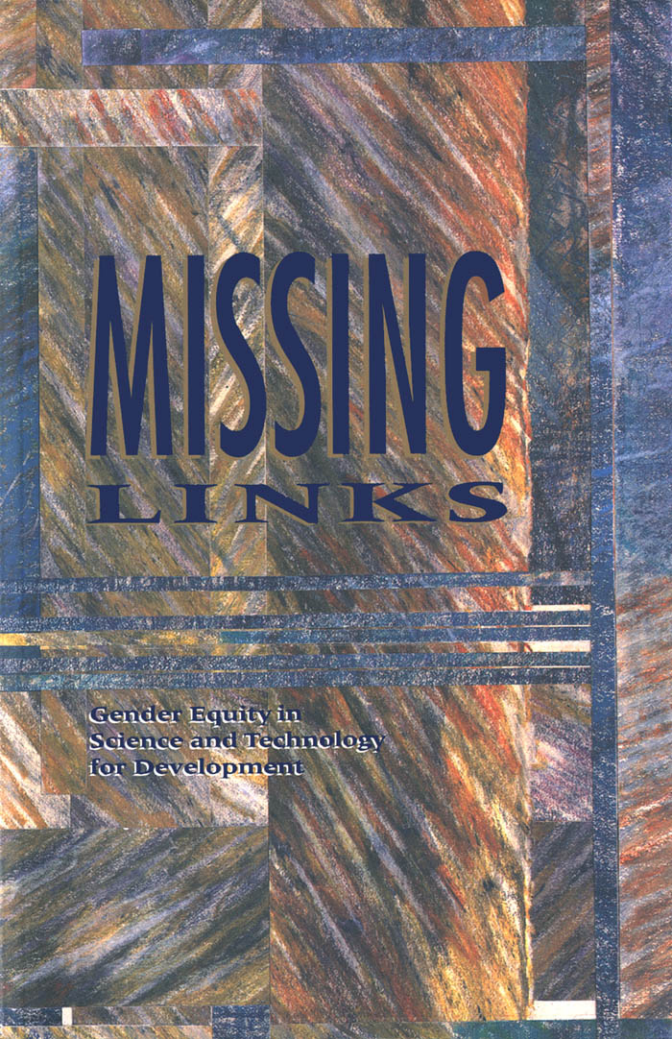
MISSING
LINKS
Gender Equity in
Science and Technology
for Development

Missing Links

This page intentionally left blank

Missing Links

Gender Equity in Science and Technology for Development

Gender Working Group,
United Nations Commission on Science and Technology for Development

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE
in association with
INTERMEDIATE TECHNOLOGY PUBLICATIONS
and
UNIFEM

Published in Canada by
International Development Research Centre
PO Box 8500, Ottawa, ON, Canada K1G 3H9

and

in the United Kingdom by
Intermediate Technology Publications Ltd
103-105 Southampton Row, London WC1B 4HH, UK

and

in the United States by
UNIFEM (United Nations Development Fund for Women)
304 East 45th Street, 6th Floor, New York, NY 10017, USA

United Nations Commission on Science and Technology Development, Genève CH. Gender Working Group

Missing links: gender equity in science and technology for development. Ottawa, ON, IDRC, 1995. xv + 376 p.

/Women's role/, /women's rights/, /science and technology/, /sustainable development/, /developing countries/ — /indigenous knowledge/, /food security/, /energy/, /health/, /decision making/, /science education/, /technology assessment/, /entrepreneurship/, /information/, /UN/, /recommendations/, references.

UDC: 396:600

A CIP record for this book is available from the British Library.

A microfiche edition is available.

ISBN 0-88936-765-5 (IDRC)
ISBN 1 85339 289 8 (IT Publications)
ISBN 0-912917-37-7 (UNIFEM)

This book is dedicated to Stanislas Ruzenza,
a member of the Gender Working Group.
Professor Ruzenza died in June 1995,
a victim of civil strife in Burundi.

This page intentionally left blank

Contents

Chapter 7

Doing the right thing, not just doing things right

A framework for decisions about technology

Arminée Kazanjian

Interest in technological choices and their effects on health has accelerated in recent years; it is manifested by the global trend to bring about health reform. Marked decline in overall economic growth and the consequent increased pressure on public budgets has been cited by public policymakers as the reason for a desire for more appropriate and effective delivery of health care. Because of the globalization of world economies, all countries have simultaneously experienced this phenomenon, albeit to different degrees.

However, health reform is variously perceived (and implemented) by countries, states, and other jurisdictional levels. Governments have sought to deal with pressures on health-care budgets in different ways, often undertaking (or contracting) evaluative studies and technology assessment to provide them with direction in reducing the cost of publicly funded services. In contrast, changing public expectations and the proliferation of medical technology, two important "external" pressures frequently cited by health policymakers, are rarely examined in the broader context of technological development and diffusion. A critical approach and feminist analysis, as expounded in this paper, provide a different frame of reference.

New health technologies (drugs, devices, and procedures) are becoming available at an increasing rate. Unfortunately, the development and diffusion of technology is associated neither with its inherent attributes nor with the prevalence of disease. Furthermore, not much is known about the diffusion of health technology — new or old. Technology does not dictate its own range of applications, nor its price; societal reaction to the technology is a key determinant of its use. For example, electronic fetal monitoring was adopted in the

absence of any evidence as to its effectiveness and substantial evidence of harm to pregnant women. Subsequent epidemiologic research confirmed that the device was of no specific value in improving fetal outcome, but doubled the rate of caesarean sections (Bassett 1993). The technique remains firmly established in obstetric practice. This example also illustrates the vulnerability of all women in the health sector as nurses, midwives, and technologists continue to use it, as well as birthing mothers, who expect it to be part of the obstetric routine.

The role of national governments in the development and diffusion of health technology is an influential one, and numerous opportunities exist for adopting a theoretical framework to guide technology decisions. In the absence of a national technology policy, decisions regarding health technology are often contradictory. How much technology and for whom? These decisions are usually made intuitively, without systematic consideration of possible alternatives and consequences of various options. A framework that puts technology into a social context and provides a critical analysis of the broad range of potential issues and interests would make the decision-making process more transparent and equitable.

Decision-support models are used to make explicit the process of thinking about alternatives and to make transparent to the decision-maker available choices and consequences of such choices. Because the human mind is limited in attention, memory, and calculation, and imperfect in perception, we tend to simplify, use limited viewpoints, highlight some aspects; unless the decision-making process is an explicit, stepwise activity, limited rationality will prevail. Policymakers respond to situations as they interpret them, not as they exist in some objective reality; the same problem in a different frame can elicit a very different response. As well, decision-making often involves difficult trade-offs, and most people adopt a simple rule that does not require trading-off incommensurables. Finally, the policymakers rarely find out the broad consequences of their decision or whether the decision was considered "good" or "bad" (Carroll and Johnson 1990).

The conceptual framework proposed here focuses on how alternative choices may have diverse consequences that stretch beyond immediate outcomes and seeks to identify desirable or preferable futures. Because it relates the technology under consideration to human needs in the broadest sense, the framework provides a synthesis of the social dynamics of each situation; it presents a critical perspective that delineates issues of power and dominance, as well as technological impact. Policy researchers erroneously assume

that decision-making always occurs in a series of fairly well-defined stages (that could also repeat and backtrack):

- Recognition of a problem;
- Formulation of possible interventions;
- Generation of alternatives;
- Information search;
- Judgement or choice;
- Action; and
- Feedback.

However, most often decision-making comprises only information search and choice (Payne et al. 1978; Svenson 1979). A broader "problem-solving" approach is adopted for the proposed framework to ensure a comprehensive understanding of the specific problem or deficit as well as a thorough examination of the consequences of alternative courses of action. The framework can be used during policy formulation as a proactive analytic tool that explicitly considers possible alternative courses of action and their respective consequences. This application also facilitates public consultation as well as solicitation of expert opinion. Alternatively, the framework can be used to analyze and aid understanding of how a past (or current) situation has occurred, especially in the case of a "wrong" technology, delineating the reasons for the negative consequences of the technology.

Society seems to be unable to manage technological change in a way that respects and serves the broad range of human interests and needs. On a global level, historic and continuing efforts to include women's needs and concerns in the way science and technology (S&T) are developed and evaluated have not yielded discernible results. Over the last two decades, many official documents containing long lists of recommendations have been produced. In *The Vienna Programme of Action on Science and Technology for Development*, it was recognized that "modern technological developments do not automatically benefit all groups of society equally ... and may have a negative impact on the condition of women and their bases for economic, social and cultural contributions to the development process" (UN 1979b). An appeal was made to strengthen support of national government efforts to promote full participation of women in the application of S&T for development.

Some years later, the *Report of the Ad Hoc Panel* of the Advisory Committee on Science and Technology for Development, postulated that the absence of women from the highest policy and

decision-making ranks in S&T "affects the process, quality, and outcomes" of the latter (UN 1984). The panel concluded that, although it is not clear how this would take shape, women should be given access to the process. Furthermore, "inadequacies of existing indicators of the impact of technological change on women" were noted and the need for better measurement of relevant concepts was identified.

Yet, S&T policy, at national and international levels, remains unresponsive to women and their needs, although there is recognition in these documents and in others that assessment, monitoring, and measurement of the effect of S&T on development is desirable. At present, any change in this regard can only occur as part of an intentional prescriptive process where goals are clearly defined at various levels and decisions are aimed at reaching those goals. The framework developed in this paper stimulates the articulation of goals, enabling the systematic monitoring and broad assessment of technological change.

Although most decisions do not follow the explicit stage-by-stage process, implicit rules of decision-making are, nevertheless, operant. Published material on decision research indicates that, in making important decisions, general, formal, or complex rules are usually desirable. Furthermore, a combination and mix of general and specific, simple and complex rules give the best results in terms of better decisions (Gustafson et al. 1992). The proposed framework meets these criteria. Consistent dimensions, identified as policy concerns, are developed for application to all technology decisions. Clearly defined, accurately measured indices of each dimension may be combined with less specific ones, or qualitative measures, to develop composite measures for each of the dimensions. The proposed model comprises several components or dimensions and provides a comprehensive approach to decision-making. However, it is designed with ease of application in mind and should not be too onerous to use.

Building on two previous studies on this subject (Kazanjian and Cardiff 1993; Kazanjian and Friesen 1993), the framework (Table 1) for technology decisions in health care was developed incorporating five key dimensions. The first four — population at risk, population impact, economic concerns, and broad social context (including ethical, legal, and political concerns) — are descriptive elements of the health problem in question and the social, environmental context within which the problem is defined. The fifth component — technology assessment — is the scientific evidence about the health problem and the technologies used to alleviate the problem. It provides information on the strength and quality of the evidence on a technology or health program.

Table 1. Framework for health technology decisions.

Dimension	Indicators	Target/goal (examples)
Population at risk[a] ✦ Epidemiological orientation ✦ Health systems research orientation	✦ Mortality: death rates, cause-specific death rates, proportionate mortality ratio, case–fatality ratio ✦ Potential years of life lost (PYLL) ✦ Morbidity: incidence rates, prevalence rates ✦ Use of health services ✦ Access to services and geographic indicators ✦ Impact of violence on health ✦ Lifestyle-related health indicators	✦ Reduced health deficits of the population ✦ Increased accessibility to services ✦ Healthier lifestyle
Population impact[a] ✦ Epidemiological orientation ✦ Health systems research orientation	✦ Disability: functional or physiological (quality of well-being); for example, functional assessment inventory, sickness impact profile, Nottingham health profile, quality of well-being scale, social relationship scale ✦ Potential impact: "etiological fraction" ✦ Quality of life	✦ Improved quality of life and well-being ✦ Reduced burden of illness
Economic concerns ✦ Compares the inputs of an intervention with some combinations of the outputs	✦ Cost-effectiveness analysis ✦ Cost–benefit analysis ✦ Cost-utility analysis ✦ Opportunity costs	✦ Optimization of total social returns by weighing estimated costs and perceived benefits ✦ Recognition of allocative efficiency
Social context[b] ✦ Individuals (by gender) ✦ Communities ✦ Organizations and groups ✦ Institutions and systems	✦ Social context ✦ Ethical acceptance ✦ Political will ✦ Legal framework ✦ Power and dominance issues	✦ Balanced gender participation in decision-making ✦ Fostering gender autonomy ✦ Gauging political will ✦ Development of legal perspective
Technology-assessment activity ✦ Role of scientific evidence ✦ Quality of scientific evidence	✦ Comprehensiveness of scientific evidence ✦ Source of scientific evidence ✦ Convergence of scientific evidence	✦ Increased understanding of conflicting interests ✦ Improved relevance of evaluative research

[a] Of problem, disease, or health issue. All indicators should be by gender, age, and cultural group.
[b] Including ethical, legal, and political concerns.

To show clearly how the framework can be applied to a health technology decision, a hypothetical situation requiring a policy decision is presented and examined: the use of ultrasound during pregnancy. The use of this procedure is common in developed countries and is rapidly increasing in developing countries, where its cost is moderate. The hypothetical decision is whether the procedure should be publicly funded and under what circumstances. Ultrasonography is the imaging technique that permits "seeing with sound" (Yoxen 1987). Its use during pregnancy is a major (albeit not exclusive) application of the technology. Sound waves sent through amniotic fluid bounce off structures to produce a two-dimensional, cross-sectional picture of the woman and the fetus on a video display screen (Gold 1984). It is used to assess the duration of pregnancy and position of the fetus in the womb.

The first two dimensions of the framework, population at risk and population impact, represent the epidemiologic orientation of health research. Epidemiology is the study of the distribution and determinants of diseases and injuries in human populations. It is concerned with the *extent* and types of illnesses and injuries in *groups* of people and with the *factors* that influence their distribution (Steiner et al. 1989). Epidemiology is concerned primarily with three major variables: person, place, and time.

- *Person* characteristics include gender, age, race, marital status, and socioeconomic status, among others.
- The *place* or geographic distribution of a health-related outcome of interest can also be important in understanding causal relations or planning health services to meet the needs of a particular community. Geographic differences can suggest a role for factors such as climate or cultural practices, including diet, method of food preparation and food storage, in the incidence and prevalence of a particular disease. Alternatively, geographic differences may be due to differential access to health services.
- Variations in the *time* of occurrence of a particular disease can also indicate causal relations along with the other factors that can account for the changes in disease distribution over time.

The variables of person, place, and time are important in understanding the nature of person–environment fit, a key construct in assessing the risk and protective factors that determine health status in groups of people.

Identifying the population at risk

Population at risk takes into account the magnitude of the problem. In health research, this population is usually defined in epidemiologic terms, such as the number of new cases of the disease or problem (incidence) or the number of existing cases (prevalence), which are known as morbidity rates (Mausner and Bahn 1974). These rates are usually known in varying degrees of precision in developed countries and may be more crudely estimated in developing countries; statistics may be compiled at national or local levels. Population at risk can also be defined in different terms such as general death rates or cause-specific death rates, known as mortality statistics. A comprehensive consideration of the population at risk includes relevant measures such as age, sex, socioeconomic status, access to health programs (that is, individual characteristics), as well as natural history of the disease or health problem and relevant social indicators, such as measures of income disparity or illiteracy rates (that is, collective characteristics).

The first step is to identify the population of interest vis-à-vis the technology under consideration. It is important to be inclusive at this stage to determine the magnitude of the phenomenon under examination. For ultrasound, all women of childbearing age (say, 15–45 years) would comprise the population of interest; however, those who are pregnant are the more likely population at risk.

To determine the size of this group, simple empirical evidence can be sought, such as the proportion of women in the age-groups of interest and fertility rates. More elaborate estimates of the potential population of interest could also be obtained by factoring in average family size, number of multiparous women, and so forth, with assistance from demographers. The important point is to determine the level of empirical precision required for the particular decision under consideration, then seek this evidence with or without assistance from empiricists in the field. Although accuracy and precision of data are desirable objectives, variations in availability and accuracy should not become a major deterrent to this approach. For example, it would be important to ascertain the geographic or ethnic distribution of the population of interest only if services are delivered in a decentralized fashion, or if cultural factors are known to contribute to risk factors. Otherwise, aggregate statistics expressed as actual counts or estimated rates would suffice.

Other statistical indicators may be of interest depending on the intended use of the technology, that is, whether ultrasound will be made available as a screening tool to all pregnant women (the current practice in developed countries) or whether (to contain costs) it

will be used only as a diagnostic tool, available to women identified by primary-care providers as high-risk pregnancies.

In summary, the decision-maker would raise two basic questions as a first step: who is the population at risk (that is, those who need this technology) and what qualitative and quantitative empirical evidence is available to describe that population in epidemiologic terms? The extent to which answers to these questions can be provided will indicate the clarity with which the magnitude of the problem at hand is defined and the degree to which an empirical appreciation of the problem exists. Furthermore, a statistical profile of current service use and, if possible, the demand for such services completes the picture. All along, the decision-maker may consult with researchers to establish the relative quality of the empirical evidence and with interested parties for assistance with broad or specific definitions of the population at risk.

Estimating population impact

Population impact takes into account the known, expected consequences of the intervention. The impact on population health is often measured by examining both functional ability (physical and social) and psychological status (quality of well-being). Measures of functional status and well-being can be either generic or system-specific (see Table 1). A wide range of narrowly defined health-status measures has been described, and discussion generally includes information about the purpose, reliability, and validity of the measurement instrument (McDowell and Newell 1987). However, these particular measures are not usually gender specific, and there is no feminist critique of them. Special effort would be required to address this obvious research gap.

In addition to population impact, other useful measures of impact include quality of life and "potential" impact. Measures of potential impact reflect the *expected effect* of changing the distribution of one or more risk factors in a particular population. Although the utility of this measure may be somewhat limited, it has important value in decision-making related to public-health issues. For example, this measure would be valuable for proactive assessment of public-health programs aimed at eliminating risk factors in a population.

The purpose of this step is to examine and understand the burden of illness. If ultrasound is being used as a screening tool, then what are the expected consequences of this screening? Once again, it is more important to raise the appropriate question and attempt to

obtain some quantifiable measure for its answer than to seek to be particularly precise in that answer. If, for example, reliable statistics exist on maternal and infant morbidity, then the decision-maker will be better informed. The next question to consider is: how much of the burden of illness may be reduced by using ultrasound technology? Often, expert clinical opinion or consensus statements may be the only available information; in this case, good epidemiologic information is available (Anderson 1994).

Another important point related to screening or diagnostic interventions is the availability of therapy or cure. Once problems have been identified by ultrasound, are there health-care or other measures to attenuate the burden of illness? Does ultrasonography provide the type of diagnostic information that, if acted upon (treatment), would make a difference to women's and babies' health and quality of life? As direct intervention to treat the fetus in utero is unusual, identification of abnormalities may not be of great value except to offer abortion.

Finally, questions regarding the potential health risk of the technology and whether it is offset by potential benefits should be raised. This is similar to risk assessment. For example, there are no known major medical or health risks associated with the use of ultrasound imaging itself, but problems of false diagnosis (due to machine or human error, or both) and subsequent investigation and treatment cannot be overlooked.

It is also important to note that the choice of statistical indicators and quantitative measures to depict the epidemiologic dimension can affect the way a situation is portrayed. For example, maternal mortality rates are expressed as maternal deaths per 100 000 (or 10 000) live births. Rates of 100 to 200 are considered very high, but pale when compared with a different expression of the same situation: years of life lost (YLL). The YLL statistic would take into account age at death and the average life expectancy of women of that age and present the cumulative figure for the 200 women at, roughly, 7 000–8 000 YLL.

Economic concerns

The economic component of the decision framework considers what society can reasonably afford. How society arrives at decisions about what it can afford is an important but opaque question. How a government agency decides appears to be based on finite financial resources. Those who plan, deliver, and pay for health services are

constantly faced with the fact that the supply of professionals, hospitals and other facilities, and technologies cannot meet the demands or needs of all patients (Sackett et al. 1985). Decision-makers must decide how to apply limited resources where they will do the most good. The solution involves both costs and consequences and, because it implies a choice between alternative courses of action, it constitutes an economic evaluation. Money may be the unit of measurement, but the real or "opportunity" cost of any health program or technology is the sum of effects or benefits foregone by committing resources to this program rather than to another one.

The economic dimension of the decision framework compares the inputs to a health-care program with some combination of the outputs. The inputs usually include:

- Direct costs to the health-care sector and to patients and their families — in aggregate, they correspond to the portion of gross national product spent on health care;
- Indirect costs expressed in terms of production losses because of morbidity, mortality, and use of health care; and
- Intangible costs — pain, suffering, grief, and so on, that is, any nonfinancial outcomes of disease and medical care.

The outputs of a health technology can be summarized in three categories.

- *Conventional clinical outcomes,* such as number of cases treated or number of life years saved. When compared with inputs, this type of analysis is referred to as cost-effectiveness analysis (CEA). It considers the possibility of improved outcomes in exchange for the use of resources. It cannot be used to choose between technologies with different outcomes or to determine what weights should be put on human life, but gives an indication about the quantity of life of a person with a given health condition (Eisenberg 1989; Bowie 1991; Feeny and Torrance 1992).
- *Monetary value of different health effects.* Comparing technology costs with its effects defined in monetary terms is referred to as cost–benefit analysis (CBA). CBA is an attempt to link cost information with medical evidence on the outcomes of treatment, but forces an explicit decision about whether the costs are worth the benefits by measuring both in the same unit of currency (Drummond and Stoddart 1984; Sisk 1987).
- Outcome is measured not only in terms of quantity of life, but also in terms of *quality of life* using such indices as

quality adjusted life-years (QALYs) and disability adjusted life-years (DALYs). Cost–utility analysis is yet another method of weighting for quality of life variations (Drummond 1987).

The choice of measure depends on the health outcome of interest. A *cost-effectiveness ratio* would be used when there is only one health outcome of interest; for example, comparing two technologies in terms of their cost per life-years gained, such as in an immunization program. A *cost–benefit ratio* would be applied when there are multiple health outcomes of interest, such as degree of hypertension and level of cholesterol. Monetary values are given to outcomes to allow comparison of the merits of each intervention. Finally, a *cost–utility ratio* would be used when the interest is on quality of health outcome, not just quantity.

Several problems arise in economic analysis, related to both theory and measurement. The theoretical basis of CBA lies in new welfare economics and is designed to identify the economic conditions that will maximize the social welfare under various resource restrictions. Changes in social welfare are not easy to evaluate. CBA cannot determine whether the objective is worth achieving; it just examines the much narrower question of payoff resulting from the use of a technology. Similarly, social costs are usually omitted from consideration because of measurement problems. As CBA for a single technology can be undertaken from the different perspectives of each interested party (or constituency), the decision-maker will possibly be able to identify potential opposition but will not have an understanding of the reasons. Cost-effectiveness is not grounded in theory and does not assist in the identification of policy direction. It does provide a comparison of cost for a selected outcome or desired effect. Thus, neither CEA nor CBA are advisable as primary tools for decision-making.

However, efficiencies in health and health care are particularly important during times of economic restraint. To apply limited resources where at least some good will result, the decision-maker has to raise the question of cost-effectiveness. Despite the difficulties cited above, a number of fundamental cost-and-benefit questions should be raised and empirical measures examined carefully.

To begin a fiscal analysis, costs beyond that of capital or acquisition costs should be ascertained, that is, operating costs for various levels of throughput (productivity). For example, once ultrasound equipment is purchased, what is the cost of providing services in hospitals (public or private), in community clinics, in urban centres only, or across the country to reach remote areas? What are the costs for service provision during regular business hours, for

additional hours of service, and for multiple shifts? The higher the acquisition cost, the higher the level of productivity required to offset such costs. In addition, costs associated with human-resource requirements should also be carefully considered. For example, payment of technologists and specialist physicians are important expenditures. However, additional costs to the system may include those for credentialing professionals, the academic research interests of clinicians, and continuing education for staff.

Once costs for a single imaging unit are ascertained, estimates of total cost can be computed for the entire population at risk and for subpopulations. This information, coupled with nonpriced (human) cost information on population impact, can begin to provide the decision-maker with a sketch of the economic dimension of options. In some situations, full-scale cost-effectiveness or cost-utility evidence might be available, including costs for alternative and complementary interventions and health outcomes.

Opportunity costs should also be examined. For equivalent expenditures, what other services can be purchased or are being forgone. Such costs can be articulated either in terms of other services to the population of interest or to another population. For example, what level of services can be purchased and what results can be obtained if the same amount of money were allocated to nutrition or to infection control for pregnant women? The effectiveness of prenatal care with a focus on nutrition is indisputable. Or, what would an investment similar in amount to that for ultrasound yield toward devices to assist handicapped women?

Finally, decision-makers should at least strive to establish a value-for-resources-expended ratio to women, service agencies, and to the health-care system for a specified quantity of fetal ultrasonography services. Value may be expressed in other than monetary or health-outcome measures, and pertinent socioeconomic factors may also be appropriate indices for such analysis.

Social context

As the health-care system is a subsector of the larger social system, the diffusion of a technology in health care should be analyzed in that context. The development or diffusion of a single health technology has implications for consumers, health professionals, taxpayers, service agencies, educational institutions, and industry, as well as social institutions such as the family, the community, and the economy (to

name a few). The reason and direction of these relations have not been well investigated in health assessment.

Social-impact analysis is a way to understand, explain, and predict the potential effects of technology on social systems. Social indicators, the quantitative measures of interest, can be expressed at the level of the individual, family unit, community, organization, or system. However, the boundaries between social and ethical, ethical and legal, or legal and political aspects are not always clear and interactive effects occur (Duncan 1984). For example, the use of health technology could result in a demographic change that might interact with an altered economic base in a region to change the power of the regional political institutions. Conversely, understanding the relations between social structure or values and health technology is equally important in the assessment of that technology. For example, why is the electronic fetal monitor firmly established in obstetrical practice despite the evidence of harm to pregnant women? Legal implications are often cited; but does litigation influence medical practice or vice versa? The value of a "perfect" child from every birth is a socially determined phenomenon; technology that is perceived to promote such "perfection" is wholeheartedly adopted. Ethical implications are focal points in all reproductive technologies, as questions are often raised about the "commodification" of women and babies. In addition, ethical implications of genetic testing and the enormous powers vested in that type of knowledge are of ultimate importance from a social policy perspective as well as from a health-care delivery perspective.

An increasingly important component of health-care evaluation concerns the expected effects of new technologies, or technology transfers, within the spheres of medical ethics and social justice. Appropriate indicators within each of these dimensions can be compiled from published research and ranked according to relative importance by panels of experts, then taken to the community (or interested parties) for consultation. In the framework proposed here, social values and technical expertise are considered to be complementary in a process that strives for justice and fairness (Garland 1992).

Specifically, constituencies and interested parties should be consulted regarding their views of the relative importance of the four major tenets of medical ethics; autonomy, beneficence, nonmalfeasance, and justice (Beauchamp and Childress 1989). *Autonomy* refers to the extent to which patients and their families are able to remain in meaningful control of their care, including decisions about which interventions to undergo (or to refrain from undergoing) as part of their care plan. *Beneficence* relates to the extent to which technologies

provide true health benefits in the areas most favoured by patients, such as enhanced quality of life and prevention of disease. *Nonmalfeasance* refers to the potential for certain technologies to produce a net harmful effect on patients. Certain painful or risky procedures of dubious or minimal benefit may fall into this category. Finally, considerations of *justice* are increasingly important in the area of health-care technology assessment because of the growing tension in some countries between a tradition of egalitarianism in health-care delivery (universal public coverage) and the shrinking pool of resources available to pay for all effective services. This consideration is of particular importance when new technologies are expected to be very expensive and of potential benefit to small numbers of patients or specific subpopulations.

Although several distinct dimensions are subsumed under this one category of social context, the framework is not intended to simplify these complex phenomena. For the sake of parsimony, and because all provide the context within which public-policy decisions ought to be examined, these dimensions are presented collectively. Depending on the situation, some permutation of them may be relevant. More likely, all these concerns may be of relevance in varying degrees.

In the case of fetal ultrasonography, the social as well as the ethical dimensions may be more important than the legal and political. To ground the technology in its social context, ask: Is this a socially acceptable technology? Finding an answer requires both empirical (objective) and subjective information. For example, social scientific research on whether ultrasound technology is congruent with the social values of the country pertaining to the care and welfare of pregnant women may be available. By providing visual access to the fetus, ultrasonography conforms with a growing trend in obstetrics to give the fetus patient status, somehow separate from its mother (Mattingly 1992). This may or may not be an acceptable change in social values. Ultrasound can also be used to make a "media spectacle" of pregnancy (Petchesky 1987) and has contributed to a change in women's and men's experience of pregnancy and expectant motherhood and fatherhood (Sandelowski 1994). Are these congruent with local social norms? The impact of technological change on social relations can vary greatly from one group to another, requiring different degrees of social change. On the other hand, the inverse may be the case; different types of social change can culminate in different levels of technological development. Critical feminist analysis has provided pertinent information on issues of power, control, and dominance (Wajcman 1991; Lindenbaum and Lock 1993).

In addition to examining empirical evidence, the decision-maker should consult women or women's groups to obtain their assessment of the issues and their particular perspective on the subject of ultrasound. Again, using the framework facilitates this process of consultation because the decision-maker can approach the interested parties with a set of criteria (the previously discussed dimensions) already elaborated. Those being consulted can follow the decision-maker's process of thought through the material presented and can take issue with any or all of the foregoing logical arguments, if they wish. Without an explicit decision framework, communication between policymaker and others can be a guessing (and outguessing) game.

Another important aspect of the social context is equity: would all those who could benefit from the technology have equal access to it? In the case of fetal ultrasonography, two questions can be raised. First, would this technology be available to all pregnant women? If so, particular attention should be given to designing a service-delivery structure that will reach all pregnant women and allow equal access. Second, if this publicly funded technology is to be made available only for certain medical indications, for example, previously defined high-risk pregnancy, the question of equal access becomes even more important, especially for rural or isolated areas or disadvantaged groups, because a "gatekeeper" to the technology has to be consulted first, requiring perhaps initial travel or forgone earnings, and further displacement for the subsequent services of interest.

Two of the major tenets of medical ethics are particularly relevant to the decision on ultrasound: autonomy and beneficence. The use of this technology often promotes the "commodification" of the fetus and pregnant woman (Sandelowski 1994), while maximizing the male role and expectant fatherhood. Seeing and getting a picture of the fetus becomes as significant as carrying the fetus, thus reducing a woman's control over the situation. This is a hindrance to the pregnant woman's autonomy, as defined by medical ethics.

The extent to which ultrasonography provides true health benefits to the pregnant woman and her fetus has been seriously challenged (Oakley 1986a,b). Ultrasound use becomes even more problematic if it is consistently and routinely misused or abused. The use of ultrasound for sex selection (undertaken routinely in some countries) has now been documented (Royal Commission on New Reproductive Technologies 1993; Wertz and Fletcher 1993; Global Child Health Society 1994). The ensuing abortion of female fetuses raises serious questions regarding beneficence as well as morality. The availability of a technology that is potentially exploitative of

women and contributes further to their subjugation should be curtailed immediately until further policy action to stop such undesirable practice is fully implemented. If there is evidence of potential and possible abuse by the health-care provider, or the consumer of the services, regulatory mechanisms to remedy this situation should be concurrently developed and legal implications fully explored and documented.

General and specific questions regarding government regulation of facilities and service organizations, as well as the professionals who provide these services are often desirable and always necessary steps in the decision-making process. Speaking at the opening of the 19th session of the Program Committee of World Health Organization's (WHO's) executive board, Director-General Dr Nakjima stated that "in the field of health, technology cannot be left to govern ethics on an empirical basis. Decisions must be made consciously by us all" (Global Child Health Society 1994).

Political concerns may vary widely among health-care systems and countries. However, in a rational stepwise approach to decision-making, political implications of technological development and change should be raised and considered. If the political imperative will, ultimately, be the only factor driving the decision, at least the decision-maker should be fully aware of the consequences of the decision along all the other dimensions. Finally, it may be desirable to weight each dimension, rather than attributing equal importance to all of them.

Technology assessment

In a narrow sense, health-technology assessment (HTA) involves the evaluation or testing of a technology for safety and benefits when used under ideal conditions (efficacy). In a broader sense, it is the process for policy research that examines the short- and long-term consequences of the technology in question. Health technology has been defined to include the drugs, devices, and medical and surgical procedures used in health care and the organizational or administrative and support systems within which health care is delivered (Institute of Medicine 1985).

The assessment of a technology sometimes combines concerns from the clinical, epidemiologic,. economic, and sociolegal perspectives. These aspects are usually specific to the technology in question. The assessment would consider:

- The safety of the technology — a judgement of the acceptability of risk in a specified situation, which may include

comment on the quality of provider or type of facility within which the technology is used;

- The benefit of using a technology or procedure for a particular clinical problem under ideal conditions (efficacy), such as within a study environment in a laboratory or at a teaching hospital;
- The benefit of using a technology or procedure for a particular clinical problem under general or routine conditions (effectiveness), such as in a field situation or within a rural or nonteaching hospital;
- Considerations of costs, volume of services, and benefits in terms of cost savings and other factors such as lives saved or serious illness prevented; and
- The implications of using the technology in the context of societal norms, cultural values, and social institutions and relations.

Some, and on rare occasions all, of these concerns form part of the analytic frame that is used to approach the technology-assessment activity.

Assessments usually incorporate one or more methods. The first step is a thorough search of published information through library databases, as well as all fugitive information, which does not appear in peer-reviewed publications. The information is examined for strength and quality. Research that has been conducted using rigorous methods is generally given more weight than research using weaker methods of study. For example, evidence obtained from at least one properly designed, randomized, controlled trial is viewed as stronger than evidence from nonrandomized or descriptive studies. An assessment will be more powerful when it is based on meta-analysis, for example, or reports of expert committees. Systematic evaluation of a technology can draw on research using any assessment method, but, currently, most technology assessments use primarily synthesis of the literature, expert opinion, and cost analysis.

Most health technology falls into one of six categories of application: prevention, screening, diagnosis, treatment, rehabilitation, and palliation. The application of the technology is particularly important as the assessment usually focuses on this aspect. Clear criteria exist for evaluating technologies or health programs for screening, diagnosis, and treatment. Technologies may be assessed at different stages of diffusion — the process by which a technology enters and becomes part of the health-care system (OTA 1976). These

stages include: emerging, new to practice, established, almost obsolete, and outmoded.

Under ideal conditions, a technology should be assessed *before* diffusion into the social system. However, in the real world, most health technology is adopted before it is examined for efficacy or effectiveness (for example, diethylstilbestrol (DES), thalidomide, and birth-control pills). The costs to the system and society are sometimes enormous, as was the case when thalidomide was used to treat nausea in pregnancy.

HTA attempts to make sense of the available information regardless of its source. Evaluation is based on analysis of the evidence and the strength of the findings. Logical and defensible conclusions about the technology are formulated in reports usually prepared for the decision-makers. Generally, assessment is undertaken to examine only the effectiveness of health care and to provide information in a timely manner for more informed decision-making by policymakers, industry, health professionals, and consumers. It is also undertaken to reexamine technology critically at various stages of diffusion. Technology assessment may be used to slow the adoption of emerging or new technologies but, most often, it is to help decision-makers allocate resources among established technologies.

The technology-assessment dimension incorporates a different type of factor into the decision process: the weight of scientific evidence specific to the health technology. Methodologic rigour and the application of rules of evidence to what is known about the technology under consideration provides arguably the most reasoned of decisions. However, complete scientific evidence is rarely available, or even possible to obtain concurrent with the decision-making effort. Health technology diffuses much faster than the time-frame required to undertake good, scientific research. The inclusion of this dimension in the framework yields new information about the interplay between research, scientific evidence, and health-technology diffusion.

The importance of this dimension in the framework depends on the weight subjectively assigned to it by the decision-maker. As a final step in the rational process, the decision-maker should consider the availability and quality of scientific evidence regarding the technology under consideration, in this case, ultrasonography. Although there is appreciable research on the efficacy of this medical imaging technology in prenatal care, information on its effectiveness and cost-effectiveness is scant and may be much less conclusive.

All the dimensions of the framework depend on reliable indicators (empirical measures) that define and accurately describe the specific policy issues of importance to the decision-maker. The

potential contribution of research to policymaking in the health sector is made more evident through the use of the framework and its explicit deliberation of each policy dimension separately, as well as of overall, integral consequences from a societal perspective. The availability and quality of the scientific evidence are, therefore, important factors; however, the lack of accurate data should not lead to the abandonment of the conceptual framework, because raising appropriate questions about the broader context of health and human needs is itself a desirable objective.

Making choices without taking chances

The dominant institutions that structure technological options in health have historically been controlled by the church, the state, the medical profession, research bodies and funding agencies, and drug companies. These technologies develop within a science culture that defines women by their biological function — child bearers — and their social function — child rearers — and research priorities are identified by male scientists. For example, research on contraceptive technologies has examined only clinical efficacy and effectiveness; the question of why particular contraceptive technologies have been developed in preference to others remains unanswered. Also, we know little about the influence of social institutions on the development of reproductive and other health technologies. Decisions about who will get how much of what in health care are made daily, mostly in an ad-hoc fashion that tends to be biased in favour of those in power; women are absent from these circles. Policy mechanisms pertaining to health technology and its diffusion are neither coordinated between local, regional, national, and international levels, nor applied consistently to ensure allocative efficiency (that is, doing "the right thing") in addition to technical efficiency ("doing things right"). Women's concerns and needs would be better met if technological choices were more informed choices.

The framework provides guidelines within which the appropriate information is sought and examined. This is achieved through raising questions for which there may or may not be answers at the time. Because of the framework's explicit and stepwise approach, it can expose the ideologic and social power of those who make decisions during the development and diffusion of technology. Focusing on analysis of the dynamics of the social context reveals women's technological concerns as well as their absence from decision-making roles. This can be corrected.

Where there is evidence of the possibility of harm to women's health and well-being, analysis using the framework exposes conflicting interests that may attempt to mask that situation. In addition, even where the technology of concern is not directly related to women's health, the framework's consultative capacity invites the participation of women in the decision process.

That process, in the hypothetical example of ultrasound imaging for pregnant women, can be rapidly demystified. Policymakers will become aware of the bias in the language of clinical practice, where ultrasound measurements during pregnancy are known as "fetal" measurements, not "pregnant women" measurements, showing a male medical bias. Epidemiologic evidence indicates that screening of all pregnant women through ultrasound imaging, on balance, does more harm than good. Although it is desirable and necessary to reduce maternal and infant morbidity and mortality rates, such evidence is not forthcoming in developed countries where there is widespread use of this technology. The evidence indicates that programs of prenatal care, such as nutrition education and food distribution, are effective in reducing slow development and other problems of pregnancy. As for economic concerns, the adoption of inappropriate technology at *any* cost is unacceptable.

Within the social context, evidence points to altered social relations, not just between mother and child or father and child, but also among members of larger groups: health-care providers, facilities, and communities. The autonomy of the expectant mother is appreciably reduced by the use of this technology, which ignores a major tenet of medical ethics. Finally, the overt misuse of the technology for sex selection is regarded as immoral and would incur political costs to the present authorities. The right decision for the policymaker (most probably in a developing country where this technology is beginning to be adopted) would clearly be not to purchase ultrasound technology.

In summary, the framework is proposed, not as a substitute for HTA, but in conjunction with it. Others have discussed the methods and limitations of HTA (Banta and Luce 1993; Morgall 1993); they observed that there is almost unanimous agreement on the need for technology assessment in general. However, little mainstream HTA is context-oriented and gender-specific; technology is rarely viewed in a social context of conflicting human interests; and an attempt to make HTA more directly relevant to policymaking is very recent (Battista 1992). The proposed theoretical framework addresses these important issues.

The framework draws on a number of disciplinary perspectives, incorporating theories of epidemiology, sociology, economics,

and systems science, and combines a critical feminist approach with that of health-services research. Application of the framework generates a package of information that includes social values. It identifies possible choices by providing an evaluation of the relative sociomedical merits of technological alternatives under consideration; the decision-maker still makes the choice, cognisant of its many consequences.

Future research needs

The recognition that empirical evidence can contribute enormously to health policy and planning has not been uniformly espoused and promoted across time and countries. Funding available for health-systems research has been low relative to that spent on health services, and has not been forthcoming in a predictable, stable pattern. Through a detailed discussion of health-policy issues, this paper emphasises the many areas where there is a lack of knowledge and lack of understanding of population health needs in general, and women's health issues in particular. This information deficit can be appreciably reduced through special, targeted funding of priority areas and continued, stable funding of all areas.

Three areas or types of research can be delineated.

- *Epidemiologic research* that expounds on the distribution and types of illnesses and injuries in human populations and the factors that influence their distributions. Particularly lacking are studies on women's health.
- *Health-systems and population-health research* which are multidisciplinary fields that recognize that health is more than medicine. For health-systems research, the focus is on system organisation and delivery of care recognizing that these are at least as important as the content of care. Research on the social indicators of health and illness constitute the major focus for population-health research. Both would contribute enormously to understanding women's health issues.
- *Health-policy development and analysis research* that expounds specifically on how health decisions are made, who makes decisions, and how best to incorporate empirical evidence into health-policy decisions, given a better understanding of the process and the people. Research on decision-support models or frameworks that facilitate a rational and integrated approach to health policy is a relatively new field. A rational, explicit approach to health policy would, at least in

the long term, be useful by bringing women's experiences into the policymaking arena.

Some official international efforts promote the use of research evidence in the health sector. In 1993, at an international consultation convened by WHO in Geneva, studies identified as "health futures" research were presented and discussed. This area is being promoted and supported by WHO because it is perceived to be essential to evolve and develop new approaches that will assist in formulating public health action aimed at accelerating progress toward health for all. The importance of futures research in this context was recognized by the World Health Assembly in 1990 (Taket 1993).

Although the "health futures" label is comparatively recent, the studies identified as such by WHO are concerned with the future of health or health services using methods more broadly defined as epidemiology, systems research, strategic planning, or modelling. The International Health Futures Network is undertaking some projects on modeling futures; however, these are generally described as projection or simulation models either based on the status quo or using hypothetical scenarios for the future. A rational, prescriptive, prospective model, such as the framework proposed herein, has not existed previously, but is particularly supported by the related "health futures" research as a possible and desirable tool.