CHAPTER 8

DISCUSSION

This study of medical technology originated with the question of why technological inputs assumed to have improved health status of populations in other countries had not brought about the anticipated improvements in India and had not succeeded in either eliminating or reducing the incidence of several infectious diseases. The subsequent examination of medical technology in relation to medicine and health systems in general, and specifically in India, has thrown up two significant sets of issues: one relating to the analytical approaches and framework used and hence, the tools employed to study medical technology; the other relating to social processes in making choices, and in the promotion, diffusion and use of medical technologies. We discuss here the significance of these two sets of questions for contemporary debates on medical technology.

A Framework for the Study of Medical Technology

The dominant approach to study of medical technology has been that of technological determinism, which imposes limits and constraints, whereby there is no attempt to look at certain glaring problems. On one hand, modern medicine has come to be associated with science, and with 'healing and curing', with health. On the other, the dominant modes of practice of medicine and of use of medical technologies are riddled with unscientific and even unsafe practices. There is no satisfactory system yet for assessment of medical technologies, and there is inadequate evaluation of effectiveness and safety of many technologies. Among sections of the medical profession there exist doubts and reservations about medical technologies. Finally, medical technologies are held responsible for pushing up the cost of medical care. Despite such unresolved contradictions, and despite their role in pushing up costs, promotion and widespread adoption of such medical technologies continues. Resources continue to be invested in developing and in procuring more and more of such expensive and complex technologies, and in advancing this brand of 'scientific medicine' as the basis for public health, despite knowledge of the social basis of health and ill-health, and long-standing concerns about the need to address the social determinants of health.

Such contradictions do not get addressed because of the attitude towards technology that underlies the TD approach. Namely progress as improvement in technology, technological progress as an end in itself; technological change as autonomous, as an 'inevitable consequence
of the inexorable progress of scientific research' leading to the notion of 'technological imperative', so there will be 'advances' in medicine and medical technologies. New technologies in medicine are taken as a given, as an independent factor and their high cost is also accepted as given. The accompanying problems of irrational use are looked upon as a 'price that has to be paid for the benefits of the technology' (even if benefits are not always demonstrated), which can be addressed by social adjustments.

There is no attempt to understand — Why is it that the 'new' or 'advanced' medical technologies are often more expensive, more 'specialized'? What is it about a (new) technology that makes it so expensive to acquire and use? Is it possible to have something less expensive, or less complex, or free of the problems that have been shown to be associated with their use? Is the bio-medical, technology based paradigm the only way to understand and address health and ill-health? Such questions do not arise at all.

Critiques of technological determinism have given rise to a large collection of studies and literature, often referred to as social shaping of technology (SST) in the 1970s and as the social construction of technology (SCOT) in the 1980s. Together, they offer better insights into the complexity of the process of development of technology and its role in society. The social shaping of technology and social construction studies view technology not as standing outside or above society, but as a social product, subject to social forces and amenable to social analysis, and thus open to social intervention. They have been concerned with developing critiques of the prevailing notions of technological determinism, and with demonstrating and explaining how social processes, forces and structures relate to technology and give rise to particular technologies. They provide insights into the social processes of the conception, invention, design and development of technology, all of which embody particular social relations. However, there are significant differences between the two.

A major difference and its limitation, is that the social constructivist approach is highly empirical and usually confines itself to examining technological innovations at the micro-level. Social constructivist studies are a-historical and do not provide answers to why we chose these technologies to begin with, or to the question of dominance of technologies in areas such as public health. Moreover, the influence of the social is limited to the actions of the individual or small groups involved in technology research and development. While this has its usefulness in conceptualizing technology development as a social process, there is no scope to relate such actions to the macro processes located elsewhere in society which may not always be visible. In
addition, the relativism\(^1\) underlying the social construction approach poses major problems in the context of an unequal, hierarchical social system. A useful theory of the relationship between technology and society needs to be concerned about the social relevance of technologies, about its positive as well as negative effects. Several researchers have pointed out the limitations of this micro-perspective, and have attempted to articulate a more comprehensive framework, that incorporates the specific with the larger context.

Researchers within the social shaping of technology go beyond social constructivism, to grasp the complexity of the social processes at several levels that are involved in technological innovation and its use. Studies within the SST genre in the 1970s looked at a range of ‘social’ and ‘economic’ factors as well as ‘technical’ considerations that pattern and affect the design, direction of innovations and processes of implementation of technology, as elaborated upon in Chapter 1. The researchers who focused on the social aspects of technology proposed that in the early stages of development of technologies choices could be made between alternatives. The choices of final products are shaped by interests – economic, social and political – of individuals, groups and institutions involved. The idea of technological systems was used in some of these studies of technology. It was argued that increasingly technologies were being made not as separate, isolated devices, but as part of a whole, as part of a system. The best example of this was the study by Hughes of the invention of the electric bulb by Edison (Hughes 1987). Another set of studies shows how the requirements/considerations of capitalist production (such as of economy, of efficiency, of profitability, of control over labour process) have shaped the outcome where choices in technology have existed. The study by Noble reconstructs the ‘failed’ and ‘lost alternative’ of record playback, to show that automation did not have to proceed the way it did. The choice in favour of numerical control resulted from deliberate selection, arising from the social relations of production wherein managers were required to control the shop floor labour (Noble 1985). Cowan’s study of the development and promotion, in the 1920s in the US, of the electric refrigerator as against the gas-based refrigerator was yet another exploration of the forces that lead to the ‘success’ of some machines and ‘failure’ of others (Cowan 1985a). In the 1970s-1980s feminist analysts provided several new perspectives on the social shaping of technology. Feminist historians of technology, who were concerned about the impact of technology on women’s lives, undertook much of the early work on domestic technologies (Cowan 1985b; Doorly 1985). It was argued that an important influence in the growth of domestic technologies (and entertainment technologies) was the way society was organized – the social prevalence of

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\(^1\) Relativism is the notion that means that one view is as good as another. This should not be confused with the concept of relativity in physics.
the nuclear-family households was used for the expansion of this market under the assumptions of the essentially unaided female homemaker, and of creating autonomy, privacy and providing choices. Such assumptions ignored the fact that women became house bound, isolated and dependent upon these new technologies at the cost of their own creativity and autonomy. With the example of nuclear power, Winner drew attention to the momentum of large-scale socio-technical systems, and brought in the theory of technological politics that takes technical artifacts seriously, and identifies certain technologies as political phenomena in themselves. He considered this perspective, which focuses attention on 'the things themselves' a necessary complement, and not a replacement, to social shaping of technology theories (Winner 1985). However, there was also need to understand the contexts in which the objects are situated – the study of specific technical systems and their history helps understand which technologies and which contexts have become important to us and why.

Within the social shaping of technology framework attempts can be delineated to address the many different levels, forms, and processes by which social relations interact with and affect choice of technology and its expansion. It is not a single, well-defined theory but includes distinctively different approaches and concepts, and the issues studied have ranged widely across types of technology, stages of the innovation process and domains of use. However, what all of them have in common is an attempt to demonstrate social influence on the direction of technological change. Yearley proposed a 'moderate constructionism' approach, which combined 'a social construction view and a political economy view' (Yearley 1988). The political economy perspective draws attention to the larger institutional structures to understand how the development of scientific and technical knowledge is influenced by economic and political priorities. Furthermore, he extended the sociological vision to an examination of the role of science and technology in the underdeveloped world, located within the broader academic concepts of underdevelopment. Social shaping of technology approach was thus described as a 'broad church', in which a variety of scholars with differing concerns and intellectual traditions find a meeting point (Williams and Edge 1996). It has been proposed by Russell that the social processes producing technologies should be situated in an established framework – that provided by a broadly Marxist form of radical social analysis. (Russell 1986).

Feenberg proposes a “critical theory of technology” – a critique that enters into the life of the technical systems and can reveal unexplored possibilities. According to him, existing cultural studies and constructivist sociology and history have shed new light on technology. However, they have so disaggregated the question of technology as to deprive it of any philosophical
significance' (Feenberg 2003). Such analyses have been unproductive because they remain at an abstract level and leave everything as it is; they do not have any implications for technological development, the actual foundation of modernity. Such studies minimize the top down control of technical rationalization, such as by corporations. Feenberg attempts to bridge technology studies with modernity theories, and develop a theory of democratic technological change that would allow reshaping of modern technological society (Feenberg 2002). Rationality, according to him, is not an alternative to culture. Rather “rationality in its modern technical form mediates cultural expression in ways that can in principle realize a wide range of values. The poverty of actual techno-culture must be traced not to the essence of technology but to other dimensions of our society, such as the economic forces that dominate technical development, design and the media” (Feenberg 2003). One of the important features of Feenberg’s theory is what he calls technical codes, namely dominant technical designs that reflect the hegemonic beliefs and values of the dominant group. The invisibility of these technical codes makes them appear as normal even though they are not. Given the pervasiveness of technology in modern societies, it has become a legislative political institution and therefore should be controlled democratically; rather than be left to a few privileged groups. Since technological development is contingent not just on reason but also on society, it ought to be democratized like other domains of social activity. He suggests that it would be useful for developing countries to learn from the reflections in the West on technology and society, where certain models have been discredited and even abandoned, to develop a more selective and critical attitude to technology (Feenberg – Preface to Chinese edition of Alternative Modernity).

These developments in social shaping technology studies inform our study of medical technology, to develop an understanding of growth and direction of medical technology in the specific sphere of Indian public health and medical care system. The essential components of our approach are a historical and dialectical method which incorporates class, political, economic and organizational aspects of technology.

Given the role it occupies in modern societies, medical technology cannot be meaningfully studied without bringing in the context of the overall medical and healthcare system. As with approaches to technology, there exist conflicting perspectives in the realm of medicine and public health in relation to society, as discussed extensively in Chapter 2. Health has been defined in ways that carry different implications for inquiry into ill-health as well as for the remedies subsequently employed. Broadly speaking, there is the biomedical view focusing on the biology of the individual, and the social medicine view focusing on the inter-relationship between the larger collective of society and health. The bio-medical view of health and disease
underlying the dominant practice of medicine and health systems, conceptualizes disease and health as a biological phenomenon at the individual level. It uses technological ways to treat and prevent diseases. The measures employed range from use of drugs and other medications, to vaccines and surgical measures. Means for detecting disease are also technology-based. The dominant form of public health has become institutionalization of this clinical medicine through hospitals and networks of peripheral institutions for provision of services at the population level. In this approach 'social' factors have been accommodated by emphasis largely on vaccination, hygiene-nutrition, measures to contain population growth, to increase health education and information levels, and to change individual behaviour to avoid sickness and disease, thereby avoiding the structural determinants of health. Promoting life-style changes and changes in individual behaviour become the centre of the social focus to avoid falling ill.

Social medicine on the other hand is based on the concept that health by its very nature is determined by social factors. The social medicine view conceptualizes health and disease as a consequence of collective social processes, and not just as biological phenomenon concerning individuals. Social medicine looks at these interactions in a systematic way and seeks to understand how health, disease, and social conditions are inter-related. Another principle underlying social medicine is that society should promote health through both individual and social means. Hence it postulates the necessity to analyze health and disease phenomena in the context of larger economic, political, and cultural processes of society. There have been several perspectives within social medicine. Perspectives related to the welfare approach acknowledge the need for inputs other than medical technology, and therefore, emphasize provisioning of these rather than questioning the structures responsible for prevailing inequities. The others attempt to address the origins of inequity and structural inequalities, such as the Latin American stream of social medicine discussed in Chapter 2. The political economy perspective, which belongs to the latter set, looks at health-related issues by explicitly focusing on the nature of the society in which the issues are investigated. Since capitalism is the dominant social form in existence today, it is the principal context in which these issues are discussed (Kelman 1985). The emphasis is on the context – since capitalism is the context it must be explicitly introduced into the analysis if the problem is to be understood. The strengths of this approach are reflected in the analyses of health service systems and programmes, as well as health of populations, in the works of public health scholars like Navarro and Banerji. Ratcliffe and Gonzalez have contributed to this stream through their conceptualization of the value-critical systems paradigm. An important aspect of the research process itself elaborated upon by them is that all systems, including inquiry systems are purposive – this means that neither the problem under study nor the system of inquiry employed is independent of either the researcher or the researcher's values. Said another way,
research problems cannot be separated from their human components, and are therefore inherently matters of values, ideals, and ideology. Hence all inquiry is normative, even that undertaken under the aegis of the allegedly value-neutral 'scientific method' (Ratcliffe and Gonzalez 1988). This paradigm also adopts an integrative method, and is concerned with interrelationships between the parts of the system under study and the entire system. Instead of conceptualizing that which is to be explained as an independent problem, it is conceived as an interdependent part of a larger system.

This study finds useful the postulation of the social context common to both perspectives - social shaping and social medicine. We adopt the more recent advancements in social shaping of technology giving rise to critical radical analysis, and the political economy analysis of medical care and health systems arising out of the social medicine perspective. Thus, viewing medical technologies as part of medical care and public health systems, as well as of modern societies, enables an understanding simultaneously of the larger social determinants of health, medicine and public health, as well as the technologies that are part of these systems.

Our analysis covers the practice of medicine, healthcare systems and of associated technologies, their development, growth, diffusion and application in the Indian context, the larger political, social and economic forces, and international influences on these areas. In other words these are the boundaries our study. The framework chosen helps understand better the links between systems of production of technology and of the medical care system through which they are delivered within the capitalist system.

**Forces shaping Medical Technology**

Technology in public health can be understood by looking at (a) notions of disease and health, and choices of medical technology made based on these notions, within the modern capitalist system, regarding medicine, medical services and public health; and (b) role of technology manufacturing industries in their adoption and diffusion.

**Notions of health and disease, choice of health systems**

When we look at the social-historical processes that have shaped the modern-day notions of health and disease and the place assigned to technology within the accompanying health care system, we find that the choice of explanatory theories is not simply related to their rationality or superior explanatory power. A constellation of larger social forces too - patronage, power groups and their interests, as also the nature of social organization- played a decisive role. We find that the debates of ill-health and disease-causation in the mid-19th century – for instance between
medical people subscribing to a constitutional medicine approach and the Chadwickians represented different social philosophies and conceptions of health, which in turn led to different kinds of public health activities as described in Chapter 2. In the period that is looked upon as 'the golden age' of public health, public health was a contested issue, and a choice was made from among different views that existed regarding health and disease causation. These choices have had profound and far-reaching implications for public health. There were possibilities of a different kind of public health and medicine, which had social justice as the foundation, and which could have guaranteed social justice and health. However, initially it was the advocates and proponents of the sanitary view who got the patronage and promotion from the state agencies sections. This focus on 'exciting factors' laid the basis for the acceptance of the germ as another exciting factor in disease causation. Subsequently, the development of a particular form of 'scientific medicine', based on the germ theory and its focus on the individual for prevention and treatment, received promotion from sections of the medical profession, and from wealthy industrialists and their philanthropic foundations. These provided 'validation' and legitimacy, and much-needed resources for research and growth, thereby enabling the dominance of the biomedical and clinical view of disease and health, and focus on 'exciting factors' only. Those who tried to point out that germ theory was not contradictory to environmental factors were ignored. Such choices then, made in favour of technically based sanitary measures and emphasis on single causative factors such as the germ, as opposed to the more encompassing constitutional medicine and social medicine approaches, laid the basis for a technology intensive medical practice and preventive public health, without having to address the root causes of disease in populations.

The consolidation of industrial capitalism by the early twentieth century, accompanied by faith in and euphoria regarding progress in science and technology to the extent that its progress in itself became an end, led to intensive use of technology in medicine. Over the late 19th-early 20th century public health became 'the application of scientific and medical knowledge to the protection and improvement of the health of populations'. In this notion of public health, technology-based medical interventions held the solution for most disease. The organization and training in public health also got based on a mechanistic, biomedical paradigm of health and disease. Public health itself became a marginalized discipline in medical education. In the process public health got conflated with medical services, and became a vehicle for the delivery and management of technology. So-called 'preventive' activities in public health also relied solely on technical inputs such as use of vaccines against diseases, technology-based screening procedures, public health engineering for sanitation, etc. We find that with the consolidation and spread of...
industrial capitalism, and the accompanying rise of welfare policies in European countries, living standards had vastly improved and problems of nutrition, hygiene and sanitation got addressed. The modern medicine based health systems of these countries claimed success of their biomedical based public health strategies. This in turn provided the rationale for the transfer of such technologies to the colonized countries.

The provision of such technologically based medical care and preventive measures has taken a certain trajectory, which has matched the developments in health system for an industrialized, capitalist society. Through the 20th century healthcare services and public health measures largely remained a responsibility of the state; healthcare provision was the barometer of ‘welfarism’ in Europe, as well as in many developing countries. This created a system where the state financed and provided the health services, but the production of technologies needed for diagnosis and therapy were very often shared by private industry. Such an arrangement also ensured large markets for the medical technologies produced by the industry. While the organization and financing of healthcare systems in England and other European countries may be different from that of the US, we see that they also provide the same technology-based medical care through their respective hospital-based healthcare systems. In Europe it was observed that government regulatory policies with respect to application and diffusion of medical technologies were influenced by the interest of national industries. In spite of the centrality of the state in providing financing and regulatory measures for medical technology, these countries are also faced with problems that accompany heavy use of medical technology, as in the US. These problems range from high costs, inadequate assessment, to inappropriate use of technology and irrational medical practices.

Coming to the issue of production of medical technology, which is an integral part of a system of production of goods and services in modern capitalist societies, we need to distinguish between the nature of the social pressures impinging on medical technologies. The industry and other commercial forces in the system do not, in reality, view medical technologies and healthcare very differently from other products. The centrality and dependence of medicine on technology suits the industry, as it creates vast markets for its products. Production of these is as a part of the capitalist system is guided by the same notions of profits and markets, and therefore necessitates the continuing development of new products and sales in new markets. Yet, in a welfare context there were some constraints imposed by the state. It is only with the relaxing of the controls that the industry has begun to intensely exploit the potential in medical technology for markets and profits, especially in the area of high-tech and specialized technologies. That this
is widespread in the drugs and pharmaceuticals industry is a well-documented fact. The medical technology industry too, like the drugs and pharmaceutical industry, comes with its objectives of profit and markets. Their needs of profits and markets get precedence over actual health needs. In case of medical equipment too there have been similar instances of pushing of pacemakers even when they were not needed, of unnecessary use of X-rays, of over-use of CCUs in cardiac care, of over-selling of CT-scanners (Chapter 5). In fact, in the context of medical technology assessment, it has been observed that: "the entrepreneurial basis of industry is not necessarily a sound way to produce the most desirable technologies. A laissez-faire approach tends to result in the production of very sophisticated machines, often very costly, which may not meet the most important technological needs of the NHS" (see Chapter 2 section 2.2).

An important group of actors in the developments in medical technology have been the elite class of professionals – doctors, engineers, scientists – all socialized and trained to think about the body, disease and role of medicine and health care in the bio-medical paradigm, within the technocratic rationality of modern capitalist societies. These professionals get support from the middle and upper classes to which they too belong, which already have access to basic welfare services, and now look to medical technology for further improvements of life spans/quality of life. Even when certain advances in technology carry hazards, or may be relevant to the health of only a small proportion of the population, still they are considered valuable (especially in India where this they constitute a few millions). Such an attitude is intrinsic to the cultural values where technology is looked upon as an answer to all problems, and advances in technology as an end in itself, no matter what the actual societal needs maybe. For instance, in the period following the two World Wars there was a search for new uses of technical knowledge acquired during the war, and efforts were made for applying them in medicine. Knowledge became an impetus for development of technologies. The interests of physicians, physicists, engineers, and technologists, and their contacts with industry and with government, played a critical role in the development of CT-scanners, ultrasound scanners, and lithotripters. This indicates the biases in making decisions regarding what equipment should be produced and promoted. In more recent times the imaging technologies in medicine embody such values, and perhaps that is why they were received with so much admiration and awe, as also receive so much professional and public attention and resources.

The following advertisement in a public health journal encapsulates the essence of this kind of thinking about 'disease' and its 'cure', and of the kind of forces that are now involved in the development and promotion of 'advanced' medical technologies.
A woman dances with her son
Because of brain surgery
That reduced her epileptic seizures
Performed by a neurosurgeon who was
Able to pinpoint the foci of the seizure
Due to breakthroughs in the
Mapping of the human brain
Advanced by physicians, mathematicians
And computer engineers around the world
Inspired by new discoveries in
Imaging Technologies
Reported in medical and scientific publications

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The state has been a significant actor also in the process of development of medical technologies. In the name of promoting scientific research and development, there has been significant financial support from the public sector for development of medical technologies. In the post-World War II period a strong S&T base was considered an important input for economic growth and development of a country. Innovations in technology, including medical technology, became important for the government. Strengthening and expansion of the medical technology industry was made a priority in innovation policy in a number of countries. According to the report of a Working Party on Expensive Medical Techniques in UK expensive medical techniques:

"Do not emerge out of the blue and then oblige the National Health Service (NHS) to devote funds to them or reject them. On the contrary encouragement given to technologists and manufacturers by individuals and groups in the NHS influenced what new techniques were developed. NHS policies created more or less favourable conditions for a manufacturer to develop and produce new equipment. The concerned government agencies may give some assistance to produce equipment to meet a known demand."

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need, especially when there is good prospect of export sales. The manufacturer then promotes it with the interested clinicians or even with charities. The government may provide financial support for manufacture in a number of ways, as also support linking of individual inventors with likely manufacturers. Most new or improved equipment came from manufacturers already in close contact, through various government agencies, with hospitals/universities, and specialist professional associations” (Council for Science and Society 1982).

In the case of development of the CT-scanner and ultrasound scanner interaction between the industrial manufacturer and the medical profession was arranged directly by the state, funds were given for the development, and commitments were made for purchase of the prototypes (Chapter 5 Section I). Once developed the technology eventually moves to the private/corporate sector; as also from small and medium private to big, corporate, MNCs. Imaging technologies especially were fairly well-developed before MNCs and other big companies stepped in to promote and sell them.

Since around the turn of the twentieth century the demands of the international economy have started affecting healthcare provisioning. These have led to a transformation from welfare-provisioning to introduction of markets in healthcare, and to health sector restructuring in the name of economy, efficiency and effectiveness as discussed at length in chapter 2. The very definition of public health is being transformed. Through several measures such as globalization, privatization, expansion of corporate entities and market-led activities, public-private partnerships, and the GATS, the social welfare functions of the nation-state are being integrated into the world economy, not for the benefit of the population at large, but for that of capital. The significance of the neo-liberal policies is that they provide the ideology and mechanisms to create an international market for medical care. While across countries the private sector in general, and multinational corporations (MNCs) specifically, have played an important role across all major sectors of the economy, in the past few years they have also entered public services, and are now increasingly involved in many aspects of medical care services, through the above-mentioned mechanisms (Hall 2003 p 77). International finance institutions such as the International Finance Corporation (IFC) are also involved in this process of commercialization and corporatization of health service provision. The model of healthcare that is sought to be implemented through these transformations is largely that of the health care system in the USA — provision of medial care based on market principles. The American experience brings out clearly that policies that encourage and promote private, for-profit medical care providers undermine the public healthcare sector in several ways. Such as: private medical care providers do not aim to provide healthcare
to society, rather than provide health products or surgical solutions; they will not supply inherently unprofitable care to anyone (Sexton 2003). The presence of the industrial and financial capital institutions in medical care has ramifications at all levels. Among other things it fosters *fetishization* of illness through an increased and intensified effort at selling ineffective, wasteful, and irrational technologies and procedures, like use of unneeded ancillary testing, overutilization of hospitals, ritualistic surgery (McKinlay 1978). The overall impact of this is brought out in the following description:

The availability of medical care got distributed according to the class structure rather than on the basis of need. It also distorted the character and supply of medical care. Insurance coverage of hospital care encouraged hospitalization for diagnostic and therapeutic procedures that could be done more safely and inexpensively outside hospitals, or avoided altogether. So well-insured persons, whether well-off or poor, became victims of excessive care. Physicians concentrated themselves in specialties and locations where they could take best advantage of the market for their services, such as in the well-off areas of big cities and the expanding suburbs, than in the poor and working-class areas. Most importantly, physicians abandoned general and primary care practice for more lucrative and prestigious specialties, or for a career in medical research. The rural areas, with its limited market for specialty services and isolation from centers of technological medicine, were of no interest to the physicians, and the urban poor were of interest only when they served as research and teaching material. Thus technological medicine combined with the market organization of medical care, to divert physicians from areas and types of services in which they were most needed to those that were profitable, most interesting, and professionally rewarding to them’ (Brown 1979 pp 212-215).

As discussed in a later section, such a scenario has been unfolding in India since the 1980s. Such transformations, being introduced through the agency of the state, are guaranteeing, creating and expanding markets for specific forms of specialized, high-tech medical technologies.

Thus, we find that there has been nothing ‘inevitable’ about the “progress”, the “advancement” of technology; and there is not much basis for the notion of a ‘technological imperative’ in medicine. Social choices were made favourable to a technocentric medical and public health systems, by influential sections of the medical profession, and the industry, policymakers and politicians.
Impact of medical practice and of industry involvement on development and adoption of medical technology

The proponents and promoters of existing and new medical technologies argue that these technologies are the best possible ones from the viewpoint of modern medicine, that they are widely adopted because they are better than existing ones, that a technology becomes 'standard practice' and 'routine', only after it has been thoroughly tested for its efficacy, effectiveness and safety, based on objective scientific criteria. Examination of the processes of development and adoption belie these claims. We examine this at two levels: (a) at the level of the medical practice where we find adoption of technologies takes place without sufficient assessment; and (b) at level of industry, which undertakes several kinds to activities that give rise to such adoption.

(a) Lack of rigor in assessment of technologies

An interesting finding is that even within the domain of scientific medicine there is conflict among the medical professionals. These are over approaches to disease, and over ways of thinking about a disease and treatment. Of these only some, like the x-ray and the associated 'specialty' of radiology - 'succeeded', while others 'failed'. Similarly, the field of coronary care is marked by differences regarding management, as indicated by the debates over invasive and non-invasive care. These examples highlight the possibilities of multiple ways of diagnosis, therapy and management of disease. This implies that one should pay attention to the basis on which final choice and promotion of the forms of diagnosis and treatment takes place.

It is striking that in a field such as modern medicine, which claims a scientific basis and is also associated with healing and curing, many of the dominant and so-called 'standard' practices are based upon a belief in efficacy and effectiveness of a technology, rather than adequate evidence based on well designed clinical trials. There is existence of double standards among the medical profession over evaluating usefulness of innovations. There are several instances of this:

§ Several issues regarding mammography were unresolved especially that of safety. Yet, it was advocated and promoted over thermography for detection of breast cancer. Coronary by-pass surgery, cardiac care units (CCUs), too became standard practice, despite insufficient evidence to back their effectiveness (Chapter 5). Yet another double standard that emerges is that regarding the concept of 'invasive' and 'non-invasive technologies/techniques'. On one hand, sections of the medical profession are always making a case for innovations that are non-invasive or minimally invasive. Yet, the potential of techniques like thermography for breast cancer
detection, which involve measurement and observation of physiological parameters as against mammography was not adequately pursued. Instead we had development and promotion of X-rays for this purpose. The fact that the X-radiations and ultrasound waves used in imaging equipment have the potential to cause injury to the body has been completely sidelined, and these technologies continue to be perceived and promoted as 'non-invasive'.

Safety of technologies does not get the attention that it should in a profession associated with healing and health. There are controversies and unresolved issues regarding the safety of the imaging technologies - both x-rays and ultrasonography. Such as: In case of mammography, the operational modalities pertaining to epidemiology and pathology, and the long-term hazards remained unresolved at the time that mammography was being advocated and promoted as a population screening measure. Breast cancer screening continued to be an intensely debated issue and consensus had not been reached even by the turn of the century. Yet mammography for breast cancer screening is promoted as a preventive measure. In case of CT-scanning no attention was paid to radiation dosage levels delivered to the patients, especially to children. It is astonishing that till 2000 none of the CT manufacturers paid much attention to reducing radiation dosage levels associated with the CT equipment. The tremendous increase in CT usage has only now led to concerns about the long term consequences of such exposures. Use of CT for mass screening of asymptomatic individuals is a recent innovation, driven partly by increased availability and convenience of CT-machines (such as for lung cancer, cardiac disease, whole-body scanning). While there is no consensus yet about their efficacy, there is significant exposure to x-ray involved, and indications are that radiation risk to lungs may be significant. Yet only now concerns are surfacing about long-term consequences of such exposures. As yet there are no large-scale epidemiological studies reported of the cancer risks associated with it. There are radiologists who hold that it is desirable to reduce CT-usage as long as patient care is not compromised, that CT-doses can be also reduced (Hall and Brenner 2008). Only now dosage reducing programmes are being introduced. Physicians and radiologists are only now talking of the importance of education to increase awareness of the hazards of radiation dose associated with paediatric CT, and of minimizing the dose by reducing or eliminating non-indicated CT scans.

Similarly, ultrasonography became part of routine antenatal practice in USA and Europe without formal evaluation of its benefits or even its need, and continues to remain 'routine' despite evidence of lack of benefit. Routine scans in pregnancies are of low benefit, and may actually present a risk for certain foetal examinations, depending on the exposure conditions.
chosen, and the training, skills and awareness of the ultrasonographer. Despite findings showing potentially adverse effects of ultrasound and uncertainties, it continues to be said that the clinical use is safe. The rider is that its use has a 'good' efficacy and safety record only when used in a proper clinical setting, according to well-laid out standards of medical practice, by skilled and well-trained people. As in the case of CT only since the past few years are medical professionals calling for caution and rigorous education and training in use of ultrasonography. Yet, obstetric ultrasonography is widely used outside research and clinical settings, by inadequately trained people, and has become 'routine' practice. Despite being used for several decades now X-rays and ultrasonography, and despite knowledge of the effects of these radiations on tissues, safety remains a neglected issue, and is set aside as a technique becomes 'routine practice'. Though reservations regarding such unsafe practices exist, these are only among a small section of the medical profession.

§ There is inadequate evaluation before introduction of a technology. It is assumed that expensive equipment such as CT and MRI would be evaluated and tested in detail before huge financial outlays are made on them; that such an investment would be based on evidence of considerable gains for medicine, actual and potential. However, the development and diffusion of CT scanners took place without formal and detailed proof of their efficacy. The evidence regarding accuracy and usefulness was based on clinical experience, and there was no information available on therapy planning and patient outcome. The adoption and diffusion of MRI also shows similar pattern. Indications for use of a technology are not sufficiently established before their adoption; the studies made on the effectiveness of technologies such as the imaging technologies, and their safety, have been quite small in number and were extremely uncritical. Formal evaluation and the usefulness of such high-cost equipment remain to be established, even though a lot of resources and institutions are committed to them. There is widespread adoption, and we find that currently many of the users of such inadequately evaluated equipment are outside teaching hospitals and established clinical research centres, largely private hospitals and diagnostic centres. It is found that new technologies in CT-scanning and ultrasonography are being widely promoted and adopted, even while studies to assess efficacy, safety, and proper applications have not taken place (Chapter 5). It appears therefore that adoption of technologies in medical practice takes place despite the absence or inadequacy of empirical support for their efficacy and usefulness, and information on safety and indications for their use. The case of Assisted-Reproductive Technologies (ARTs) is a contemporary example of a technology that is in an experimental stage. Yet its use is being legislated by the Government of India, thus indirectly promoting it as a tested, standard technology (Government of India 2008).
§ A distinct trend is seen in diagnostic equipment in favour of 'advanced' imaging systems and scanners that hold information in a computer, and come at a tremendous cost. In the process of making choices between existing multiple ideas and techniques, the influence of factors such as the 'culture of engineers' needs to be borne in mind, in which the most automated is presumed to be the most 'scientific', the most 'advanced', the 'best', and in which there is a fascination with computers and the most automated techniques. In this culture human factors (such as in measurement) are construed as sources of error that need to be eliminated. This is a value strongly held by the dominant sections of the professional class of engineers, scientists, doctors, managers, and technocrats in general. To what extent such factors contribute to the immense 'success' and glamour of technologies such as CT-scanning, MRI, and other imaging technologies, in general, rather than just their actual usefulness in diagnosis and management of the disease is an issue that needs to be considered.

Our analysis reveals that innovations become part of medical practice despite the inadequacy of empirical support for their efficacy and usefulness, and information on indications for their use. In other words, there seems to be premature acceptance of technology. There is a tendency to apply imperfect, costly, half-way technologies even before they have been proven to be safe or effective, and ignoring their side-effects. Complex imaging technologies are being adopted even before adequate education and training have been established for their use, carrying serious implications for their safe and effective use. In the context of technology assessment in health care it has been pointed out: "Why does the healthcare system use technological methods and procedures that have not been proven to be effective, why does it not stop using technological methods and procedures that have proven to be inefficacious, ineffective, or inefficient? Even in the age of evidence-based medicine it appears to be difficult to make the healthcare system implement the results of technology assessment" (Hofmann 2002).

Such premature adoption of technologies seen since the 1970s is in sharp contrast to the earlier times when the process of introduction and acceptance of technologies into medical practice was a long-drawn out process and all technical innovations were greeted with caution, and even skepticism or opposition by sections of the medical profession. This was largely due to the limitations of the innovation, and the subsequent process of refinements. Elaborate research on the subject was conducted by the concerned researchers, and comprehensive treatises were published in support of the concerned technology. For example: the thermometer was not accepted for a very long time because of lack of comprehensive information regarding the value of temperature recordings in health and illness (sec 1.2.2).
(b) Actions of industry to promote adoption and diffusion adoption of technologies

Hence the development, adoption, promotion and widespread diffusion of medical technology since the mid-twentieth century cannot simply be attributed to 'progress in research' and to 'scientific/effective medical practice'. It indicates that factors other than the results of objective evaluation are involved in the diffusion of medical technology, in the rate and the extent of its spread. There is sufficient basis to attribute the widespread usage of these technologies to industry actions to promote their use. Once investments are made by industry on products, and research and development that it considers to be significant, its influence on adoption of that technology needs to be taken into account.

§ The manufacturers of imaging equipment are undertaking several activities other than manufacturing. They are selling services to accompany their products, in order to promote and sell imaging equipment. It is seen that manufacturers offer a variety of services, including maintenance, education of personnel, software support, financing for very expensive equipment, and specialized construction/modification of buildings. At the immediate level this leads to a kind of dependence on the part of the medical professional purchasing the equipment. Furthermore, the more technically complex the product and the less technically sophisticated the doctor the harder it is for them to experiment with competing brands. While doctors lack the time and resources to evaluate the 'new knowledge' that is being made available, disproportionately more forces are available to the manufacturers producing such 'knowledge'. This makes the doctor receptive to the selective information presented by the industry side of the medical-industrial complex. This has been extremely well-institutionalized by the pharma industry, through the vast network of medical representatives, and is now spreading to the medical equipment industry too.

§ The manner in which training and education in new medical technologies takes place, and the manner in which new information about them becomes available to the medical professionals also raise questions about their quality and objectives. At present CME courses, seminars, conferences, live operative workshops demonstrating use of endoscopy equipment, demonstrations of ultrasound scanning on live subjects, and exhibitions of medical equipment are the major means of acquiring and exchanging information about new technologies and procedures. The issue of scanning pregnant women for demonstration has been discussed earlier (sec 5.1.6). Another example is that of endoscopy and minimal invasive surgery that was introduced during the 1980s. It has been said:
"The surgical revolution set in train by the technological advances of the mid-1980s was largely uncontrolled, with few safeguards to protect patients from enthusiastic, but inadequately trained surgeons. People took it up before it was proven, and before they acquired necessary skills. Some people have certainly tried in the past to do operations for which they were insufficiently trained. Some patients definitely died as a result" (Cusheri and Jones 2000).

In fact, nowadays these types of activities have become annual events and predate publication of refereed articles or studies. These events are sponsored and funded by pharmaceutical and equipment industry. A section of doctors justify practices such as live demonstrations on grounds of providing 'educational benefit'. However, others have raised several concerns, and pointed out that it is unlikely that any increase in skill levels can be achieved from a single demonstration, where the audience is shown the diagnostic capabilities of the equipment and the technical ability of the expert performing the demonstration. They are essentially marketing exercises and poor alternatives, if at all, to structured teaching and training. There is a serious danger of some degree of over-simplification of the examination process (Barnett 2003).

A major activity of manufacturers is that of organizing education, training and research in medical imaging. The MNCs such as GE and Philips are putting resources into not only marketing, but also into education, training and research, and trials in academic centers, as described in Chapter 5. In case of the imaging technologies, technological developments and research on new clinical applications are taking place hand-in-hand. As manufacturers need data on the equipment, they are teaming up with clinicians and offering incentives to place equipment in hospitals to gather data from patients (Chapters 5&7). Thus the immediate source of information about medical innovations happens to be the industry itself, and the specialists/experts involved in the research and development of the innovation.

Such promotional activities of the medical equipment industry have to be seen along with the fact that medical care services are now part of a global marketplace, with healthcare provision, equipment for high-tech healthcare, health insurance and pharmaceutical manufacturers as sub-markets. The medical equipment market is being looked upon as a big marketing opportunity – and several market research companies are putting out projections of size, growth, etc, in the healthcare industry in many countries, including that in India. The medical equipment industry is increasingly becoming a global industry. Medical equipment
manufacturers are of the view that in order to facilitate expansion they must look increasingly at developing economies for future growth. This especially applies to the US companies. US companies involved in medical equipment and devices, telemedicine and e-health, are targeting what is considered to be a growing market for medical products and services in Asia. They receive significant support and trade promotion assistance for this from their government trade authorities to establish links in Asia, and in lobbying with foreign governments for favourable trade policies.

Within the medical equipment industry medical imaging is beginning to occupy a significant place and becoming a big business. It is also significant that MNCs with multiple lines of business – Philips, GE, Siemens, Toshiba – are the major players in this sector, which holds a lot of glamour among sections of the medical profession.

Companies in the hospital and diagnostics sector are also using business strategies to create demand for specialized services and technology. Companies are getting into a range of what they term ‘healthcare products and services’. There is also congruence of interests among the various players in the ‘healthcare industry’ and this should also be considered while analyzing the promotion and adoption of such technologies. Trials of equipment and accessories, related techniques, search for new applications, are being carried out by companies by placing the equipment in hospitals, diagnostic centers, and educational institutions, through joint ventures, tie-ups, etc. The concern for the industry is not so much regarding clinical needs and priorities or safety, but more to exploit the medical care sector in both public and private sector, to find new applications, and to use it for further marketing and promotion. We see that without undertaking proper evaluation in institutions equipped to evaluate and test new technologies, medical technologies are being promoted and sold widely based solely on anecdotal or descriptive accounts of a handful of doctors using them. Concerns have been raised from within the medical community itself about the huge differential in availability of funds for technological/commercial development and that available for basic scientific and health-related research (Barnett 2003).

Given the vast financial interests it is not surprising that there is also growing acceptance of marketing and advertising within this ‘healthcare industry’. There are several journals, business magazines and newspapers devoted to marketing and business in medical technology, and in provision of medical services. There are also web sources discussing current market issues, marketing communication and advertising, and considerations in developing marketing plans.
Thus the present nature and role of medical technology, and of the accompanying
problems of irrational use, high cost, begin to make sense when seen from the context of the
nature and values of the capitalist system of production, and the logic that this context brings with
it. We can discern the influence at several levels:

- At the level of thinking and perception of health and disease.
- At the level of production of technologies by private industry for profits. This can explain the
introduction and promotion of inappropriate technologies, of technologies with inconclusive
assessments of their safety and effectiveness, the high cost of technologies, the overselling of
costly and/or ineffective procedures, the lack of attention to/neglect of safety issues, irrational
use of technologies, etc.
- At the level of delivery of healthcare. The organization of health services along business
lines can explain the emphasis on certain specialized forms of medical care, on promotion of
certain forms of prevention such as screening, on secondary and tertiary levels of care, etc.
- In recent times there is also overlap of interests of the medical equipment industry and the
healthcare companies that are in the business of providing healthcare services, and that is also
shaping the delivery of health services as well as medical practice itself.

The specific case of Medical Technology in India

India has a mixed experience of application of technology for development and welfare. This
section examines use medical of technology, which has been highly influenced by western
institutions and therefore, has features in common with the western experience, and some specific
to the Indian context. There are divergences, given the different social context and the history of
over two hundred years of colonization. The place of medical technology in India is discussed
in light of the specific choices and policies made during and after the colonial period. These have
been the choice of modern medicine in the colonial period and a technology-based public health
system, influence of international institutions, subsequent attempts at self-sufficiency, and the
present international environment with respect to the medical equipment and healthcare industry.

Influence of system of medicine and of health system on adoption of technology

In India modern medicine (popularly known here as western medicine or allopathy), and setting
up of current forms of health systems took roots in the colonial period, and their expansion and
pre-dominance can be traced to the policies and actions of the colonial rulers. Western medicine
was chosen by the colonial state to be the established mode of providing medical care, and it was
also adopted by the dominant, educated classes in India. However, 'there was nothing inevitable
about this process of medical colonization nor was it uncontested' (Arnold 1993). In the initial 1800s western doctors were interested in learning from practitioners of Indian systems, and looked to them for guidance, attempted to translate the texts, etc. Thus, there were opportunities during the colonial period to have a pluralist system of medicine, based on western medicine and those that were practiced here, and to evolve an appropriate health services based on these. However, things changed by the 1860s. Initial public health measures for sanitation were restricted to the army, and not applied to the general population, which was supposed to be afflicted by 'tropical diseases'. Even the technology used was restricted to uncomplicated measures like small pox vaccination, while malaria and cholera were neglected. The preferences of the colonial rulers, of the provincial governments, and of the medical professionals trained in the colonial period for modern medicine, and the accompanying modes of thinking about public health systems were clearly in favour of western medicine. Priority was given to it also in medical education, which was supported by not only the colonial state, but also by indigenous private philanthropic organizations, as well as the Rockefeller Foundation. The adoption of the 'western' medicine by the Indian middle-classes and the training they received created an elite class of medical practitioners. They reproduced those patterns of education and thinking, continued to maintain their professional links, and all this was only re-inforced and strengthened in the post-1947 period, as discussed below.

After 1947 the Indian rulers adopted a path of planned economic growth and development within the welfare model of capitalism. The patterns established during the colonial period were largely retained by the Indian rulers after 1947; the recommendations and measures of the Bhore Committee set up by the colonial government in 1944, provided the framework. India also received aid for the health sector in the early years of Independence from the Western countries for health programmes and projects, and from private foundations such as Rockefeller Foundation (RF) towards research and training. Thus the influence of western institutions continued to shape the kind of medical technologies that got transferred and adopted here.

From 1950-1965 there was a period of growth at several levels of medical care. Medical colleges with tertiary-level hospitals, advanced research institutions and Primary Health Centres (PHC) in rural areas were set up; vertical disease control programmes also continued. By the mid-1960s however, the pushing of the family planning programme had an adverse impact on the expansion of the general medical care services. Similarly, graduate medical education grew while training of nursing and other health personnel lagged behind. A significant number of institutions of indigenous medicine and homoeopathy were set up, but with nominal resources as compared to the allopathic institutions.
As pointed out by Banerji, 'the political vision to establish a comprehensive health service system in the aftermath of Independence was unfortunately short-lived' (Banerji 2001). Beginning in the late 1960s, the further growth of a three-tier referral network of health facilities was drastically stunted by the implementation of vertical disease control and population control programmes, a measure which also had support of international funding organizations. The concepts of Primary Health Care that emerged in the 1970s - from failures of the vertical programmes and innovations in community health in India and other developing countries - provided another opportunity to re-orient and put in place a system of basic health services (envisaged in the earlier planning period), based on local needs and capacities (self-reliance), and to shift from use of highly sophisticated medical technology to less sophisticated or locally appropriate ones for public health. However, the Alma Ata Declaration was simply used to camouflage the inability to put in place the planned public health system for proper curative and preventive services. The Indian rulers used the resentment (in the international arena) against modern medicine to introduce community health workers' schemes for the rural areas, without addressing the problem of why the trained allopathic doctors were refusing to work in the rural areas. While the proposals of the Alma Ata were never seriously implemented, the selective PHC advocated by international institutions was adopted, which re-inforced the vertical programmes to be delivered through community health workers. On the other, medical education continued with its emphasis on specialization and urban orientation. We find that by the mid 1970s specialized technologies (ultrasonic fetal examination, fiberoptic endoscopy, cardiac catheterization, renal dialysis, cobalt isotopes for radiotherapy, open heart surgery and laser beam therapy) had been introduced in government teaching institutions. The public sector institutions can be considered to have been the leaders in the use of high-tech in medical care. Thus the foundation for a dual system of medical care got laid - of preventive medicine for rural areas: this comprised technologies only for specific vertical programmes for rural areas to be delivered through health workers, para-medicals and ill-equipped rural health centres - namely a "poor peoples' medicine circuit" (Jobert 1985). And another one of curative and high-tech care for the urban areas to be provided through highly trained medical professionals located largely in the well-equipped urban hospitals. While the community health worker programmes helped defuse some of the social tensions building up in the rural areas, the medical education paradigm and attention to secondary and tertiary institutions in urban areas kept intact the interests of the elite urban middle-classes (as both consumers of medical care and as professionals involved in it).

The government turned a blind eye to recommendations to re-orient the existing pattern of medical education and to make it less techno-centric. As a result the country continues to produce thousands of highly trained doctors, largely from the middle and affluent classes, who
opt to work in the urban areas or to emigrate. The ideological training they receive is best reflected in the attitudes of doctors towards "population" as a problem, which can be solved by use of contraception, sterilization, and experiments with pregnancy vaccines. The emphasis of medical education on western (modern) medicine, along with the policies that encouraged specialization, led to doctors concentrating in urban areas where hi-tech medical facilities were made available. The inadequacies of the government health system has reinforced this trend, and diverted doctors from services and areas where they are most needed to those that are profitable, and professionally interesting and rewarding to them. The training and exposure of these doctors gives them access not only to the best technologies, but also access to research and training in western countries, to the corporate hospitals in the country, as well as to international markets in healthcare. There is a strong tendency and interest among these elite medical professionals to acquire the 'latest' and to have 'world class health services', as well as to provide only certain kinds of treatment. (see US experience, this chapter p 417).

From the beginning the state has also explicitly accommodated and promoted private interests in the medical care system. Although the provision of public health and medical care and education was undertaken by the state, from the start manufacture and supply of pharmaceuticals and medical equipment and instruments, and other hospital supplies have been left to private parties, both domestic and foreign. Since the 1980s policies explicitly began to encourage and to utilize in various ways the presence of the private sector in medical care. Incentives were given for private investments in health care, by offering concessions for import of high-tech equipment and to non-resident Indians to invest in industry and in the welfare sector. Once again, this received support from the urban professional middle-classes that prescribed the private sector as a panacea for failing public systems. They used the situation to discredit the public health system, and to further their careers and interests in the emerging corporate hospitals in the private health sector. Since the 1990s there has been growth of services at the secondary and tertiary level in private medical care, and increase in corporatization of healthcare services at these levels. Whereas, the rate of establishment of primary health care institutions for rural areas decelerated, and the state of existing ones deteriorated from lack of personnel and equipment.

Thus due to reasons - largely political and social - the goal envisioned in the aftermath of Independence of a three-tier basic health system based on welfare principles has not been achieved. The compulsions of the structural adjustment policies, combined with its neo-liberal ideology, of the 1980s-1990s provided the justification and legitimacy to completely shift from earlier welfare objectives and goals, of state provision of universal health care. Government
policies explicitly encourage growth of the private hospitals and diagnostic services, directly by offering various tax subsidies and benefits, and indirectly through the policy of public-private partnership and allowing the public sector institutions to remain dysfunctional.

In this paradigm provision of medical care has become a business that should yield profits, and is being organized along business lines. This rising 'Indian healthcare industry' is projecting an increase in demand for healthcare, and working for expansion, in the name of removing pressure off the public sector. The importance attached to economic growth, services sector, foreign exchange, etc., in the neo-liberal paradigm is being exploited by this healthcare industry to boost 'medical tourism' to provide specialized and high-tech services to foreigners and non-resident Indians at costs lesser than that in their own countries. This receives support from both, Ministry of Health and Ministry of Tourism.

A significant development is the formation of the Indian Healthcare Federation by leading corporate hospitals, manufacturers of advanced medical equipment, like Philips Medical Systems- India, and the Confederation of Indian Industry (CII) for the establishment of an active industry association, an 'organized private sector' in India, for provision of healthcare, as against the prevailing unorganized, fragmented and unregulated sector comprising largely of small hospitals and nursing homes. According to this Indian Healthcare Federation, an association of big private hospitals, diagnostic centers, medical equipment manufacturers and pharmaceutical companies, an active industry association could play an important role in the development of the healthcare sector. The IHF has prepared a Report of the Healthcare Industry in India, which forecasts a shift over the ten year-period from 2002-2012, from acute infectious to life-style diseases (such as cardiac diseases and cancer), and hence a huge increase in demand for healthcare infrastructure. The Report is meant to provide a roadmap for the creation of this infrastructure, to plan for this increased demand for high-quality, specialized, tertiary care by the organized private players, in a viable and cost-efficient manner. The Report recommends increase in levels of investment in the sector by industry and government, public-private partnerships in healthcare, concessions from government on land, and reduction in cost of equipment to improve economics of tertiary care facilities (CII-McKinsey HealthCare Study 2002).
Growth of private medical care sector - Impact on nature and diffusion of medical technology

As discussed at length in Chapter 7, hospitals and diagnostic facilities in India are now planning for a national and international marketplace in healthcare. They are raising funds through venture capital, loans, etc., for setting up laboratories, for activities such as expansion, acquisition, etc. Corporate hospitals and diagnostic companies are also setting up facilities for medical tourism, as well as to cater to needs of laboratories in US, Europe, Middle East, etc. As in the case of corporate hospitals sector, where Apollo Hospitals talked of setting standards through ‘brands’, in diagnostics sector also, the diagnostic companies are planning for creation of ‘brand names’, and leaders, etc. Thus the policy shifts in the medical and health care sector have gradually led to creation of markets for specialized medical care relying on specialized technologies. Another development observed since the late 1990s onwards, is the setting up of independent, private imaging centers in many urban areas, which offer a range of x-ray, CT, MRI, and ultrasound imaging facilities. Diagnostic companies from US, such as Quest, are also beginning to set up centers in India.

These growing numbers of private hospitals and diagnostic laboratories across the big and small cities and towns, offering a range of services and diagnostic tests, are the major consumer of the high-tech and other medical equipment. Use of state-of-the-art equipment is the major selling point (USP-unique selling point!) for all these facilities, and acquisition of any new gadget or equipment is given wide publicity, and highlighted by all laboratories without exception. In fact, they use their acquisition of ‘advanced technology’ to create an aura of expertise, professionalism, and quality.

Medical technology in the private sector in India is highly visible, in fact is advertised and displayed as the major ‘qualification’. However, it is not the case that government institutions do not have the ‘latest’ sophisticated technology, and that they do not acquire ‘state-of-the-art’ machinery and equipment. Several hundreds of crores of rupees are being spent on setting up six new AIIMS-like institutions, and on purchasing equipment and machinery for secondary level facilities. However, a substantial proportion of this capital investment remains misutilized. Non-utilization of expensive equipment is the norm, found across the country. There is a lot of wastage of resources in the government health services due to idle and unutilized medical equipment, and indifference to using medical equipment for the public good for which they are being purchased. There are also specific features in the government health system, such as corruption, mismanagement and wastage of resources in the use of medical technology, as
repeatedly brought about by audit reports on procurement and state of medical equipment in
government hospitals across the country, including Delhi (sec 7.II.2). Instead of taking steps to
remedy this situation, which is not such an impossible task, this is being used to delegitimize and
tarnish the public sector health system, and instead create markets for the medical equipment
companies as well as the providers, through PPPs for provision of diagnostic services at the
secondary level.

Availability of Medical Technology – influence of national policies and international economy
Several recommendations and measures were suggested by the government committees on health
in the 1950s to have indigenous manufacturing capacity for medical instruments and appliances.
Further, the policies adopted then did lay the foundations for a domestic equipment
manufacturing capacity. We see that currently there is indigenous manufacturing capacity for a
range of hospital furniture, medical equipment, appliances and devices in the country, from low
technology to the medium technology, developed in the early years of overall policy planning to
build self-reliance and reduce imports, and support to small and medium industry. Small
consumables (syringes, intra-venous sets, gloves, blood-bags, catheters, etc.) and 'low
technology' equipment, like conventional ECGs, defibrillators, bedside monitors, diagnostic x-ray
equipment, and therapy equipment like diathermy - ultrasound-electrotherapy, surgical diathermy,
respiration monitors, ultrasound scanners, analytical equipment for pathological and biochemical
analysis, incubators, pacemakers and other such instruments and equipment are manufactured in
the country by local producers with small capacities. Although necessary expertise and a certain
amount of infrastructure exist in the country, the local industry has not grown to the required
extent, and the micro-processor based counterparts of many of the above equipment are all
imported. Time and again several committees have emphasized the need to examine fiscal and
import policies regarding medical technology, and to curb excessive imports in order to support
the indigenous capacities. However, the government has not taken steps to support local
manufacturing and to reduce import of finished medical equipment. Till date the issues continue
to remain unaddressed as far as government policy on manufacturing of medical equipment is
concerned.

The existing manufacturing capacity for a range of medical equipment and devices is
being undermined by the government policies of liberalization and producing goods for
international markets and not necessarily to meet indigenous requirements. In general, hardware
production in the electronics segment has become erratic, especially after liberalization: there has
been rapid closure of a large number of Indian units in recent years, and growing stature of
multinational corporations with increasing market share in India. Since the 1990s the manufacturing base has been adversely affected by liberalized imports of all kinds of medical technology, ranging from low to high technology equipment and devices. Tables 6.6 to 6.13 give an idea of the wide variety and magnitude of medical equipment and devices that are imported every year. It ranges from import of the simplest to the so-called high-tech; from stethoscopes, thermometers, blood pressure instruments, needles, syringes, catheters, etc., to stents, heart valves, etc., to the most sophisticated digital x-rays, ultrasonography equipment such as Doppler and echocardiographs and other imaging equipment such as CT-scanners, to linear accelerators for cancer therapy. The market for Indian syringes and needles was growing in the previous years due to certain government incentives for brand promotion abroad. However, due to adverse government policies the import of finished syringes and needles has become very cheap. The Indian syringes and needles manufacturing industry is facing stiff competition since 2002 from cheap imports from China and Korea; as a result most of the manufacturers had started trading in cheap imported needles and syringes, repackaging and selling them under any name. The import of syringes (with needles) increased by 122.7% between 2004 and 2005, and by 69% between 2006 and 2007 (Table 6.13).

In fact, import and sales of equipment comprise the major segment of the medical equipment market in India. Newer categories (and sub-categories) concerning medical equipment have been created in our foreign trade statistics, as the quantity of goods imported became significant. Imports are made under different descriptive names in category of life-saving equipment, even when the concerned equipment is manufactured indigenously. There are concessions for different categories of hospitals. For instance: public hospitals and related public R & D institutions are allowed duty-free imports. Charitable and other hospitals that provide free treatment to at least 40 per cent of their outpatients and 10 per cent of their inpatients are granted exemption from import duty on equipment.

The imports largely are for the tertiary and secondary levels of healthcare institutions, which are concentrated in the urban areas. While the developments in electronics and innovations in diagnostic, therapeutic and communications technologies have been widely utilized in the tertiary and secondary healthcare, the needs of the primary healthcare setup have not been adequately addressed in India. For example: there is reluctance to manufacture much-needed light, inexpensive, electronic weighing machines for adults for early detection of under-nutrition; of simple haemoglobinometers that could be used by the ANM to check for anaemia in pregnant women; of light, inexpensive electronic blood pressure monitoring apparatus.
The growth of imports has been accompanied by the entry of several local corporate entities, through joint ventures with multinational manufacturers, as well as entry of subsidiaries of multinationals, for importing equipment. Several multinationals and other medical device companies from the US are also outsourcing manufacturing activities to India. This is seen as a way of reducing costs in manufacturing, in R&D. The activities that are being shifted here comprise the following: making India the base for business operations in the south Asian region; making use of Indian companies for contract manufacturing components for global markets; exploiting the software skills for developing software for the advanced imaging equipment manufactured by them. Indian manufacturers are now lobbying for support to local manufacturing through concessions and setting up of SEZs here, as in China. Indian industry now wants to produce specialized medical equipment and devices for international markets. The Association of Medical Devices and Suppliers of India (AMDSI) wanted the Government to set up medical technology parks in the country and give income tax and other benefits so that Indian companies can start manufacturing. It had also submitted a memorandum to the Ministry of Health to consider setting up a Special Economic Zone (SEZ) in Chennai to encourage indigenous manufacturing, and R & D, and help reduce dependence of imports (Business Line August 5 2006). Such a ‘MediPark’ has been set up in suburban Chennai for manufacture of health-care devices and equipment of international standards (see p 343). It includes a vaccine park to be completed by 2011, for manufacture of traditional and ‘new-generation’ vaccines, and to function as a hub for R & D.

The creation of conditions favourable to foreign manufacturers, both, in terms of favoring imports to meet domestic requirements and in setting up SEZs to manufacture for international markets, has to be placed also in light of the developments in the international economy and the importance attached to economic growth at all costs. We have seen that the medical equipment industry from the US and other countries are looking at developing countries to increase their profits, through expanding markets and reducing their costs as well. They receive a lot of support in this from their government and instruments such as GATS.

**Promotional activities by the medical equipment industry – research, education, lobbying**

As discussed in Chapter 6, in India too medical technology is being promoted through frequent and regular trade exhibitions and conferences/ similar events in metropolises and bigger towns across the country. We find the equipment industry organizing awareness raising programmes among doctors on the ‘latest’ technology in various ways – holding seminars, having product launches at medical conferences, and prominently announcing installation of their technologies.
The industry is also organizing advice/consultancy on ways to procure equipment, to organize financing, etc. The MNCs and foreign manufacturers are getting into education and training in a big way – several companies now organize/sponsor CME, seminars, and training programmes during conferences for use of their equipment. Some are entering into arrangements with local hospitals to organize training for their products. MNCs like GE and Philips are entering into partnerships with private corporate hospitals, where they place their equipment for clinical trials of equipment, software and imaging agents. Given the exorbitant costs of many technologies, it is not surprising that the medical equipment companies and suppliers themselves also arrange for leasing medical equipment, or financing their acquisition. Several banks and state financial institutions now offer loans to doctors for purchase of equipment. Foreign companies are also undertaking R & D, and clinical research and trials in India for their products. For this they are entering into partnership arrangements with local companies as well as hospitals and diagnostic centres. One finds diagnostic companies in India entering into arrangements to conduct clinical trials for pharmaceutical companies, for imaging agents. Similar to the medical equipment companies, several imaging centers, like the Diwan Chand Agarwal Imaging Research Centre, Delhi, also function as training and education centres for use of specific procedures and technologies.

The medical equipment manufacturers and traders are also undertaking several kinds of lobbying activities with the government. The IHF described above is one instance – several other industry associations have been formed to promote industry interests. In this regard we find that there are two kinds of associations – one representing the corporate entities and multinationals in equipment manufacture as well as the corporate hospitals; and the other such as the AMDSI mentioned above, representing the smaller manufacturers and traders, who are demanding support/concessions for local manufacture in Special Economic Zones.

Status of Regulations - implications for diffusion, implementation and safe use of technologies

So far there are no specific standards and regulations governing use of medical technologies, except that of X-rays. There exists no mechanism to address and end the non-utilization of equipment and lack of accountability in this regard in the public sector. However, total lack of regulations and monitoring mechanisms for the expanding private sector in diagnostics and medical care is an area of greater concern for reasons discussed below.

(a) Regulation of private medical care sector

While there has been a lot of activity in the so-called “healthcare industry” since the 1990s in terms of growth of private hospitals and diagnostic centres, the government has still not devised
regulations and standards to monitor nature, quality, and cost of services provided by them. There has been no attempt to lay down guidelines to ensure the even distribution of such facilities and hence availability of such technologies. The absence of standards and any authority for monitoring these institutions would be leading to unchecked growth and expansion of these facilities. It also leads to lack of vital and reliable information on this sector. There is brazen violation of the stipulation of provision of free treatment against concessions on land and equipment by hospitals across the country, including the corporate hospitals in Delhi, such as the Apollo Group. The private sector is also resistant to monitoring and unwilling to provide any information regarding its activities, as brought out by the experience of the Qureshi Committee in Delhi, which faced non-co-operation from several hospitals and refusal to provide information. It also highlights the inability and lack of will on part of the government to make private hospitals adhere to their commitments.

Existing regulations regarding setting up of x-ray facilities are ineffective. A public interest litigation was filed in the Supreme Court of India in 2001 on violation of these measures by various hospitals and diagnostic clinics. In fact, the Delhi Medical Association reported that there was violation of the safety guidelines by hospitals and diagnostic centres in Delhi (Times of India November 24 2001). The hazards of CT-scanning discussed in the earlier section assume grave proportions in such a situation. There are a large number of x-ray installations, including CT-machines, but not much information on their spread and usage modalities, no effective implementation of existing regulations, and there is also not much concern and information among the medical community as well. Existing information available from the Directorate of Radiation Safety (DRS), Kerala, gives an idea of the extent of violation of safety requirements. In the initial survey of 100 x-ray installations that DRS undertook around 1999-2000, it covered 10 government installations and 90 private ones. In only 44 of these at least one qualified radiographer was available; unqualified people operated the machines in the remaining 56. In 92 of these installations safety standards were poor (Department of Radiation Safety, Department of Health and Family Welfare, Government of Kerala undated). The number of CT-machines was increasing with accelerated sale of units by all leading manufacturers. According to a Report of the DRS submitted to the AERB in 2003, Kerala was reported to have about 1900 x-ray installations, of which 5% (~96) were CT-machines. Of these only 43 satisfied safety regulations. As of 2007 there were 2600 x-ray units, 150 CT-units and 182 dental x-ray units in the state, according to the Head, DRS (The Hindu November 7 2007). According to the Head, DRS, about two-thirds of the x-ray and CT-scan centres were manned by unqualified people, and the shortage of qualified personnel was a critical issue for public health. Furthermore, a large number of CT-machines were refurbished equipment (second-hand), whose safety level could be
lower than desirable. The DRS was set up in 1999 to monitor and regulate CT-X-ray centres across the state, but could not do so because of shortage of staff, equipment and other facilities; it did not have its own office building! The Department of Atomic Energy, which is the agency responsible at the national level, is faced with problems of similar nature and magnitude. This indicates the lack of interest of the government in enforcing safety guidelines and regulations for medical technology.

Similarly, in India use of ultrasonography during pregnancy has become 'routine' practice, and there are thousands of ultrasound scan centres across the country. However, the scenario regarding use of ultrasonography is not very different from that of CT. Whatever little information is available points to the potential hazards in the usage of this scanning modality too. For several years now the Indian Radiological and Imaging Association (IRIA) has been regularly commenting on the lack of formal training and qualifying examinations for sonographers, and lack of competent and well-qualified radiologists and ultra-sonographers in the country. According to the IRIA, unrestricted access to equipment has prompted doctors with inadequate training in radiology to set up imaging centres, leading to wrong diagnosis (Doda 2006). While Imaging is not taught adequately at the undergraduate level and it is totally a post-graduate course, the number of seats for courses like radiology have remained more or less static for years. As a result there are not many competent and well-trained radiologists and sonologists. According to another President of the IRIA, currently medical graduates setting up radiological practice were either from different disciplines, or ones who had undertaken a house-job in radiology or taken ultrasound training from a qualified radiologist (Lal 2004). Private medical and diagnostic centres and private practitioners offer short-term training on use of 'latest equipment' and several equipment-based techniques. Doctors who had invested in diagnostic equipment included general practitioners, gynaecologists and orthopaedic consultants. Such doctors often approached private imaging centers for short-term training and then 'set up shop' in small towns. The Association says there is sufficient anecdotal evidence to indicate that a large number of non-radiologists are investing in and operating x-ray and USG equipment. At a recent annual conference of the IRIA the President said that the association was 'fed up with quacks running x-ray and ultrasound centers' (Doda 2006).

(b) Regulations for procurement and use of medical technology
While there has also been an increase in imports and interest in manufacturing certain kinds of medical equipment, in this case too the government has not devised a system of regulations and standards for manufacture and import, and regulation of all these activities. There is no initiative by the health ministry to monitor and regulate such large-scale diffusion of medical equipment in
the country, and to lay down guidelines and standards for their manufacture, import and use. Despite consistent recommendations by several government committees regarding standards for medical technology, we find that India still does not have a comprehensive set of rules for manufacture and marketing of medical equipment and devices, for new or existing technologies, with the exception of x-ray equipment. An important issue, about which information is lacking, is that of import of refurbished scanning equipment (CT-scanners, MRI equipment) from the developed countries. There is no information on the quantum of such imports, condition of the equipment, and the buyers of such equipment. This has grave implications for safety, as it can affect the dose of radiation delivered by the equipment and lead to high exposures to X-rays, as discussed earlier in the context of safety of CT-scanning.

We also find that policy directives regarding medical technology emanate not from the health ministry, but from other quarters, associated with industry, commerce and business. There has been no attention to assessing the nature of technologies, and the quantum of medical technology for the health services, and their rational utilization. Till recently the role of the health ministry itself regarding medical technology was conspicuous by its absence; only now some token efforts are being made to regulate import and manufacture of some devices and implants.

Thus, nature and availability of medical technology in India is an outcome of the interaction of political, social and economic factors involved in the introduction and institutionalization of western medicine, and the accompanying notions of medical care and public health. From post-independence to 1980s it has been an outcome of the shifts in the social and political forces that moulded the provisioning of medical care and of the medical-based public health system. These forces included the common interests of international development institutions (WB, IMF, WHO, etc) and the elite Indian professionals and bureaucrats, in sustaining and furthering techno-centric medicine entailing heavy use of technology. Since the 1980s nature and availability of medical technology are being shaped by overlapping interests of these forces, and that of equipment manufacturers and healthcare companies (national and international), for markets for medical technologies and ‘healthcare products’. The state patronizes this partnership and is used as the ‘steward’ to push private interests through subsidies, cuts in public expenditure, PPPs and facilitating the activities of the private sector. The neo-liberal framework provides ideological legitimacy to the undermining of welfare and public provisioning, and promotion of market mechanisms. In fact the technology requirements of primary level medical care and of middle-level supportive institutions have been marginalized, and the entire focus has shifted to tertiary care, involving use of expensive high-technology. These have therefore become profitable areas of investment.
Concluding Remarks

We find that the medical-equipment industry, along with other commercial forces, is exploiting the overall societal concern with health to promote certain kinds of 'healthcare products', which may not necessarily enhance health, or be related to epidemiological priorities or needs of the majority. Markets and profits are their over-riding concerns. This industry, like others, is motivated by factors such as saleability, feasibility, profitability, markets, competition, etc. We find that the medical equipment industry too indulges in market manipulation, price fixing, promoting insufficiently evaluated technologies, and other kinds of unethical medical and business practices. In the present context medical technology and health systems are being shaped by the larger social context of globalization, and their accompanying structural adjustment policies and health sector reforms, which are primarily to address the crisis in capitalist system than to address failing health systems and health of populations.

The Indian medical and health care system exhibits some of the worst features of use of medical technology in the developed and developing worlds. As in the developed world there is dependence on highly trained doctors and nurses, high cost, irrational use, and neglect of safety. This is particularly so in the private medical sector. The public sector too is now under the influence of commercial forces. As a developing country the entire medical and healthcare sector are subject to the demands of international business in medical technology and medical care, leading to re-organization of medical and health care systems, dependence on heavy imports of technologies and knowledge systems, penetration of business principles in public health systems, and enhanced export of skilled medical personnel. In addition, the complete absence of any regulations and monitoring of the vast private sector in these activities is compounding the problems of safety, quality and cost of services. What emerges sharply is that the vision of a modern medicine-based public health system envisioned as part of a welfare state has given way to one based on the economic considerations of growth, profits, market efficiency, and their promotional instruments of lobbying & marketing. It is these forces that have a significant presence currently in the arenas of medical technology and public health in India, and are the prime movers in shaping the priorities and use of technology.

Through this inquiry we have attempted to show that in India the adoption of western medicine and the medical-based public health in the first place, and the subsequent shifts towards a techno-centric public health system have not been due to any 'technological imperative'.
Rather they are related to the political and policy choices made by the ruling classes. By focusing
on, or rather re-opening, the issue of choices regarding medical technology and the context in
which they are made, and their implications for the majority, we hope to place in the larger public
domain the issue of medical technology. By showing the commonalities and links with the
experiences of the developed countries, we hope to contribute towards learning from those
experiences to develop a more critical attitude to medical technology in specific, and technology
in general, in India.

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