening for homozygous or heterozygous disease. Malaria may cause profound anaemia through haemolysis and in many areas is its major cause. Susceptibility to malaria is increased in pregnancy, particularly in primigravidae, and prophylaxis, investigation and treatment are important parts of care for all pregnant women in endemic and epidemic areas. The treatment and prophylaxis of malaria in pregnancy will not be dealt with in detail here as a report from a WHO expert working group dealing with this is in preparation. Local patterns of prevalence should determine policy on screening for malaria and other parasitic diseases which can be the underlying cause of anaemia. Reliable data on parasitic disease, though often better than data on maternal health, may not be available. Where there is doubt, small scale prevalence studies are then needed as a guide to practice.

In these circumstances routine administration of iron to all pregnant women prophylactically may prevent development of anaemia in large numbers of women with frank or borderline iron deficiency, or correct mild anaemia in many. There is, however,
a paucity of well conducted studies demonstrating this effect or an improvement in outcome for mother or infant. The potential for benefit depends on the actual prevalence of iron deficiency and iron deficiency anaemia in the population. The levels of anaemia, or mean haemoglobin concentration in the population, at which universal supplementation would be beneficial are not clear, in part because the level at which detriment to mother and/or fetus occurs is also uncertain.

Haemoglobin levels can rise between 0.4 and 0.7 g/dl per week on a dose of 120 mg ferrous salt with 5mg folate, so that moderate iron deficiency anaemia may theoretically be corrected by oral therapy in women attending for antenatal care in the mid-trimester. However, oral iron causes nausea and constipation, and the side effects appear to be related to the amount absorbed (Hughes, 1990). Not all studies demonstrate such marked improvement with oral therapy but it is not clear whether the differences in outcome are due to variations in absorption, perhaps related to other dietary factors, nutritional status or disease, to non-compliance with treatment because of side effects or cultural factors, or to failure of health services to deliver treatment or motivate women (WHO, 1990e). Intravenous or intramuscular iron is also proven to be effective in correcting iron deficiency leading to correction of anaemia (Hughes, 1990). This avoids the problems of compliance and gastrointestinal side effects, but requires facilities and skills for intramuscular injection or intravenous infusion and for emergency treatment of allergic reactions.

The realizable benefit will depend on dosage, coverage and compliance. The first essential step is to ensure that adequate supplies of oral iron are actually provided to pregnant women at appropriate times. Lack of supplies, poor access due to distance or limited opening times, artificial constraints on the quantities given per visit and other operational difficulties may make routine supplementation programmes ineffective. Even if supplements are provided, women must be motivated to take them.

A similar argument can be made for routine folate supplements, which again show no real benefit in communities in which deficiency is rare, but may be beneficial in developing countries where it is common (Mahomed and Hytten, 1989), and is particularly important where malaria is common.

Even if routine iron and folate supplementation is available, screening for moderate or severe anaemia is still needed, since women with more than mild anaemia need additional investigation and treatment. At present, for many rural women this is only done by inspection of conjunctivae and mucous membranes if at all. The sensitivity and specificity of clinical diagnosis using these methods has been shown to be poor. Reliable tests exist to detect anaemia and investigate its cause, including the standard technology used in developed countries, the Coulter counter, but difficulties are encountered in providing accurate diagnosis for the whole pregnant population. Research is planned or underway to develop appropriate technology for simple reliable methods of measuring haemoglobin (Hughes, 1990) as well as operational research on improving the availability and coverage of screening. The copper sulphate test can be used with acceptable reliability to detect anaemia below a chosen cut off point if reagents and training of health workers are provided. Alternatives being investigated or in use include colour charts for
comparison with conjunctival colour to improve clinical detection, battery operated centrifuges for haematocrit measurement and various colorimetric methods using diluted or undiluted blood specimens or dried blood spots.

3.2 Hypertensive disorders of pregnancy

Difficulties are encountered in comparing rates and studies of hypertensive disorders in pregnancy (HDP; includes pregnancy induced hypertension, pre-eclampsia and eclampsia) because of inconsistencies in definition and in detection (WHO, 1987b), but throughout the world they constitute one of the leading causes of maternal and perinatal death. In areas with high maternal mortality the proportion of all maternal deaths which are due to hypertensive disorders is relatively low because of the large number of deaths from haemorrhage and infection. However, the absolute risk of death from HDP is high in these areas both because of higher incidence and higher case fatality. Moreover, mortality from HDP is not as responsive to improvements in basic delivery care as is mortality from the other main causes. Duley (1990) has pointed out that the maternal mortality ratios for HDP are remarkably similar in Africa, parts of Asia and Latin America despite large differences in the all cause maternal mortality ratios.

Figure 4 shows the points at which interventions during pregnancy might improve maternal outcome from HDP. These include primary prevention, detection of increased risk, and early detection of any stage of HDP with secondary prevention of progression by treatment at primary level or referral for expert care. It must be recognised, however, that not all cases of HDP follow an orderly progression from mild to severe disease, and that women may be found to be suffering from any stage of disease including eclampsia without having apparently passed through the preceding stages. The natural history of HDP is not fully understood, and the relative importance of degree of hypertension, proteinuria, oedema, or biochemical abnormalities as indicators of severity of disease or prognosis is unclear (Redman, 1988).

3.2.1 Risk factors and primary prevention

The geographic variation in incidence (WHO, 1988a; Redman, 1988; Duley, 1990) suggests the possibility of prevention, if causes amenable to change can be identified. Nulliparous women are twice as likely to develop pre-eclampsia as are multiparas (Wallenburg, 1989), and this risk is particularly high at extremes of age. Multiparous women who have suffered from HDP in previous pregnancies are at increased risk compared to multiparas who have not (MacGillivray, 1983). Risk is also higher in those with a positive family history, obesity, or excessive weight gain in pregnancy. However none of these factors alone or in combination confidently predict women who will develop HDP (Wallenburg, 1989). Despite frequent suggestions to the contrary, incidence of HDP shows no consistent pattern with socioeconomic class or any dietary factor, including salt intake (MacGillivray, 1983; Green, 1989, Wallenburg, 1989). In reviewing trials of fish oil or calcium supplementation for the Oxford Database of Perinatal Trials, Duley has concluded that both these interventions show promise, but that large scale, carefully designed trials are needed, including long term follow-up of infants to exclude any deleterious effects (Duley, 1992 in ODPT). No other environmental
factors have been reliably demonstrated which could easily be manipulated for primary prevention of HDP.

Data from thirteen trials of low dose aspirin and or other antiplatelet agents to prevent pre-eclampsia and intra-uterine growth retardation were reviewed by Collins (1992, in ODPT; Collins and Wallenburg, 1989). Though the results so far available show promise, they are not conclusive. Further results are awaited from some of these studies, but even so larger studies are still needed to evaluate the true effectiveness of this promising intervention. One study is currently underway in Jamaica, where the incidence of proteinuric pre-eclampsia was found to be 4% (WHO, 1990a).

3.2.2 Early detection of hypertension and proteinuria and assessment of severity of disease

The wide variation in case fatality suggests that differences in care can improve outcome. In African countries the case fatality from eclampsia is estimated at between 7 and 25%, whereas it is only 1.4% in Sweden (Duley, 1990). There is epidemiological evidence that improved detection and care for women with HDP has improved maternal outcome, but little clear evidence of how or what specific treatments are effective. Redman (1988) points to the fact that most eclamptic fits in the United Kingdom still occur in hospital as evidence that early detection and treatment are not effective at preventing disease progression. However, this could also be taken to show that those women at risk of eclampsia are at least detected and admitted to hospital, where, even if specific treatments to prevent fits is not effective, supportive care is available and delivery can be expedited, so reducing mortality. Analysis of historical data for Sweden (Hogberg and Joelsson, 1985) suggests that the early fall in mortality from eclampsia seen there was primarily due to improved case survival, that is to better treatment of advanced disease, whereas the continued fall over the last two decades is accounted for by a falling incidence of eclampsia. There is a strong sense, backed up by data from confidential enquiries round the world (Walker, 1986; Department of Health, 1991) that women who die of HDP have usually received substandard pregnancy care, including failure to diagnose the condition until comparatively late or to act on the diagnosis promptly. In Jamaica, where HDP was the commonest cause of maternal death, accounting for 31% of the total, failure to recognise the severity of the condition, to refer to hospital, to start drug treatment or to expedite delivery were all noted as avoidable factors in a confidential enquiry (Walker et al., 1985, and 1986). However, such enquiries lack any comparison group to show that standard care improves survival, or to indicate which element of detection or treatment might be responsible. A recent analysis of data on 13,127 women in the 1970 British Births Study did not show any reduction in the incidence of pre-eclampsia or eclampsia in women booking early for antenatal care compared to those who booked late, but even larger prospective studies than this may be needed to show an effect of treatment on progression from pre-eclampsia to eclampsia (Thomas et al., 1991).

Roughly half of the deaths associated with HDP in the UK are related to pre-eclampsia and half to eclampsia, though the incidence of pre-eclampsia is estimated to be a hundred times that of eclampsia (Redman, 1988). In developing countries the great majority of fatalities are due to eclampsia (Walker, 1985; Yosef and Kifle 1988;
Mtimavalye, 1980; Munoz-Aguero, 1980; Duley, 1990), and the percentage due to eclampsia is higher where antenatal coverage is lower. This is often taken as evidence of higher probability of progression from pre-eclampsia to eclampsia in the absence of antenatal care (Duley, 1990). The observed differences in proportional mortality from pre-eclampsia and eclampsia may, however, be subject to selection and/or detection bias. For instance, selection bias can affect hospital based studies because women who fit are more likely to be admitted to hospital than those who do not. Even population based studies which trace all maternal deaths in the community may be subject to detection bias in ascribing cause of death. Fits are a striking and memorable occurrence, easily reported by a lay informant, and generally taken as pathognomonic of eclampsia in a pregnant or recently delivered woman who subsequently dies. A retrospective diagnosis of pre-eclampsia is more difficult to establish post-mortem in the absence of antenatal recordings of hypertension, proteinuria or oedema. Carefully conducted case control studies of women dying from, compared to women surviving, severe HDP could give estimates of the effectiveness of early detection and clues as to which elements of care are worth investigating in large scale trials. It is difficult to separate the effects on mortality or morbidity from HDP of lack of access to early detection of HDP and lack of access to referral level services for treatment and delivery.

Early detection of hypertension and proteinuria is possible with relatively simple instruments. Measurement of arterial blood pressure is the most sensitive screening test for diagnosing HDP, but not all women with arterial hypertension in pregnancy have or develop proteinuric pre-eclampsia, and some women present with sudden onset of eclampsia with little preceding hypertension. In a retrospective record study in a routine antenatal clinic in Scotland, measurement of blood pressure antenatally had a sensitivity of 71%, a specificity of 95% and a positive predictive value of 40% for pre-eclampsia during pregnancy, labour or puerperium (Hall et al., 1980). In addition, the performance of a test which must be repeated at intervals will depend on the interval chosen and the speed with which the condition appears. The ideal timing and frequency of blood pressure measurement has not been determined (US DHHS, 1989). Pregnancy induced hypertension, by definition, is hypertension occurring after 20 weeks of gestation in a previously normotensive woman, implying the need for at least one early or pre-pregnancy baseline measurement to differentiate this condition clearly from chronic hypertension in a pregnant woman. Blood pressure tends to fall in mid-pregnancy and rise again in the last trimester. In addition it is not entirely clear whether an absolute level of diastolic (fourth sound) pressure of >90mm Hg, or a rise in diastolic pressure of more than 20mm Hg, or a combination of the two is the best diagnostic and prognostic sign (Wallenburg, 1989).

A problem in interpreting the effect of many screening tests is that of length bias: milder disease, which progresses more slowly and has a better prognosis is more likely to be picked up by screening than is more aggressive disease, and this may give a falsely optimistic view of the effect of screening on outcome (for example screening for breast cancer). The natural history of pregnancy induced hypertension is not well enough understood to assess this properly. On the one hand, it rarely appears before 28 weeks, but when it does the prognosis is worse so that more serious cases are picked up sooner by earlier measurement. For this reason Wallenburg (1989) recommends monthly blood
pressure measurement throughout the second trimester. On the other hand, severe pre-eclampsia or eclampsia can develop very suddenly, and the relative contribution of this to the severity of disease or poor prognosis in those diagnosed late is not clear. The minimum number and timing of measurements to detect most cases reliably and early is not known.

In many developing countries blood pressure measurement is not available to all women at the primary level. Requirements in terms of equipment and skills are set out in WHO guidelines (WHO, 1992b). The difficulties of ensuring universal blood pressure estimation prompted a study of the accuracy of prediction and diagnosis of pre-eclampsia from the presence of oedema or proteinuria or a combination of both (Golding et al., 1988). Unfortunately, even using either oedema or proteinuria detected only 43% of women who developed antenatal diastolic hypertension, and 35% of those who developed eclampsia. Detection of pre-eclampsia was better, with a sensitivity of 76%. These levels of sensitivity do not suggest that detection of oedema and proteinuria should be advocated as an alternative primary screening test to blood pressure measurement, though it may have a place as an interim measure in some areas until universal blood pressure screening can be provided.

Widening the availability of blood pressure measurement at primary care level could be tackled from two angles, development of appropriate technology and operational research. Training health care workers to take blood pressure measurements in a reliable, unbiased fashion can be difficult anywhere in the world. Several other measurements needed at primary level have been revolutionised by simplification, such as colour coded arm circumference tapes to replace numerical measurement tapes. It is more difficult to imagine how to develop simpler technology for BP measurement, but this should be explored. It might be possible to develop a measuring device with a single cut off point for diastolic (or systolic ?) pressure as a first screening test for hypertension and referral for further investigation. Even a simplified scale might help, for instance with colour coding for normal/abnormal. Systolic pressure is easier to measure, as it can be done by feeling the radial pulse, but diastolic is thought to be more important in prognosis.

Urinalysis to detect proteinuria is also recommended in women with pregnancy induced hypertension, as this is an important prognostic factor. In those who are normotensive a positive result may indicate urinary tract infection or renal disease. A very small percentage of women who develop pre-eclampsia may show proteinuria before the rise in blood pressure, but it is not clear whether universal urinalysis at every antenatal visit in the absence of hypertension is worthwhile. Accurate chemical tests and reagent strips are available relatively cheaply for detection and quantification of albuminuria (PATH, 1988). However, reliable tests are not universally available or used at primary level. Research into appropriate technologies, and operational research on how best to provide an accessible screening system are needed (Guidotti and Jobson 1989 & 1991).

Dependent oedema is common in normal pregnancy, but generalised oedema is a sign of pre-eclampsia. Examination of all pregnant women to detect oedema at primary health care level is often advocated, and is particularly necessary in those who develop
hypertension, or where blood pressure measurement is not available. Examination for oedema of hands, face and sacrum does not require any equipment, and only modest skill. Where more accurate diagnostic tools are not available at the primary level, pregnant women, their attendants and the community could all be taught to recognise generalised oedema as a sign needing rapid referral to a centre where blood pressure and proteinuria can be measured, and treatment arranged. The potential effectiveness of this strategy is not clear, but may be limited in view of the sensitivity found in the WHO collaborative study of proteinuria and oedema discussed above (Golding et al. 1988 and 1990) and the problems of ensuring referral and transport.

3.2.3 Treatment

Given that the effects of early detection are hard to demonstrate, it is not surprising to find that the effects of treatment are equally uncertain. Women with pre-eclampsia and eclampsia appear to experience better outcomes when they have access to and use professional care. In the last fifty years, during which mortality rates from HDP have fallen dramatically in developed countries, treatments have come and gone, untested by trials, and with unknown effects on the case fatality. The treatments advocated have included heavy sedation with barbiturates, enforced rest in a darkened room and prophylactic forceps delivery under sedation or general anaesthesia. Over the same period, in developed countries, general supportive measures have improved, as has care and detection of complications such as clotting disorders, more effective drugs for inducing labour to expedite delivery have been developed, and the safety of anaesthesia and caesarean section has increased. The contribution of these advances to the reduced mortality from HDP is uncertain.

The current debate on the treatment of HDP centres on the role of rest, anti-hypertensives and anti-convulsants. Rest, either in hospital or at home has a long history in the treatment of mild pregnancy-induced hypertension and pre-eclampsia. Crowther has reviewed the evidence for the ODPT (Chalmers, 1992). She concluded that there is as yet insufficient evidence from the two small trials available of bed rest in hospital for women with non proteinuric hypertension to assess its effectiveness in preventing proteinuric pre-eclampsia or a rise in diastolic blood pressure of 10 mm Hg or more. Two trials of strict bed rest in hospital compared to hospitalisation with no restriction on movement, actually appear to show an increased risk of fulminating pre-eclampsia in the rest groups, but the numbers are small and the effect could be due to chance (Crowther, 1992 in ODPT). Questions remain on the effectiveness of rest at home or in hospital in treating mild pregnancy induced hypertension. Evidence from developed countries may not be directly applicable to developing countries where women are often involved in heavy physical work for much of the day and where rest at home may not be possible, but the information to judge the effectiveness of rest for pre-eclampsia in developing countries does not yet exist. Rest in hospital might have an indirect beneficial effect through putting women at risk of progression to more serious stages of HDP within reach of medical care. The proportion of women who might benefit in this way cannot be quantified at present, nor its inverse, the proportion who would be admitted to hospital unnecessarily.
Overviews of trials of various anti-hypertensive drugs, including diuretics, beta blockers, hydralazine and methyl dopa, indicate that anti-hypertensive treatment does prevent further increase in blood pressure when given to women with mild or moderate hypertension. However, neither the effects on the development of proteinuria nor the final outcome for mother and infant are clear, and further trials are needed on a scale large enough to determine these. At present there is little to recommend one drug or type of drug over another (Collins and Wallenburg, 1989; Collins and Duley, 1992, in ODPT). Similar conclusions have been reached in the case of severe pre-eclampsia and eclampsia; and which anti-hypertensives drugs to use to control blood pressure, and maybe to reduce the risk of hypertensive encephalopathy and cerebral haemorrhage is unclear (Collins and Wallenburg, 1989).

Current practice in anti-convulsant therapy for fulminant pre-eclampsia and eclampsia is very different in the UK, North America, and Sweden, though all three countries achieve low case fatality rates. Magnesium sulphate is the drug of first choice in North America, while diazepam or other benzodiazepines are favoured in the UK, and "lytic cocktails" containing hydralazine, with one or more of chlorpromazine, pethidine, diazepam and chlorothiazide in Sweden (Collins and Wallenburg, 1989). Trials comparing magnesium sulphate and diazepam do not yet give definitive evidence in favour of either, though there is a suggestion that the former may better prevent further fits, albeit at the expense of a higher caesarean section rate (Duley, 1990). The place of prophylactic anti-convulsants in severe pre-eclampsia is not clear.

3.3 Obstructed labour

Obstructed labour is, by definition, a problem specific to labour and definitive treatment, including caesarean section, must be available to improve the outcome for mother and infant. It is in situations where access to professional delivery care, including operative delivery, is poor or delayed that obstructed labour may frequently result in maternal mortality or morbidity, such as vesico-vaginal fistula, as well as perinatal mortality (WHO, 1989a). Interventions in pregnancy along this pathway can be aimed at primary prevention, or at detection of women at increased risk and their referral for delivery in a well equipped centre, as indicated in figure 5.

3.3.1 Primary prevention

Obstructed labour is usually due to cephalo-pelvic disproportion (CPD) or malpresentation. Strategies for primary prevention of CPD include improved nutrition of girls to ensure they reach their full growth potential, and interventions to delay first births till women are fully grown. These interventions include contraception, education, delayed marriage and improved economic opportunities for women, which are outside the scope of antenatal care. There is some encouraging evidence that antenatal care for very young primigravidae may increase their own growth during pregnancy. In Zaria, Northern Nigeria, a combination of nutritional supplementation (iron and/or folate) and treatment of malaria increased linear growth in teenage primigravidae (Harrison et al., 1985b). More than half the subjects in this small study were however excluded for noncompliance or were lost to follow up, leaving only 69 girls in the final analysis. Some doubt has also
been cast on the measurements of height in this study, as some girls increased their stature by very large amounts, and height is notoriously difficult to measure reliably (Scholl et al., 1988). Pelvic growth is completed later than growth in height, and the true gain during pregnancy is not clear. Further careful randomised control trials are needed to see whether nutritional supplementation and antimalarial chemoprophylaxis in teenagers does decrease their risk of disproportion and obstructed labour. The possibility remains that nutritional supplementation may, as it can increase birth weight in malnourished mothers (Rush, 1989), increase the risk of disproportion and need for caesarean section. Adequate provision for and access to operative delivery would then be a prerequisite of such a supplementation programme to women of any age or parity. Insufficient evidence is available as yet to address this question.

3.3.2 Risk assessment and referral

Many attempts have been made both in industrialised and developing countries to predict which women will develop obstruction in labour, based on detection of feto-pelvic disproportion and malpresentation.

The best test of pelvic capacity is labour, and feto-pelvic disproportion can be virtually ruled out in a woman who has previously delivered a good sized infant, unless her current fetus is very large. In Zaire multigravidae who had required intervention in a previous delivery, or had a stillbirth or neonatal death were found to be at ten times the risk of obstructed labour of multigravidae without these risk factors (Kasongo Project Report, 1984). However the positive predictive value of this test was only 10%, and its sensitivity 29%.

This population, unusually, showed a higher risk of "life threatening feto-pelvic dystocia" including transverse lie and ruptured uterus, among women having their second birth than in primigravidae or grand multiparas. The authors put this down to the high proportion of low birth weight babies in primigravidae, but it might also reflect some selection amongst women attending for care based on the level of difficulty of their first birth. A study in Papua New Guinea found that 23% of 119 women with a previous long labour had complications in the index delivery, compared to 12% of women without such a risk factor. However, none of these required operative delivery, the problems being third stage complications and sepsis (Lennox, 1984). Lennox has also found that a history of previous long labour may be poorly recorded. Only 10% of 51 women in Papua New Guinea with this risk factor had it correctly identified and recorded on action-oriented antenatal cards (Lennox, 1981), compared to 100% recording of previous caesarean section (number=4).

Information on previous obstetric history clearly is not available for primigravidae, who might all therefore be regarded as high risk. However, the majority of primigravidae will not experience prolonged labour or obstruction, and a more specific test, with higher predictive value is needed where specialist delivery services are scarce. The simplest additional screening tests used are maternal height, foot size and age, as proxies for internal pelvic diameters. Hofmeyr (1989), reviewing studies from around the world concluded that, though short stature, small foot size and very young age are undoubtedly
correlated with risk of cephalo-pelvic disproportion and caesarean section rates, they are poor discriminatory tools. Maternal height is probably the most widely used. In Aberdeen, Scotland, 17% of women less than 152 cm tall were delivered by caesarean section, and 11% by rotational forceps, compared with 8 and 5% respectively of taller women (Chng, Hall and MacGillivray 1980), giving a positive predictive value of 28%. It is not possible from this published report to obtain estimates of sensitivity or specificity. The performance of maternal height as a screening test depends on the chosen cut-off point. The taller the at-risk height is set, the better the sensitivity, but at the cost of poorer predictive value and specificity. Though 150 cm is often quoted as a cut off point to define high risk, in fact the most appropriate "at risk height" is variable between populations, with average height, and probably within populations, over time with cohort changes in average height. One of the weaknesses of maternal height in predicting CPD is that it is a risk factor both for the mother having a small pelvis, and for risk of having a low birthweight baby. It is possible that a combination of maternal anthropometric measurements reflecting both long term (eg height) and current (weight, weight for height, weight gain, arm circumference) nutritional status might discriminate better between women at risk of CPD and low birth weight, but this is not yet clear and further research is underway (Maternal anthropometry, 1991).

Clinical pelvic assessment by manual examination is a part of routine antenatal care in industrialised countries, usually performed by an obstetrician, but sometimes by a midwife or general practitioner. If it were a reliable test it might be used as a secondary level screen in conjunction with referral of women of short stature or very young age, to distinguish before labour those women at high risk of CPD. This strategy was adopted in a study of the risk approach in Sirur, India, but insufficient outcome data is provided to assess its effectiveness (Sirur Project, 1985). There is some evidence that experienced examiners can identify women with severely contracted pelvis (Bauer 1988) but insufficient data are available to assess the reliability of clinical examination in identifying women at high risk of obstructed labour, or its effectiveness as part of an antenatal care programme. The significance of non-engagement of the fetal head near term particularity in women of African descent is not clear (Hofmeyr, 1989). In Kasongo, amongst 837 primigravidae who attended an antenatal clinic during the ninth month of pregnancy and had engagement recorded by an auxiliary midwife, 176 were recorded as not engaged. Seventeen percent of these women went on to "life threatening feto-pelvic dystocia" in labour compared to 1.5% of those in whom the head was engaged (p < 0.001). Non-engagement did not predict an increased risk of forceps or ventouse delivery, and data on length of labour are not given. The numbers were, however, small and more data are needed (Kasongo Project Team, 1984). Clinical tests such as whether the head will engage on half sitting have been advocated, but their usefulness cannot be assessed from available evidence. Even the reliability of x-ray and ultra-sound pelvimetry to predict fetopelvic disproportion remain in doubt (Hofmeyr, 1989), leaving little scope for antenatal screening to improve outcome by arranging delivery appropriate to risk, unless reliable screening tests, which combine acceptable levels of sensitivity and specificity, can be established.

The other major immediate causes of obstructed labour are malposition or malpresentation. These are more frequent in grand multiparae and in multiple
pregnancies. Obstetric history, including number of previous deliveries and difficulties experienced, is the first step in assessing risk, and can be assessed at any time during pregnancy. In the Kasongo study (1984), multiparous women with a history of complicated delivery had a relative risk of 42 for "life threatening feto-pelvic dystocia" (LTFPD) in labour, which included transverse lie and ruptured uterus. This history identified six of the 48 multiparas who had either LTFPD or "abnormally prolonged labour", (APL, defined as needing forceps or ventouse delivery, not by length of labour) delivering in the study hospital, yielding a sensitivity of 12.5% and a positive predictive value of 15%.

Abdominal examination by a skilled examiner in late pregnancy can reveal multiple pregnancy, polyhydramnios and abnormal lie, presentation, or position of the fetus. The closer to labour that examination is performed, the more accurately it predicts the actual presentation and position of the fetus in labour. External cephalic version (ECV) of breech presentations at term, but not before, has been shown to reduce the rate of caesarean section and of breech delivery (Hofmyer, 1989, and 1992 in ODPT). However, there is insufficient evidence to judge the effectiveness of ECV in transverse and oblique lies, which are much less common, and it is not possible to extrapolate from the effect on breech, as the causes may be different and may be associated with a greater degree of instability after version. In the Kasongo study, 69% of multigravidae (2494 women) attended the antenatal clinic during the ninth month of gestation and had the position of the fetus noted on antenatal cards by an auxiliary midwife. Only 19 cases of transverse lie were recorded, and only one of these had LTFPD, and none APL. It is not possible, however, to make any assessment of the accuracy of the auxiliary midwife’s diagnosis or its predictive power from the published data.

More data from epidemiological studies are needed to assess the accuracy of clinical examination by primary health care workers and specialists to detect abnormal lie, and to make an estimate of the likelihood that position would change between examination near term and labour. Large scale studies are needed to determine the level of skill required to detect abnormal presentation near term and its predictive accuracy for malpresentation in labour. Transverse and oblique lie, with their very serious risks to mother and infant, should be easier to detect than breech, even with very moderate skill or training, but insufficient reliable data were found with which to examine this. In the current state of knowledge, women with these presentations near term must be advised to deliver in a fully equipped referral level facility. The problems of ensuring that this occurs, as in any risk and referral system must be dealt with. Large scale multi-centre trials would be needed to assess the value of ECV at term to correct transverse and oblique lies and so prevent obstructed labour.

3.4 Puerperal sepsis and genito-urinary infection

3.4.1 Puerperal sepsis

The proportion of maternal deaths related to puerperal infection appears to rise with the total maternal mortality ratio. Figure 6 shows the possible ways in which care
during pregnancy might reduce the risk of death or long term sequelae from puerperal infection. These include: risk detection and referral; health education for clean delivery and about seeking care for signs of infection or ruptured membranes; supply of clean delivery kits to women to prevent unclean delivery; detection and treatment of genital tract infection present prior to labour; and recognition of and treatment after pre-labour rupture of membranes.

Although reliable data are hardest to obtain in areas where the risk is highest, the risk of infection and death appears to be related to lack of trained assistance at delivery and poor obstetric facilities. Historical data suggest that most puerperal sepsis is related to infection introduced at delivery and that the risk is increased in proportion to the frequency of vaginal examination and intervention during labour. The early improvement in maternal mortality from puerperal sepsis in developed countries arose primarily from improved hygiene practices at delivery. Later, the introduction of antibiotics to treat infection virtually eliminated deaths from this cause in industrialised nations (Loudon, 1991).

Following this model, the role for antenatal care in reducing mortality and morbidity from infection would be limited. Health education to promote clean delivery in the home, distribution of "clean delivery" kits directly to pregnant women, and promotion of delivery by trained attendants might prevent some infection. Education might also lead to better recognition of the importance of symptoms and signs of infection after delivery and earlier care seeking. However the crucial factors giving rise to unclean delivery are probably more related to poverty and lack of facilities for any alternative than to ignorance, and thus the effect of health education alone is likely to be small.

In addition, the potential of referral for institutional delivery based on assessing likely risk of infection at delivery is probably slight. Many risk factors are likely to be features of the community in which a woman lives, and the delivery care and facilities available to her rather than ones which could distinguish between women at high and low risk in a given community.

One of the most successful interventions in pregnancy in developing countries has been the introduction of maternal vaccination to prevent maternal and neonatal tetanus resulting from infection at delivery. Although often implemented through antenatal care programmes, the coverage and so the operational effectiveness has been greatly increased by inclusion in Expanded Programmes of Immunisation, through targeting all women of childbearing age, and active outreach programmes (Stanfield & Galaska, 1984).

The role of pre-existing lower reproductive tract infection in puerperal infections is not clear. Though it may not account for much acute puerperal fever and mortality, it may be related to much more low grade infection and chronic morbidity including pelvic inflammatory disease and secondary infertility. Epidemiological studies are needed to clarify the prevalence of various infections and their contribution to morbidity and mortality in various developing countries.
Prolonged rupture of the membranes before delivery carries an increased risk of ascending infection. This is true both in prolonged labour with ruptured membranes and rupture of the membranes prior to full-term or pre-term labour. The risk is increased by the number of vaginal examinations performed. Current evidence does not support induction of labour in the case of uncomplicated pre-labour ruptured membranes either before or at term. Trials of induction fail to show a significant reduction in subsequent infection in mother or child, and the risk of caesarean section is increased (Grant and Keirse, 1989; Crowley, 1992 and Hannah, 1992, both in ODPT). In preterm rupture of membranes in women not in labour, prophylactic antibiotics do appear to reduce the risk of subsequent infection and to prolong pregnancy, and corticosteroids reduce the incidence of respiratory distress (Crowley 1992, in ODPT). It is difficult to be certain that the balance of risks and benefits seen in these trials, predominantly from industrialised centres, is directly applicable to developing countries. The use of corticosteroids is not without risk, and assumes a reliable estimate of gestation. Women with pre-labour rupture of membranes should be referred quickly to a level at which skilled assessment and management are available. Depending on local circumstances, it may be appropriate to begin treatment with antibiotics and even corticosteroids before transfer. Routine antenatal care has a limited place in prevention and management. Pregnant women can be taught about the importance of seeking care promptly when the membranes rupture, but the means for them to do so must be provided for this to be effective. No assessment of the effectiveness of this sort of health education has been found during this review. Ascending infection from the lower genital tract may predispose to membrane rupture and chorio-amnionitis (Wang and Smaill, 1989), so investigation and treatment of vaginal discharge in antenatal clinic attenders could prevent some cases, as could screening for and treating sexually transmitted diseases.

3.4.2 Sexually transmitted diseases (STD)

Sexually transmitted infections during pregnancy can give rise to serious maternal morbidity and to perinatal mortality and morbidity, though early infection in women is often asymptomatic. Screening of all pregnant women has long been advocated, both because of specific risks of consequences of infection in pregnancy to the woman and fetus, and as opportunistic screening of a sexually active population in an attempt to control the spread of disease. The evidence that opportunistic screening is effective in controlling the level of disease in the population is limited, but the scope for benefit to the health of women and children may be very considerable if the prevalence is high.

Information on prevalence of syphilis, gonorrhoea and other STDs in the local population is needed before deciding whether universal screening should be a priority, but this is an area in which antenatal care clearly can have an important benefit for mother and child. Analyses in the United Kingdom and United States of America have demonstrated continuing high cost benefit ratios for a policy of routine screening for syphilis despite low prevalence (Stray and Pedersen, 1983 and Williams, 1985, cited in Wang and Smaill, 1989). Many developing country studies have found seroprevalence rates of syphilis amongst pregnant women of between 5 and 15%, which is one or two orders of magnitude higher than those in industrialised countries today, but similar to levels reported in the early part of this century (Friedman and Wright 1977; Osoba, 1981;
Ursi et al., 1981; Hira et al., 1990) so the scope for intervention is huge. Schulz et al. estimate that systematic screening and treatment of syphilis in pregnancy would be at least as cost-effective in terms of child health as is the Expanded Programme of Immunisation (Schulz et al., 1991). A recent study in Zambia found a seroprevalence of 8% amongst antenatal clinic attenders, and a predictive value of 58% that these pregnancies would result in abortion, stillbirth, prematurity, low birth weight or congenital syphilis compared to 10% amongst seronegative women (Hira et al., 1990). In this population syphilis was the single commonest cause of adverse outcome of pregnancy. The study highlighted three major failings by the routine antenatal service: (1) failure to screen 80% of clinic attenders, even though serology in this clinic was supposed to be mandatory; (2) failure to treat three-quarters of those found to be positive, or almost any of their partners; and (3) failure to detect infection acquired during pregnancy, after initial screening. Even during the intervention study, screening and treatment were suboptimal, but the percentage of adverse fetal outcomes was halved.

Several reliable tests for syphilis exist, some more sensitive, and some more specific than others and at varying cost. Rapid, cheap serological tests are available which give almost instant results. Using these means women can be screened and treated in one clinic visit, thus improving the take up of treatment. Routine screening is of no use if adequate treatment, follow-up and treatment of partners is not available. All these components should be integrated into routine antenatal care. Operational barriers to effective screening and treatment of all pregnant women need to be identified and overcome. Guidelines on appropriate tests for initial and follow up serology in different situations are being developed by the WHO. Screening high risk groups, coupled with investigation of women with symptoms, or whose partners report symptoms is a "second best" alternative, but only in areas of proven low prevalence. Investigation and treatment, or even presumptive treatment of women with genital ulcers and their partners may have an impact on transmission of HIV, though studies of this are still underway. Women at high risk of acquiring infection should be screened both early and late in pregnancy, which, in some areas, will mean repeated screening of all women.

Wang and Smaill (1989) have reviewed the effectiveness of screening for gonorrhoea in pregnant women, mainly in developed countries, and find that it is justified by the potential benefit, even where prevalence rates are not high. The risks to a woman's health of gonococcal infection may be increased by pregnancy. There is some evidence that blood-borne spread, giving rise to disseminated infection and involvement of joints and other systems, occurs more commonly in pregnant than non pregnant women. Ascending infection may lead to septic abortion in early pregnancy, or chorio-amnionitis and pre-labour rupture of membranes. Maternal gonorrhoea may occasionally lead to severe disseminated neonatal infection but by far the commonest complication in neonates is ophthalmia neonatorum. Universal application of silver nitrate or tetracycline eye drops at delivery is a cheap and effective strategy for preventing blindness due to ophthalmia neonatorum in infants (Schulz, 1991). This can make a significant impact on child health cheaply without the need for screening, but it does nothing to improve the health of women with gonococcal infections who need effective systemic antibiotics to prevent immediate and long term complications of infection. Definitive diagnosis of gonorrhoea depends on culture of a fairly fastidious organism, and so necessitates access
to a microbiological laboratory, though a presumptive diagnosis can be made on microscopy. Nevertheless, Wang and Smaill (1989) advocate screening of all pregnant women early in pregnancy by culture, with repeated testing for high risk groups of women. The benefit of universal screening again depends on local prevalence.

Investigation of symptomatic women and women whose partners have symptoms or confirmed gonococcal infection is also very important. As with syphilis, effective safe treatment for gonorrhoea exists, though knowledge of local patterns of antibiotic resistance or culture for sensitivity is needed. Presumptive treatment of symptomatic women and their partners may be necessary where laboratory diagnosis is not available, particularly if prevalence is known to be high. Local prevalence surveys may be needed to establish this, and they could be used to identify locally appropriate risk factors. Ascending infection at delivery or afterward may contribute to secondary infertility. Epidemiological research, including case control studies of pelvic inflammatory disease and secondary infertility could be carried out to investigate this risk.

Even in developed countries the prevalence and consequences of chlamydial infection are less clear. Infants of infected mothers are at risk of inclusion conjunctivitis and pneumonia. Infection may be related to abortion, preterm delivery and low birthweight, but a causal link has not been proven. Chlamydial infection may give rise to cervical discharge or dysuria, but is often asymptomatic. Diagnosis rests on sophisticated laboratory techniques of cell culture or antigen immunofluorescence. These are rarely available to all women in developing countries. How important chlamydia will prove to be in terms of chronic morbidity is not yet clear, and deserves some attention, but the detection and treatment of syphilis and gonorrhoea are both of greater priority and more easily achieved.

In some regions of the developing world, infection with the human immunodeficiency virus is the overriding public health problem in young adults and children. This important subject cannot be covered in detail in a report of this length. It is no longer thought that pregnancy accelerates the progression to AIDS or other long term sequelae in women infected with HIV in developed countries and infection is not regarded as a definite indication for termination of pregnancy. Estimates of the rate of vertical transmission vary greatly, but the most recent results from reliable cohort studies suggest that it is lower than previously thought, probably about 35% (Newell et al., 1991). Screening of women at high risk, or in areas of high risk has been advocated (Wang and Smaill, 1989), though the main consequences of a positive result at present is in counselling about the advisability of further pregnancies and avoidance of transmitting the infection, and in early detection and treatment of opportunistic infections. Anti-retroviral drugs are used in late pregnancy in developed countries though their effects on the fetus and on materno-fetal transmission are not known. No specific references to the risks of bacterial infection at delivery in women with HIV or AIDS were found. There is, however, an increased risk of active tuberculosis in those infected with HIV.
3.4.3 Urinary Tract Infection (UTI)

Screening in pregnancy for asymptomatic bacteriuria and treatment with antibiotics of positive cases is widely recommended (US DHHS, 1989; Wang and Smaill, 1989; Smaill, 1991), following evidence from randomised control trials that treatment reduces the risk of pyelonephritis, cystitis, preterm delivery and low birth weight. Whether the reduction in preterm delivery and low birth weight is due to reduction in pyelonephritis or via eradication of micro-organisms, particularly beta haemolytic streptococcus, in the cervix is not clear (Smaill, 1991). In these trials screening was generally done early in the first trimester, and this is when it is recommended by the report "Caring for Our Future: the Context of Prenatal Care" (US DHHS, 1989), though it is not clear whether the timing matters, or whether anything is to be gained by repeated screening. Most bacteriuria, like most symptomatic UTIs, is due to E. coli. Short courses of antibiotics appear to be as effective as longer courses, and there seems to be little to choose between ampicillin and other antibiotics in terms of effectiveness. The benefit of this strategy will depend on the prevalence of asymptomatic and symptomatic urinary tract infection in the population. Reliable estimates from developing countries are difficult to find. A study from India in which antenatal clinic attenders were screened for asymptomatic bacteriuria, using the Griess test for nitrates in the urine, gave a prevalence in this population of 2.7%, at the low end of the range 2 to 20 % reported in studies from industrialised countries (Joseph et al., 1988). Further research is needed on appropriate technology for screening for bacteriuria in populations where prevalence studies indicate that screening would be worthwhile.

3.5 Interventions related to other maternal health outcomes

Pregnancy and childbearing have a profound and long lasting effect on women’s health and influence the risk of mortality from most major causes. Pregnancy involves enormous physiological changes involving all bodily systems over a relatively short period. It is therefore not surprising that it influences the risk and course of many diseases. Indirect maternal mortality, according to the ninth revision of the International Classification of Diseases, is defined as death during pregnancy or within 42 days of its termination, resulting from previous existing disease or disease that developed during pregnancy, and which was not due to direct obstetric causes, but was aggravated by the physiological effects of pregnancy (WHO, 1977). The definition of "indirect " maternal morbidity is more problematic (Graham and Campbell, 1990; Campbell and Graham, 1990). At its narrowest it must include those conditions which can lead to maternal mortality, but this excludes many chronic, potentially disabling morbidities. It has been argued that the definition of maternal morbidity should include all conditions directly or indirectly arising from or aggravated by pregnancy, childbearing and its management (WHO, 1990f; Graham and Campbell, 1990).

Which illnesses most frequently affect pregnant women in a given setting will depend on local patterns of prevalence in the general population as well as the influence pregnancy has on the course of the illness. The causes of adult mortality and morbidity in developing countries is a neglected topic (Feachem et al., 1991; Hayes et al., 1989). Much of the data that are available are from vertical programmes for control of particular
"tropical" communicable diseases. This is the area in which direct extrapolation from experience in developed countries is least appropriate, as the levels and nature of morbidity encountered are very different. Very little information is available on which to judge the effectiveness of antenatal care provision to reduce maternal mortality and morbidity from conditions not directly caused by pregnancy but exacerbated by it. Nevertheless, the higher prevalence of treatable disease experienced by women in developing countries suggests that there is a much greater potential for detection and treatment of illness during pregnancy in these populations. This is particularly true of infectious and parasitic diseases. Susceptibility to many of these, including tuberculosis, malaria and hepatitis, may be increased in pregnancy and they may be important causes of maternal and perinatal mortality and morbidity.

A confidential enquiry into maternal deaths in Addis Ababa, Ethiopia, identified hepatitis as the commonest cause of indirect maternal mortality (Kwast et al., 1989). In this setting, hepatitis B appears to be associated with especially high case fatality in pregnant women. The incidence of hepatitis B infection and prevalence of the carrier state are high in many parts of the developing world (Sobelavsky, 1980). Primary prevention of hepatitis B is possible through vaccination, including neonatal vaccination of infants of carrier mothers to prevent vertical transmission. However, more information is needed on the incidence, natural history and management of the several types of viral hepatitis in pregnancy. Tuberculosis is a leading cause of death in many developing countries (Rodrigues and Smith, 1990), and the risk of active tuberculosis is raised in pregnancy. Rheumatic fever and other sequelae of infection are still commonplace in some developing countries. Pregnancy affects the severity of morbidity and the survival rates from these conditions profoundly. Policies for screening and treating pregnant women will depend on local prevalence and population screening and control programmes. Treatment will depend on local patterns of drug sensitivity/resistance as well as on evidence of efficacy and safety in pregnancy, including, where available, teratogenesis. Co-ordination with specialist services for treatment and control may be necessary. Antenatal care programmes may allow opportunistic screening and recruitment of women into other health promotion and health care programmes. The effectiveness of incorporating these services into routine antenatal care is difficult to assess, and few data are available.

4. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

What is striking in examining the evidence for or against the effectiveness of care during pregnancy in reducing maternal mortality or serious morbidity is how little is known. This is not just a problem of how to deliver services of proven efficacy in developing country settings. The recent report on antenatal care in the USA emphasises the same fundamental lack of certainty about the efficacy of many established practices which is apparent from this review (US DHHS, 1989), and the need for good research to provide the information required for future policy making. These questions are more urgent in developing countries because the levels of mortality and morbidity remain much greater and the lack of reliable information even more marked.
Underlying this uncertainty is ignorance of or lack of information about:

a) the aetiology, pathogenesis, and natural history of even some of the commoner complications of pregnancy, such as pregnancy induced hypertension;

b) levels and patterns of causation of maternal mortality in many developing countries;

c) levels and patterns of maternal morbidity;

d) the biological efficacy of treatments in current use.

In many developing countries far more women attend for at least one antenatal visit than are delivered by a trained attendant. In situations of high maternal mortality all opportunities of contact with pregnant women or women of childbearing age by the health services should be used to maximum effect. However, good intentions are not enough. If these opportunities are to be seized, and if more women are to be persuaded to attend for antenatal care, it is essential to make the most effective use of staff, resources and women’s time as possible. In the face of such large gaps in knowledge, and particularly in basic epidemiological data about maternal mortality and morbidity in developing countries, it is difficult to decide on the priorities for research.

Nevertheless, there are some interventions in pregnancy which have been shown to be effective in detecting, treating or preventing conditions in pregnant women which may give rise to serious morbidity or mortality. These are outlined in Table 1. They relate mainly to chronic conditions - anaemia, HDP, and infections in pregnancy - rather than directly to acute conditions such as haemorrhage or obstructed labour, which emerge close to the time of delivery. However, even in these more chronic conditions the picture is not entirely straightforward, and further research is needed.

Prevention and treatment of anaemia should be a priority. Effective remedies exist, but the questions to be answered in deploying them are complex, as outlined in Table 2. Routine supplementation with iron and folate is probably warranted where the prevalence of anaemia and iron deficiency is high, but how high? Epidemiological studies of haemoglobin levels and pregnancy outcome, and controlled trials of supplementation are needed to determine whether, and at what level of haemoglobin, supplementation improves maternal and/or perinatal outcomes. Operational and anthropological research are called for to overcome difficulties in providing adequate supplements for long enough in an acceptable form. In addition, suitable techniques and strategies to allow universal screening for anaemia need to be devised or identified and tested. Strategies to ensure the effective treatment of moderate and severe anaemia with existing or new iron formulations must be worked out and tested in large careful trials.

More fundamental research is required to obtain the information necessary to plan services to reduce mortality and morbidity from hypertensive disorders of pregnancy. Though it appears that professional care in hospital reduces mortality from eclampsia, the
best treatment for this or milder stages of disease are not clear, nor is the effectiveness of early detection certain. Table 3 outlines the questions which need to be answered and the types of study required. Adequate management of hypertensive diseases of pregnancy appears to require screening of all women and prompt appropriate referral for treatment and further investigation or surveillance, coupled with 24 hour access to care for emergency cases. However, questions remain on the best method and timing of screening, and on how to provide it effectively to all women in developing countries. Whether treatment of mild disease (pregnancy induced hypertension or mild pre-eclampsia) with rest, any group of anti-hypertensives, or other drug or behavioural treatment prevents progression to more serious disease is not clear and can only be clarified by large scale carefully conducted randomised trials. Similarly the effectiveness of different types of antihypertensive drug in severe pre-eclampsia and eclampsia to control blood pressure, prevent complications and improve survival for mother and fetus can only be determined by large scale, meticulous, randomised trials. The same is true of anticonvulsants. How to provide this care at the most peripheral health care level possible can then be explored. Trials of preventive strategies or agents could also be carried out in populations of high risk women, but epidemiological studies of aetiology are also still needed.

Women with severe pre-eclampsia require specialist care. Guidelines for first aid and referral are needed, adapted to local circumstances and with strategies to maximise co-operation and communication between primary and first and subsequent referral levels. The role of prophylactic anticonvulsants and anti-hypertensive drugs and the level of training needed to supervise their use need to be clarified. The effectiveness of health education to improve recognition of the importance and gravity of symptoms such as headache, abdominal pain, and visual disturbance in late pregnancy, and particularly in conjunction with signs of pre-eclampsia needs to be evaluated.

Turning to infection, the potential for improving maternal and child health through detection and treatment of sexually transmitted or genito-urinary tract infections is high. Reliable tests and effective treatments exist for syphilis and gonorrhoea, as shown in table 1. Table 2 sets out the remaining questions which must be answered if these infections are to be dealt with effectively in antenatal care. A high priority must be operational research to identify the best ways of making screening, treatment, follow up and health education for prevention of syphilis and gonorrhoea available to all pregnant women. The performance of these services must be subject to evaluation, with the collection of outcome as well as process measures a priority. Better epidemiological data on levels and trends of infection are needed, and the relationship between infection and outcome measures for mother and infant. In the case of chlamydia, further epidemiological research on prevalence and consequences is needed, as well as the development of screening and diagnostic tests appropriate to developing country settings. The role of screening for HIV, and the appropriate response to a positive result is less clear in terms of patient management though epidemiological data are urgently needed on levels and trends. Information is needed on the prevalence and consequences of asymptomatic and symptomatic urinary tract infection in pregnant women in developing countries. Appropriate screening and diagnostic tests, and operational problems will have to be addressed in extending this screening to the whole pregnant population in areas where the prevalence warrants this.
The major questions regarding the potential of antenatal interventions to prevent or ameliorate the effects of haemorrhage and obstructed labour are set out in Tables 5 and 6. There is clearly much that can be done to improve maternal health through improved standards of and access to delivery care. Levels of maternal mortality from haemorrhage, obstructed labour and puerperal infection are responsive to improvements in the quality, coverage, utilisation and emergency access to delivery care. The role that antenatal care might play in reducing mortality or serious morbidity from these causes is not clear and has not been tested. One major pathway through which it might do so is by screening and referral for supervised delivery, but this could only be effective where delivery services can cope with the additional workload. Obstructed labour is better predicted than other life threatening complications using maternal height, which is certainly a cheap and simple test, but suffers from poor sensitivity and specificity. Epidemiological questions regarding risk factors and their ascertainment, and operational questions related to maximising the potential benefit of antenatal care remain. The effectiveness of the risk strategy to reduce mortality or serious morbidity has not been systematically examined in trials.

Basic research, both epidemiological and operational, on antenatal care is not an academic luxury; improved information on patterns of maternal health and the efficacy of investigation and treatment are essential to rational planning of effective health services to reduce maternal mortality and morbidity from their current alarming level. Many of the fundamental questions raised in this review apply to countries throughout the developed and developing world. However, developing countries are the best settings for much of the recommended research for several reasons. The fact that incidence and mortality rates are higher in developing countries means that the questions are more urgent, but also that sample sizes could be smaller, and benefits more easily seen. The information obtained would be directly relevant to the populations which could benefit most from the interventions. Research studies could provide opportunities to strengthen local expertise in research and clinical practice, and to find solutions appropriate to local needs and circumstances.

Though this report has looked at interventions during pregnancy, the effectiveness of these should not in fact be considered in isolation. Effective prevention of maternal mortality and morbidity will require improvements in all aspects of women’s health and health care throughout their lifespan.
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Overview 5942.

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THIS LISTING HAS BEEN DERIVED FROM THE OXFORD DATABASE OF PERINATAL TRIALS.
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<th>Test or treatment</th>
<th>Effect</th>
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<tr>
<td>Prevention of anaemia</td>
<td>Routine supplementation with iron and folate during pregnancy</td>
<td>Reduces or prevents fall in haemoglobin. Reduces percentage of women anaemic</td>
</tr>
<tr>
<td></td>
<td>Malaria chemoprophylaxis</td>
<td>Reduces percentage of women who become anaemic. May reduce low birth weight. May improve growth in very young primigravidae</td>
</tr>
<tr>
<td>Detection and investigation of anaemia</td>
<td>Copper sulphate test</td>
<td>Detects haemoglobin level below chosen cut-off point</td>
</tr>
<tr>
<td></td>
<td>Colorimetric tests</td>
<td>Estimates haemoglobin concentration</td>
</tr>
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<td></td>
<td>Packed cell volume</td>
<td>Measures haematocrit</td>
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<tr>
<td></td>
<td>Coulter counter</td>
<td>Allows diagnosis of type of anaemia</td>
</tr>
<tr>
<td></td>
<td>Blood film microscopy</td>
<td>Diagnosis of type of anaemia, and of malaria</td>
</tr>
<tr>
<td>Treatment of iron-deficiency anaemia</td>
<td>Oral iron</td>
<td>Can raise Hb by 0.4-0.7 g/dL per week</td>
</tr>
<tr>
<td></td>
<td>Intramuscular and intravenous iron</td>
<td>Can raise Hb at same rate as oral. Avoids problems of compliance, but need for IM or IV equipment and trained staff, and danger of anaphylaxis</td>
</tr>
<tr>
<td></td>
<td>Packed cell transfusion</td>
<td>Raises Hb immediately, but involves hazards of blood transfusion - infection, fluid overload, need for equipment and skill</td>
</tr>
<tr>
<td>Detection and investigation of HDP</td>
<td>Measurement of blood pressure with sphygmomanometer</td>
<td>Detects hypertension - most sensitive test for pre-eclampsia</td>
</tr>
<tr>
<td></td>
<td>Urinalysis of &quot;clean catch&quot; urine</td>
<td>Detects proteinuria - indicative of pre-eclampsia in presence of hypertension</td>
</tr>
<tr>
<td>Treatment of severe pre-eclampsia</td>
<td>Transfer to first referral level for expert care</td>
<td>Control of disease. Reduced case fatality</td>
</tr>
<tr>
<td>Condition/stage</td>
<td>Test or treatment</td>
<td>Effect</td>
</tr>
<tr>
<td>-----------------------------</td>
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<td>------------------------------------------------------------------------</td>
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<tr>
<td>Treatment of eclampsia</td>
<td>Supportive first-aid - maintaining airway and preventing injury during fit</td>
<td>Reduced case-fatality</td>
</tr>
<tr>
<td></td>
<td>Recognition and speedy transfer to fully equipped first referral level facility</td>
<td>Reduced case-fatality</td>
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<tr>
<td></td>
<td>Expedited delivery</td>
<td>Only definitive treatment</td>
</tr>
<tr>
<td>Screening for infection</td>
<td>Serological screening for syphilis</td>
<td>Detects asymptomatic disease. Coupled with effective treatment, contact tracing and follow-up, reduces fetal loss and maternal and infant morbidity</td>
</tr>
<tr>
<td></td>
<td>Microbiological screening for gonorrhoea</td>
<td>Detects asymptomatic disease. Coupled with effective treatment, contact tracing and follow-up, reduces fetal loss and maternal and infant morbidity</td>
</tr>
<tr>
<td></td>
<td>Screening for bacteriuria</td>
<td>Detects asymptomatic disease. Treatment with appropriate antibiotics prevents pyelonephritis and preterm delivery/low birth weight</td>
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<tr>
<td>Primary prevention of infection</td>
<td>Tetanus immunization in pregnancy or women of childbearing age</td>
<td>Prevents maternal and neonatal tetanus</td>
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<td>Research question</td>
<td>Method of study</td>
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<tr>
<td>Primary prevention</td>
<td>Can dietary advice prevent anaemia?</td>
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<td></td>
<td>Does routine iron/iron and folate supplementation improve health outcomes for</td>
<td>Randomized Controlled Trials (RCTs)</td>
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<tr>
<td></td>
<td>mother and/or infant? (maternal and perinatal morbidity and mortality,</td>
<td>Epidemiological</td>
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<tr>
<td></td>
<td>birthweight, preterm delivery)</td>
<td>Epidemiological</td>
</tr>
<tr>
<td></td>
<td>At what population level of anaemia is routine supplementation justified?</td>
<td>RCTs</td>
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<td></td>
<td>How can adequate coverage and supply be ensured?</td>
<td>Operational</td>
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<td></td>
<td>How can adequate compliance be ensured?</td>
<td>Anthropological</td>
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<td></td>
<td>Is staple food fortification, food supplementation, or supplementation with iron</td>
<td>Drug formulation</td>
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<td></td>
<td>and folate tablets or syrups most effective in preventing anaemia?</td>
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<td></td>
<td>What is the aetiological fraction due to inadequate food supplies, dietary taboos,</td>
<td>RCTs</td>
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<td>malaria, infection, other cause?</td>
<td>Epidemiological</td>
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<tr>
<td>Detection and</td>
<td>How can screening for moderate and severe anaemia be provided at primary health</td>
<td>Technology development</td>
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<td>investigation</td>
<td>care level?</td>
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<td></td>
<td>What is the effect of testing only those who are clinically anaemic or &quot;at risk&quot;?</td>
<td>Epidemiological</td>
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<td></td>
<td>What investigations of causes/types of anaemia should be provided at primary</td>
<td>Epidemiological (prevalences)</td>
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<tr>
<td></td>
<td>health care level?</td>
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<td></td>
<td>How can adequate investigation be ensured at referral level?</td>
<td>Technology development</td>
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<td>Operational</td>
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<tr>
<td>Treatment</td>
<td>How can the effectiveness of oral iron be improved in practice?</td>
<td>Anthropological</td>
</tr>
<tr>
<td></td>
<td>How can adequate treatment and follow-up be ensured?</td>
<td>Drug formulation</td>
</tr>
<tr>
<td></td>
<td>What degree of severity requires referral for adequate treatment?</td>
<td>Operational</td>
</tr>
<tr>
<td></td>
<td>When is intramuscular iron or intravenous total dose iron more effective than</td>
<td>RCTs</td>
</tr>
<tr>
<td></td>
<td>oral?</td>
<td>Operational</td>
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<td></td>
<td>When is packed cell transfusion indicated rather than iron?</td>
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<td>Does (effective) prevention and treatment of anaemia reduce mortality from</td>
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<td></td>
<td>haemorrhage or need for transfusion?</td>
<td>Epidemiological</td>
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<td>Stage/condition</td>
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<td>Method of study</td>
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</tr>
<tr>
<td>Primary prevention</td>
<td>What are current levels of incidence of pregnancy induced hypertension, pre-eclampsia, eclampsia and mortality due to HDP? What are the trends in incidence, progression and case-fatality? What are the alterable determinants of HDP? (e.g. dietary factors) Can incidence or severity be prevented by supplementation with calcium, fish oil, other prostaglandin pre-cursors or low dose anti-platelet drugs, in all or high risk women?</td>
<td>Epidemiological</td>
</tr>
<tr>
<td>Detection and investigation</td>
<td>Does early detection prevent disease progression and mortality? What is the most efficient method of screening at primary care level (blood pressure measurement, urinalysis, oedema, symptoms, combination)? How can blood pressure measurement be made available at primary care level/universally available? Can health education of pregnant women and community improve recognition of severe pre-eclampsia, appropriate care-seeking and outcome? How often and at what gestation must blood pressure be monitored? What is the most efficient method of detecting severe disease?</td>
<td>Epidemiological</td>
</tr>
<tr>
<td>Treatment: mild to moderate pre-eclampsia</td>
<td>Does bed rest at home or in hospital in pregnancy induced hypertension or pre-eclampsia prevent disease progression or improve maternal or fetal outcomes? Does treatment with anti-hypertensives in mild or moderate pre-eclampsia prevent disease progression or improve maternal or fetal outcomes?</td>
<td>RCTs</td>
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<tr>
<td></td>
<td>Is any type of antihypertensive superior to others? (beta-blockers, diuretics,</td>
<td>RCTs</td>
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<td></td>
<td>methyl dopa, others)</td>
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<tr>
<td>Treatment: severe pre-eclampsia</td>
<td>Below what level should blood pressure be controlled?</td>
<td>RCTs</td>
</tr>
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<td></td>
<td>Which antihypertensive drugs are safest and most effective in terms of maternal</td>
<td>RCTs and/or epidemiological</td>
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<td></td>
<td>and fetal outcomes? (beta-blockers, methyl dopa, hydralazine, diazoxide, others)</td>
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<td></td>
<td>Should antihypertensives be given and/or blood pressure controlled in primary</td>
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<td></td>
<td>care before transfer to first referral level?</td>
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<td></td>
<td>Do prophylactic anticonvulsants prevent fits/progression to eclampsia when given</td>
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<td></td>
<td>in severe pre-eclampsia?</td>
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<tr>
<td>Treatment: severe pre-eclampsia</td>
<td>Should prophylactic anticonvulsants be given in primary care before transfer to</td>
<td>RCTs</td>
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<td>(cont.)</td>
<td>first referral level?</td>
<td>Epidemiological and operational</td>
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<td></td>
<td>What are the best guidelines for transfer to first referral level?</td>
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<td></td>
<td>What are the best guidelines for expedited delivery?</td>
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<tr>
<td>Treatment: eclampsia</td>
<td>Can health education and TBA-training improve &quot;first-aid&quot;/ emergency care at</td>
<td>Trial/evaluation of health</td>
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<td>primary level?</td>
<td>education</td>
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<td></td>
<td>How can rapid transfer to first referral level be ensured?</td>
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<td></td>
<td>Should antihypertensives and/or anticonvulsants be used at primary level before</td>
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<td></td>
<td>transfer?</td>
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<td></td>
<td>Epidemiological</td>
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<tr>
<td></td>
<td>What is the best antihypertensive in terms of safety and maternal and fetal</td>
<td>RCTs</td>
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<tr>
<td></td>
<td>outcomes (diazoxide, hydralazine, methyl dopa, beta-blocker, others)?</td>
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<td></td>
<td>What is the safest and most effective anticonvulsant in terms of maternal and</td>
<td>RCTs</td>
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<td></td>
<td>fetal outcomes (MgSO₄, diazepam, phenytoin)?</td>
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<td>Does plasma expansion improve maternal and fetal outcomes?</td>
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<tr>
<td>Primary prevention</td>
<td>What is the contribution of pre-existing genitourinary infection to puerperal sepsis?</td>
<td>Epidemiological</td>
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<td></td>
<td>Is there an increased risk of puerperal sepsis in AIDS/HIV infected women?</td>
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<td></td>
<td>Does health education of women during pregnancy about risks associated with pre-labour rupture of membranes and unclean delivery reduce infection at delivery?</td>
<td>RCTs</td>
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<tr>
<td></td>
<td>Does distribution of &quot;clean delivery&quot; supplies to women during pregnancy reduce infection at delivery?</td>
<td>RCTs</td>
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<td></td>
<td>Can risk factors for infection at delivery be identified during pregnancy?</td>
<td>Epidemiological</td>
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<tr>
<td>Detection and secondary prevention</td>
<td>Does health education during pregnancy about symptoms and signs of puerperal infection lead to earlier care-seeking?</td>
<td>RCTs</td>
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<tr>
<td></td>
<td>What is the local prevalence of treatable STDs in the population (syphilis, gonorrhoea, chancroid, chlamydia, etc.)?</td>
<td>Health education evaluation</td>
</tr>
<tr>
<td></td>
<td>How can screening for treatable STDs be provided to all pregnant women and partners (esp. syphilis and gonorrhoea)?</td>
<td>Epidemiological (cross-sectional prevalence surveys - with serology and culture, etc.)</td>
</tr>
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<td>What is the local prevalence of HIV in pregnant women?</td>
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<td>How can adequate treatment and follow-up of confirmed STDs in pregnant women, their partners and infants be provided?</td>
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<td>Detection and secondary prevention (cont.)</td>
<td>Should suspected STDs be treated without confirmation if laboratory facilities are not available?</td>
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<td>What is local prevalence of asymptomatic and symptomatic urinary tract infection?</td>
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<td></td>
<td>How can screening of pregnant women for asymptomatic bacteriuria be provided in</td>
<td>Operational Technology</td>
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<td>areas where the prevalence warrants it?</td>
<td>development</td>
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<tr>
<td>Primary prevention</td>
<td>Does treatment of HDP with antihypertensives reduce the risk of antepartum haemorrhage?</td>
<td>RCTs</td>
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<tr>
<td>Secondary prevention</td>
<td>Does effective prevention and treatment of anaemia reduce morbidity and/or mortality from haemorrhage?</td>
<td>Epidemiological</td>
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<td>RCTs</td>
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<tr>
<td>Risk detection</td>
<td>Can risk of haemorrhage be accurately predicted?</td>
<td>Epidemiological</td>
</tr>
<tr>
<td></td>
<td>Does risk detection and referral for delivery reduce morbidity and/or mortality from haemorrhage?</td>
<td>Epidemiological</td>
</tr>
<tr>
<td>Recognizing danger signs</td>
<td>Do women regard bleeding in pregnancy as a reason to seek medical care?</td>
<td>Anthropological</td>
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<td>Are there traditional interpretations and/or treatments for bleeding in pregnancy which delay or prevent women seeking medical care?</td>
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<td>Does health education about bleeding in pregnancy improve outcome?</td>
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<td>Epidemiological</td>
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<td>Health education evaluation</td>
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<td>Method of study</td>
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<td>---------------------------------</td>
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</tr>
</tbody>
</table>
| Primary prevention of cephalo-pelvic disproportion | Does supplementation with iron, folate and/or other nutrients increase growth in very young primigravidae and reduce the incidence of CPD/prolonged labour/operative delivery?  
Does treatment or prophylaxis against malaria and/or other prevalent infections in very young primigravidae increase growth and reduce the incidence of CPD/prolonged labour/operative delivery?  
In fully grown women, does nutritional supplementation increase the incidence of CPD (by increasing birth weight) and need for operative delivery? | RCTs                        |
| Risk detection/prediction       | Can CPD prediction be made more accurate by use of a combination of personal and anthropometric measurements (compared to standard prediction, e.g. based just on height)?  
How accurately can clinical pelvimetry (by staff with various levels of training) predict CPD/prolonged labour/operative delivery?  
How accurately does clinical detection of malpresentation near term predict malpresentation in labour?  
How effective is risk ascertainment and referral in practice: (1) in ensuring that women at high risk deliver in an appropriate place, (2) that women who do experience CPD or malpresentation deliver in an appropriate place, (3) in reducing maternal and perinatal morbidity and mortality? | Epidemiological (follow-up studies)  
RCTs  
Epidemiological (follow-up studies)  
RCTs  
Epidemiological (follow-up studies)  
RCTs  
(1) Operational and epidemiological  
(2) Operational and epidemiological  
(3) RCTs |
<p>| Secondary prevention of malpresentation in labour | Does any form of external version near term reduce the prevalence of malpresentation in labour (esp. transverse and oblique lie)? | RCTs                        |</p>
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<tr>
<td>Secondary prevention of morbidity due</td>
<td>How can uptake of delivery supervised by a trained attendant or in an appropriately</td>
<td>Anthropological</td>
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<td>to CPD and malpresentation</td>
<td>equipped and staffed facility be improved?</td>
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<td>What level of services are required to meet needs of population?</td>
<td>Epidemiological</td>
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<td>Operational</td>
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</tbody>
</table>
FIGURE 1
POTENTIAL ANTENATAL INTERVENTIONS TO REDUCE MATERNAL MORBIDITY AND MORTALITY

MATERNAL MORTALITY
OR CHRONIC MORBIDITY

↑

MORBIDITY IN PREGNANCY

↑

ANTENATAL INTERVENTIONS
Secondary prevention of disease progression
Treatment
Detection of morbidity

Preparedness for care which may be needed e.g. hospital delivery
Primary prevention
Assessment of risk

Assessment of risk
Screening for disease
Primary prevention

↑

AT INCREASED RISK OF MORBIDITY

↑

PREGNANT POPULATION

↑

WOMEN OF CHILDBEARING AGE

PRE-CONCEPTION/OTHER HEALTH CARE
Planned patterns of childbearing
Primary prevention
FIGURE 2
POTENTIAL ANTENATAL INTERVENTIONS AGAINST HAEMORRHAGE

Postpartum Haemorrhage

Intrapartum Haemorrhage

Antepartum Haemorrhage

Immediate referral for investigation and treatment

Increased risk of further bleeding

Referral for investigation and treatment

Referral for supervised delivery

Assessing increased risk:
- History of haemorrhage in previous pregnancy
- Grand multiparity
- Polyhydramnios
- HDP
  - hypertension
  - clotting defect
  - Premonitory bleeding

Pregnant Population
FIGURE 3
POTENTIAL ANTENATAL INTERVENTIONS AGAINST ANAEMIA

CONtributes to maternal mortality from haemorrhage and heart failure and to perinatal mortality

↑

Severe anaemia: Maternal morbidity

↑

Mild/moderate anaemia

↑

Iron deficiency

↑

At-risk group

↑

Pregnant population

Detecting severe anaemia
Referral for expert investigation and treatment

Detecting anaemia
Treatment with iron and folate
Follow up? Cured.
Investigation and treatment of cause

Detecting deficiency
Treatment with iron and folate (oral or parenteral)

Screening for anaemia
Screening for iron deficiency
Routine iron and folate
Screening for elevated risk

Screening for anaemia
Routine iron and folate
Malaria prophylaxis
FIGURE 4
POTENTIAL AN TENATAL INTERVENTIONS AGAINST HYPERTENSIVE DISORDERS OF PREGNANCY

DEATH FROM ECLAMPSIA OR PRE-ECLAMPSIA

ECLAMPSIA

Treatment of severe disease at secondary or tertiary level -
? antihypertensives, ?anticonvulsants

'S first aid' at community level

SEVERE PRE-ECLAMPSIA

Detection of severity -
BP level, proteinuria, oedema,
symptoms, biochemical tests

Treatment - hospitalization, drugs

Referral for expert care

MILD PRE-ECLAMPSIA

Detection

Intervention - rest, drugs, etc.
? referral for expert care

Detection of raised BP

Secondary prevention of progression -
Treatment - rest, drugs

NON-PROTEINURIC HYPERTENSION OF PREGNANCY

Preparedness for need of further intervention/increased surveillance

AT INCREASED RISK OF HYPERTENSIVE DISORDERS OF PREGNANCY

Detection of increased risk

PREGNANT POPULATION

Primary prevention
? low dose aspirin

Primary prevention

NB. Any of these stages may be reached without apparently going through the preceding stages
FIGURE 5

POTENTIAL ANTENATAL INTERVENTIONS AGAINST OBSTRUCTED LABOUR

MORTALITY OR CHRONIC MORBIDITY

↑

OBSTRUCTED LABOUR

↑

FETO-PELVIC DISPROPORTION OR MALPRESENTATION IN LABOUR

↑

APPARENT DISPROPORTION OR MALPRESENTATION NEAR TERM

↑

PREGNANT POPULATION

Referral for delivery at "1st referral level"

Detection - physical exam
?Pelvimetry - clinical, X-ray, ultrasound

Referral for delivery at "1st referral level"
?External cephalic version

Risk assessment - age, height, pelvimetry, obstetric history

PRIMARY PREVENTION

?Growth promotion in teenage primigravidae
FIGURE 6
POTENTIAL ANTENATAL INTERVENTIONS AGAINST PUERPERAL INFECTION

MORTALITY AND
CHRONIC MORBIDITY

PUERPERAL SEPSIS

INFECTION AT DELIVERY

PREGNANT POPULATION

Delivery kits
Health education - clean delivery, pre-labour rupture of membranes
Referral after pre-labour rupture of membranes: antibiotics
Detection and treatment of GU infection
Detection of increased risk?