European Foundation
for the Improvement of Living and
Working Conditions

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INTERACTIVE TELECOMMUNICATIONS OF THE FUTURE

THE SOCIAL IMPACT OF TELEMEDICINE AT HOME

Working Paper No.: WP/92/12/EN

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by
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SUMMARY

The Report aims to investigate social aspects of telemedicine and telehealth systems in the electronic home.

Telemedicine home systems intend to provide care in the familiar home environment. At the same time, they represent a reaction to increased demand for hospital services in most developed countries, due to chronic illness related with the aging populations and injuries from accidents.

Telemedicine is also a major market for advanced technology products; the industrial goal of the EC AIM Program is the advancement of the European IT sector in order to compete with the US and Japanese industries. Large scale R&D is undertaken on home medical monitoring devices, communications networks and advanced applications such as image archiving and transmission. Chapter 2 provides an overview of related technologies.

Most assessment studies use the cost-benefit analysis, which is applied by experts. Chapter 2 discusses assessment methodologies in order to specify alternative approaches. It is argued that it is not sufficient to simply criticize cost-benefit methods, but, further, it is required to involve multidisciplinary teams of experts, as well as public participation; this does not mean simply to organize debates, but also to use formalized and computerised methods which take into account value systems, and promote health advocacy.

Chapter 5 explores various social aspects, including patient rights, special groups and special interfaces for the disabled. Most R&D projects on telemedicine imply that health care is illness-oriented (complaint-therapy and to some level prevention) and pro-institutional; the doctor-patient relationship is considered 'asymmetric' (in terms of expertise). It is argued that most negative aspects of institutionalized medical care are propagated into telemedicine applications, or even threaten to take alarming dimensions: for instance, home patient remote surveillance and massive screening of medical records could easily become the problem rather than the solution.

Since telemedicine is socially useful, a major shift is required in order to avert negative social implications. The emerging comprehensive concept of health emphasizes the well-being of the individual, the total health environment, consciousness raising and community involvement (discussed in Chapter 2) can provide a socially and technically sound alternative model of health care. These are taken into account in Chapter 5, aiming to be critical as well as constructive: problems are identified, but also possible technical solutions are discussed. When the new concept of health is taken into account, the range of applications is broader, and overall positive effects stronger. It is possible

not only to provide new services, such as community telematics support networks, but also to alter the design requirements of the new systems; for instance, the DH-MIS is proposed (Section on 'Democratic control'), which refers to a management information system capable of supporting democratic control.

Public policy is a major factor in health provision. In Section on 'Public policy" it is argued that health policies should take a much wider view. For example, the narrow medical response to lung cancer would be a method of therapy. The broader policy would start from therapies and extend beyond, to antismoking lifestyles and related intervention programs, as well as to the impact of smoking reduction for the tobacco production complex (which cuts across primary, secondary and tertiary economic activities).

Areas and topics for further research are discussed throughout the Report, and are summarized in Chapter 6.

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Certainly, the usual disclaimer on the views presented here should be made; so responsibility for any errors remains with the author.

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1 INTRODUCTION

1.1 The Informational Revolution

Health care is entering the Era of the Informational Revolution. New all-pervasive technologies are becoming applicable in remote care provision, in the Electronic Home in particular. Drawing on previous research (Veneris, 1984, 1986, 1990, 1992b) we can observe a historical 'spiral' macro-trend. The home has been the place for health care for many ages. Specialised institutions existed in the antiquity, including Hippocratic medical institutions in ancient Greece and in Rome. It was with the Industrial Revolution that a major trend started towards institutionalized care. This included medical care, as well as various forms of 'asylums' for the handicapped, the orphans and the elderly. Traditionally, the home was also the 'productive unit', staffed by the members of the family. The Industrial Revolution needed a 'footloose nuclear family', which could respond to the changing demands of mass production, also 'institutionalized' into the factory; the elderly and the handicapped were considered as an unnecessary burden. The current Informational Revolution brings about a major reversal of this trend. Production tends to return to customized products produced in flexible robotic factories, while the home tends again to become not simply a residence, but also a place for work, leisure, education and health care. These developments do not bring us 'full circle' back to the pre-industrial cottage. The information age 'cottage' is the Electronic Home which makes possible participation in McLuhan's "global village".

There is no generally agreed concept of what makes an electronic home. Moran (1991) identified two general trends, one prevalent in the US and Japan aims to produce complete home systems, while another followed in Europe adopts an incremental approach which intends both to retrofit existing houses as well as integrate into new homes. Related R&D is undertaken under the EUREKA/ESPRIT EC Projects, while the European Home Systems Association has been established.

1.2 Home telehealth care in social context

Information technology applications in health care derive from the overall conceptualization of what constitutes 'health'. The medical 'mainstream paradigm' (in the Kuhnean sense) would consider health care as disease-oriented, and would deal with a person only after an illness has occurred in order to institute therapeutic treatment. Various telemedicine technologies can make possible then home patient monitoring and therapy. One step further are practices which aim at prevention, or prophylaxis from illness. Technologies such as regular screening of medical records may be used to this end. Evidently, these approaches manifest a pro-institutional bias, having not a person, but a patient on the one end, and a doctor, or a medical system, on the

other. An asymmetry of knowledge is assumed between the two ends, one that Parsons' sociology would consider essential for the maintenance of the social and institutional status quo. A large market is created for related technologies and it is not surprising that R&D funding and industrial projects aim to supply related devices, expecting high returns. Technology assessment methodologies such as the cost/benefit analysis are applied by experts; social acceptability is often understudied.

These limited and rather anachronistic approaches are now challenged by broader concepts which are health-orientated and aim to contribute to the individual's wellness and well-being; health maintenance rather than complaint-response/illness-therapy is now the issue. Along with this come concepts and practices such as changing the 'total health environment', primary needs satisfaction, lifestyles, 'belonging' to a community, consciousness raising, community involvement and advocacy. Telehealth technologies have much wider range than telemedicine technologies. It is interesting that many of them are readily available and yet not utilized to their potential. 'Returns' may not be as high as with telemedicine, while asymmetry in knowledge is difficult to establish.

Inevitably, assessment of such technologies cannot be based on narrow economic benefits; public participation is required. This could avoid the mishaps of technologists. For instance, telemedicine technologies such as remote surveillance of the electronic home and screening of personal medical records could easily bring to mind the 'big brother' effect and cause 'neoluddite' reactions, which could render invalid large investments. The ensuing discussion of assessment methodologies puts emphasis in participation and advocacy; the present Report would find its best use if it could support such activities.

McLuhan perceived the information media as "extensions" of the human. Information technologies in health care appear to 'extend' the social and institutional frameworks within which they function. Debate should aim to make 'problematic' these 'frameworks' in order to define better, or better use of, technologies.

Telemedicine and telehealth technologies could provide improved health care for all. However, it is instructive to quote some recent remarks by Javier Venezuela, the General Director of UNESCO (Venezuela, 1992). Instant communication is now available, but the residents of 600,000 villages of the planet have to travel 30 kilometres in order to find a telephone; the whole Africa has fewer telephones than Tokyo. Nutrition is an obvious critical health factor, but 20,000 children die every day due to lack of food and water. The financial resources to bridge this gap can be found: perhaps it is commonplace to note that developed countries spent in 1990 300,000 million dollars, and the developed 980,000 million dollars in weapon systems.

1.3 Structure of the Report

The present Report is divided into four areas. The first, in Chapter 2, discusses definitions and related concepts concerning medical care and the emerging concept of 'health', as well as telemedicine and telehealth, within the framework of the current Informational Revolution.

The second, in Chapter 3, deals with the various approaches to technology assessment and aims to extend modes of analysis beyond the conventional cost-benefit methods.

The third, in Chapter 4, intends to provide an overview of existing and emerging telemedicine and telehealth technologies. A classification scheme is proposed, which identifies four major categories of related technologies; three of them (MCTS, HAS and NAS) are discussed in Chapter 4, while the fourth, that is CAS, is discussed in Chapter 5.

The fourth is the larger part of the Report and concerns the social aspects of telemedicine and telehealth in the electronic home.

References and related bibliography follow.

Annexes present some diagrams and reference tables for the major EC Programs which involve R&D in telemedicine and telehealth.

2 CONCEPTUAL DEFINITIONS

2.1 The changing definition of health

2.1.1 The concept of health

Conceptualization of "health" is shifting from a common sense view of health as "non-illness" towards a more radical and comprehensive definition which is currently advocated and advanced by institutions such as the World Health Organisation (WHO). According to this new concept health is a state of complete physical, mental and social well-being.

This definition has been debated by critics. For instance, Nutbeam (1986) sees it as "idealistic" and "unattainable and largely irrelevant to the lives of most individuals". He suggests a "less abstract" definition, according to which health is specified as "the ability to achieve one's potential and to respond positively to the challenges of the environment".

Health is a state in everyday life, rather than provision of therapy for specific disease or infirmity, and thus extends to include a broad spectrum of social services and quality of life aspects, along with conventional medical care. Due to this emphasis on the dynamics between the individual and the environment the new concept is called "socioecological".

The main resources for health and health enhancement are income, shelter and food; information concerning life skills and healthy choices among goods, services and facilities; and the total social and physical environment.

2.1.2 Health-related concepts

The broader definition of health makes relevant a number of health-related concepts. Since most of them are used throughout the ensuing text, and since they themselves provide a view of the range of concerned issues and of technological applications, basic definitions adapted from Nutbeam (1986) are given here. Generally, they have been classified here in three categories; this was preferred to alphabetical listing since it makes possible to comprehend conceptual dependencies. The three categories have been called 'health', 'the community', 'the individual'.

<u>Health</u>

. Total Health Environment (THE)
It includes those factors of the social, economic and physical environment that may influence the health of individuals or groups.

. Health services
A formally organised system of established institutions and organizations, the multi-purpose objective of which is to cope with the various health needs and demands of the population.

. Primary health care
This includes several activities, such as health education, nutrition, safe water and sanitation, maternal and child care as well as family planning, immunisation, treatment of common diseases and injuries, and the provision of essential medication.

. Disease prevention
This is related to the reduction of risk-factors for, or the enhancement of host-factor that reduce susceptibility to, a specific disease. It aims to conserve health and deals with individuals as well as target groups ("at risk groups").
Primary prevention aims to prevent the initial occurrence of a disease.
Secondary prevention aims to arrest or retard existing disease, and/or to reduce the probability for chronic disease.
Health education is an aspect of prevention.

. Health education
Health education addresses:
. the individual, for the purposes of prevention, through the KAB chain;
. groups, in order to develop the awareness about the total environment for healthy life, as well as to supply information supporting possible courses of action to be taken.

. Intervention program
In disease prevention a planned course of action usually targeted on a specific group of discrete population at risk of some identifiable disease or disorder, in order to reduce the risk of this disease or disorder.

. Mass campaign
A series of planned activities and strategies directed at whole populations, using also the media.

. Risk factor
States known to be associated with, or be the cause of, increased susceptibility to a specific disease, ill health or accident. May include social, biological, economic, etc. states. Often used in disease prevention. Identified risk factors may be modified by actions such as intervention programs of health education, but may result in the isolation of a single factor only out of negative aspects of the THE.

. Health promotion
Aims to enhance health and considers the whole population, in the context of its everyday life, and its interaction with environmental determinants of health. Public participation is

considered as essential in the definition of problems, decision-making and action-taking. It represents a positive, looking ahead conceptualization of health.

. Problem-definition, Decision-making, Action (PDA)
All three are considered with a view to promote health.

. Knowledge-Attitude-Behaviour (KAB)
KAB form a chain. All three are subject to positive or negative change in order to achieve a health-related change, either by addressing the individual, the group, and/or their environment.

The community

. Community
Each individual may belong to several communities, or groups, which may be defined by geographical, occupational, social or cultural factors.

. Social health inequality
Unequal opportunities, rewards or possessions related to health, available to individuals of different social statuses.

. Community development
This includes actions and related informational support at developing and changing the total environment, as well as development of social networks and social support.

. Community involvement
The active participation of individuals in communities in PDA.

. Pressure group
A voluntary group of individuals, linked by shared goals and attitudes, who attempt to obtain decisions and actions favourable to their goals.

. Decision making skills
Ability to use supplied information on available options concerning the THE, provided that such options exist. Necessary for community development and involvement.

. Consciousness raising
The process through which individuals or groups develop awareness on factors which may influence their THE.

. Consumer group
A group aiming to influence the delivery of health care services. In the context of health promotion this requires provision of information to the public with which to develop awareness of the impact of different goods, services, personal activities and THE conditions on health.

. Social networks
Networks of people contributing to social support and coping.

. Social support
Information sharing, emotional support, provision of goods and services.

. Health advocacy
The actions of health professionals (and other specialists) to influence health-related decisions, through provision of health information, promotion of public participation, etc.

The individual

. Well-being
A subjective assessment of health, extending to self-esteem and sense of "belonging" through social integration. Widely used under the WHO definition of health.

. Wellness
An emerging concept of health emphasizing the quality of life, the experiential as well as behavioural dimensions of human existence, views health in an holistic way, beyond risk behaviours, into the realm of lifestyles

. Lifestyles
The way an individual lives may affect, positively or negatively, his/her health.
Lifestyles are "transmitted" through social networks as well as the mass media. Certainly, there does not exist optimal lifestyles since no ideal state of health can be defined. However, culture, income traditions, conditions of living and working, family and age are factors that influence lifestyles.

. Health choice
Creation and selection of options for decision-making on the enhancement of health.

. Health behaviour
Behaviours consciously directed at improving health, irrespective of its effectiveness.

. Health-related behaviours
Behaviours not necessarily consciously directed towards improving health.

. Health knowledge
Information accessible to individuals for decision-making about health and health/risk behaviour.

. Coping
Ability (cognitive, physical, resources) to deal with everyday life problems, by changing the situation, the perception, or stress generated. The aim is to avoid risk behaviours.

. Self help
Non professional actions at health promotion or prevention in a community.

. Self care
Includes self medication/treatment and first aid. Requires both knowledge of what to do, what not to do, and when to ask professional advice.

. Self help groups
Voluntary groups for mutual health-related aid.

. Self esteem
The extent to which an individual values his perceived image of himself. Influenced by personal or family factors, as well by the THE.

. Self empowerment
The achievement of personal autonomy through the development and use of life skills.

. Risk behaviours
Behaviours with negative impact on health, sometime resulting from attempts to cope with stress (e.g. smoking, drinking, drugs).

2.2 Telemedicine - Telehealth

2.2.1 Definitions

According to the 'official' definition (AIM 20.07.90) Telemedicine is:

"The investigation, monitoring and management of patients and the education of patients and staff using systems which allow ready access to expert advice and patient information no matter where the patient or relevant information is located."

Venters (1990) proposes a 'functional' definition, according to which Telemedicine is:

"The clinical monitoring and management of patients using devices and systems which afford universal access to expert advice no matter where the patient or relevant information is located."

The former definition is broader than the latter; however, both of them are illness-orientated and perceive care in the framework of institutionalized medicine.

In order to take into account the emerging conceptualization of 'Health', Telehealth could be defined as:

The provision of telematics services and related goods which can provide telemedicine services, assist in raising the consciousness and in increasing the involvement of both the individual and the community towards the total health environment, aiming to improve the well-being and wellness.

The above definition makes reference to telemedicine, but, in addition, it intends to give the individual a conscious and active role, it gives importance to social integration and lifestyles (implicit in the terms well-being and wellness) and addresses the issue of the total health environment rather than a specific illness and its therapy, or even prevention. It will be seen in the ensuing discussion that this approach is not only socially sound, but operational as well, since it opens up new directions for the development of telehealth services and goods.

2.2.2 Why telemedicine at home?

Telemedicine is considered necessary for various reasons. For instance, AIM (20.7.90) identifies the following:

. Socio-demographic challenges. The aging of population in Europe makes increasingly prominent degenerative and chronic illness, while fewer younger people are available to care for the increasing number of the frail elderly.

. Geographical distribution patterns of population, ranging from dense conurbations to dispersed rural settlements.

. Cost containment. Costs increase as the patient moves from home to the various levels of the medical hierarchy.

. Clinical effectiveness. Since cure of degenerative disease is unattainable, the aim should be to increase patient independence.

. Social equity, in order to provide health care to socially and/or geographically isolated people.

. Market opportunities, including new devices and systems, new telematics networks, value added network telemedicine services, and new markets and topics in medical expertise.

Most of the above factors favour telemedicine in the (electronic) home and/or the local community. This is also stated in AIM (Jan91):

"At present there is a trend away from institutional care towards primary and home care. " (p.13)

AIM (7.5.1990) also notes:

"Many patients, who are presently treated at an hospital, could be adequately treated at a health centre close to their home, by a team with whom they have a long-standing personal relation. Many could even be treated at home" (p.9).

The same Report also defines "systems for monitoring and support of home care" as follows:

"Specific clinical and social conditions could be considered. Alarm and control systems, the linkage between the home, the health services and the multimedia medical record are obvious concerns. The work done in other areas, such as the 'intelligent home', could be used for this activity." (p.10)

Home care and home monitoring of patients includes also rehabilitation and therapeutic compliance. The need for this is attributed by AIM (7.5.1990) to the large number of accidents and the better chance of survival, which increase the number of people with special needs, varying in type and degree. The built-in flexibility of informatics technologies would make them capable to adapt to such differing situations.

Further, if regional decentralization is to be promoted as a response to urban congestion, medical services should be readily available within reach from smaller population centres (e.g., Veneris, 1984, 1992b). The same is true for health care in developing countries.

The above may emphasize the emerging trend away from hospitalized medicine, but remain within the confines of institutionalized care. They appear to represent a response to the strains imposed upon the health care system, rather than a concern for the emerging concepts of the total health environment and well-being. Keenan and Fanale (1989) judge in this respect that the main beneficiaries of home telemedicine would be the hospitals (due to fewer referrals, earlier discharges and improved payment systems) and the insurance companies (by reducing hospitalization).

However, Blanpain (1985), reviewing the experience in eleven European countries found that the existing medical-legal framework and an active pro-institutional provider system are negative diffusion factors for home care. Institutionalized care thus demands and at the same time deters diffusion of home telehealth systems. Within this frame of reference, many social problems of existing institutional health care systems would tend to be reproduced in the emerging home telemedicine system, simply because the latter is been perceived as an extension of the former. Some problems, as will be seen in the sequel, are actually exacerbated further, threatening to take alarming dimensions.

In the same way that medical care was extended to deal with health, well-being and wellness, telemedicine and telehealth services in the electronic home should be also perceived in this wider context, following the way of some of the applications reviewed here. This would make possible not only to take advantage of technologies, but also to serve a more socially useful purpose.

2.2.3 From health services to health goods: an example of the 'self-service' society?

Through human history, technological developments seem to follow a pattern according to which what constitutes a human function at a given moment in time, is turned into a good in a future moment.

David Ricardo studied such processes concerning the productive activities and identified a trend towards substitution of people by machines. Related research on the "mechanization" of production and the associated concepts of "technical change" and "capital to labour substitution" is found in economic studies (e.g., Veneris, 1984, 1986, for review and discussion).

Gershunny (1978) extended this analysis into a services-to-goods substitution process in societies, and saw in that an emerging 'self-service economy'.

An analogy could be drawn between these trends and the emerging 'mechanization' of health care, including telemedicine and telehealth: certain health services tend to be substituted by health goods, that is systems (devices, networks, etc.) which perform the functions previously undertaken by persons, including professionals of various levels, or even lay persons. This, seen from another point of view, involves a process through which devices take up the skills of trained medical personnel; de-skilling, work restructuring and job displacements follow (see Chapter on 'Health Professionals').

Various advantages and disadvantages can be identified throughout these processes, which are discussed in other Chapters.

3 TECHNOLOGY ASSESSMENT APPROACHES

3.1 Introduction

Technology assessment is more often associated with methods such as the cost-benefit and cost-effectiveness. However, these methods have been criticised and several alternative approaches have been proposed. The aim here is to identify the strong and weak points of each one in order to inform the ensuing discussion.

3.2 Logical-positivist/naive-realist

The 'logical positivist' approach is based on the evaluation of empirical data. Using simple or sophisticated techniques for data analysis, it expects to define the risks and benefits related with each technology. The implicit belief that a direct matching can be established between facts and their measurement is also called 'naive realism'. It considers thus possible "to find a (numerical) correspondence between a set of facts and both the risks and benefits that emanate from these facts in such a manner that a judgment could be made whether or not to pursue a particular technology." (Sassower, 1990, p.441)

This approach is subject to the general criticisms normally addressed against positivist methods; for instance:

. Data selection problems, that is what data are to be collected.
. Measurement problems, encountered in the phase of data collection.
. Data analysis problems, related with the techniques used to analyse data.

These relate with what is called in technical terms 'problems in system identification'.

Further, if "hypothesis testing" methods are employed, then several epistemological problems arise (e.g., Veneris, 1984)

3.3 Cultural relativism

Cultural relativism attacks the very foundation of the positivist approach, by making problematic (Sassower, 1990:

. the very choice of what to consider a "fact" worthy of measuring and thereby worthy of assessing as a "risk" or "benefit";
. the procedures by which these "facts" are evaluated.

This approach considers that decisions related with the above two issues are "culturally determined", which discards the "objectivity" of naive realism (Douglas and Wildavsky, 1982).

3.4 "Middle ground"

Since the positivist and the cultural relativist approaches seem to occupy the opposing ends of the spectrum, the "middle ground" approach aims to combine the two by accepting the empirical basis of the former, with the critique of the latter.

It starts from an understanding that if all measures could be equally well accepted or rejected under the criticisms of scientific and social relativism, then no decision could be possible, no comparison across cultures and/or nations, even if it comes to critical technologies such as the nuclear power. The "middle ground" aims to remove this "cul de sac". For instance, though cultural biases, and political and economic pressures may question the objectivity of the assessment of a certain technology, it is possible to identify the social, economic, psychological, religious, etc., influences and arrive at a "reasonable judgment" concerning particular technologies (Johnson and Covello, eds, 1987; Shrader-Frechette, 1980; Sassower, 1990).

Standing on an assumed "middle ground" however does not guarantee success. For although it takes into effect social and ethical variables, it is still based on empirical data, no matter whether they concern facts on the technology or facts on its perception by various social and national groups (Rothman, 1989, Sassower, 1990). Also, in some cases the middle ground may not exist at all.

3.5 Integrated impact assessment

The integrated impact assessment aims to bring together technology assessment as well as social and environmental impact assessment (Rossini and Porter, eds, 1983).

Le Gales and Moatti (1990) explore a multicriteria analysis which is used to assist a group of experts to reach consensus about health care technologies. This approach takes into account not only cost/effectiveness and technical and practical feasibility but also qualitative criteria such as ethical acceptability, global impact on health education and information follow-up in time. They state that results differ significantly from those of pure cost/effectiveness analysis.

This approach could be also considered as "technocratic" (Sassower, 1990): specialists involved in the assessment may cover a broader spectrum, extending beyond the narrow confines of technologists to include social and environmental scientists, but the views, expectations and reactions of the public and of the users of the technology are not taken into account.

3.6 Constructive

The constructive technology assessment aims at "tracking down, formulating and developing desirable technology applications for society" (Smits, 1990) and "analysis so that the mismatches, the wrong investments and possible social conflicts can be minimised, while at the same time the beneficial effects and opportunities can be fully exploited (OECD, 1988). This approach has been applied by Cullen and Moran (1991) in the assessment of technologies for the elderly. Three main domains are distinguished, namely needs, technologies, and applications; the latter aim to 'map' technologies into particular needs served.

3.7 "Therapeutic Moments"

All previous approaches rely almost exclusively on expert opinion, irrespective of the range of interdisciplinary coverage. The therapeutic moments approach aims to involve the public in the assessment procedures. The approach is described as follows:

"Unlike moments of assessment that occur when specialists deliver their calculations about secondary effects, potential benefits and possible hazards, therapeutic moments come about when citizens express their views about a specific technology through a readily available medium." (Sassower, 1990, p. 443)

The method draws an analogy with participatory democracy: "just as every person in a democracy should have her/his "day" in court, so the therapeutic technique should have its "moment" in the process of assessment" (Sassower, 1990, p.443). The public decides, no matter on what grounds, on what is appropriate. Expert advice is as good as any other advice one may choose to follow or ignore, since data are always incomplete and changing, while measurement is subject to various biases.

The method correctly raises the issue of the "multiplicity of meaning" (ibid.) and attempts to draw attention to two aspects, namely:

- that legitimacy should be awarded to popular expressions of (psychological) considerations emanating from technology applications;
- that the development and application of scientific and technological innovations affect everyone psychologically.

The approach intends to involve everyone who wishes to participate, and calls citizens to express their anxieties and hopes (even if they appear unfounded and/or fantastic), without the mediation of a specialist; a "critic" is only needed to record the "moment".

3.8 Critical remarks on assessment methods

It is evident that most technology assessment methodologies assume that requirements could be synthesized into an assessment. Most assume a benevolent team of experts who produce an assessment apparently conforming to the general social interest. This is not a simple assumption; it is common practice. Specialized institutions dealing with health technology assessment rely only on expert opinion (e.g., Dubinsky and Ferguson, 1990, for discussion of assessment at the National Institute of Health, USA). This issue was also raised in the AIM (26.11.90) Workshop (concerning the Eurodiabeta project). It was admitted that neither social and psychological aspects, nor the reactions of General Practitioners and patients have been taken into account in the project.

The 'constructivist' approach recognises that social conflicts may exist, but assumes that they could be minimised by the experts. It is only the 'therapeutic moments' approach which gives a role to the 'public'.

Behind these one finds a certain conceptualization of the states of the social system. It becomes essential then to consider assessment in its social context, which in turn would require some input from sociology as well as from related discussions in public policy and planning. Extensive review and discussion can be found in Veneris (1984, 1992 forthc.) In general, sociological theories are divided into two broad groups, namely, theories of cohesion and theories of conflict.

Theories of cohesion relate with the work of Talcott Parsons (1937) and the 'structural functional sociology'. Parsons attacked both positivism and utilitarianism, the first for ignoring motives, the second for seeing them as varying without order. Maintenance of social order and control of deviation became his main concerns, considering the Hobbesian all-powerful state as unsatisfactory. He found the solution in what he called a 'voluntaristic theory of social action' in which a framework of common ultimate ends acts upon social actors through a system of norms, i.e. verbal descriptions of desirable courses of action, diffused through institutional structures. Selection of means to achieve ends is restricted by norms. Different systems of ends as well as deviation from norms are considered as chaos and corrective action is required. It is within this framework that the 'asymmetry' in the patient-doctor relationship is viewed as a factor for the maintenance of social order (see Section on 'Asymmetry').

Theories of cohesion are countered by the theories of conflict which generally emphasize that, as a matter of fact, conflict of values and interests is inherent in all forms of human society. The structural-functional theory is criticised as ignoring issues of power. Coordination of social activities in the framework of 'common ends' and stability derive from the direct or indirect

coercion of less powerful by more powerful groups (Goldthorpe, 1977). Theories of conflict are classified into two main groups, namely the marxist and the pluralist (ibid.). The first assumes that social classes are formed on the basis of dominant economic relations of production and exist objectively although they may have not developed class consciousness. The theory has a dynamic element, since one class is dominant until it is dethroned by another. Pluralist theories do not start from strict definitions of classes but, rather, use broad categories such as 'interest groups' and see a continuous process of conflict around particular issues. Variants of these theories consider cohesion within the class and conflict between classes; other envisage also conflict within the class. A dynamic approach sees also a process of situations of cohesion and conflict.

Pluralism is also the concern of the so-called 'postmodern' approach (Harvey, 1989, for review), along with the related issues of 'multivalency' and 'otherness'. It states flatly that 'radically different realities may coexist, collide and interpenetrate', it privileges "heterogeneity and difference as liberative forces in the redefinition of cultural discourse", as opposed to the "generally perceived as positivistic, technocentric, and rationalistic, universal modernism" which aimed to 'even-out contradictions' to the level of disappearance. The whole postmodern project represents "a distilled representation of the whole antagonistic, voracious world of otherness", while emphasizing that "the multiple forms of otherness as they emerge from differences in subjectivity, gender and sexuality, race and class, temporal and spatial geographic locations and dislocations".

Following the above, it can be said that social systems and their sub-systems (however defined) have two main states, both in the synchronic and in the diachronic senses: cohesion and conflict. Concerning actions, they take social meaning through a system of values. Value systems can be classified accordingly.

The above analysis should be considered as mandatory for assessment. Assessment and assessment factors have social meaning and should be seen as belonging to diverse value systems; 'cohesive assessment' is then different from 'conflict assessment'. Cohesive assessment would consider only technical 'mismatches' and cost/benefits, within an overall social consensus. This is not an impossible situation and may be realised within a social group, which shares the same value system. Also pluralist social contexts can be realised in an overall consensus, which makes possible participation and eventual convergence. Pluralist and conflict assessment would require that preparation and evaluation of the 'desired assessment' should be made according to the plural or conflicting values.

The multiplicity of value systems provides also the background for the so-called 'advocacy' approaches; a typical work is Davidoff (1965). It should be noted in this connection that 'advocacy' assessment would require that opposing groups present full proposals. Health advocacy is a relevant concept and practice.

In a pluralist context, expertise is considered as 'distributed' and ignorance as 'symmetric' (between the expert and the public), and related decision-making processes are 'argumentative'; these agree with the arguments developed further in the Section on 'Asymmetry' of the present report.

Further, what I have called 'the Law of Requisite Goal Variety' (Veneris, 1984; 1992 forthc.) specifies that the variety of a social practice, such as a technology assessment, should at least match the variety of value systems in operation in the (social) system.

Presenting alternative assessments to the public (for instance in a 'therapeutic moments' session) gives the opportunity to base this practice on epistemological grounds. Reference is made here to an approach advanced by Hillier, Musgrove and O'Sullivan (1972). It is based on the 'conjectures and refutations' Popperian epistemology, which sees the scientist as developing conjectures, that is hypotheses to test, then to be either refuted by experimentation, or maintained until disproved. The assessment version of this could be that the assessment report (or the alternative reports) prepared by experts become the 'expert conjectures', which are presented to the concerned people, to be either adopted or refuted, facing expert as well as 'common sense' refutations, by the user or the public.

Public participation and "therapeutic moments" should not be considered either as a procedure through which experts listen and discuss the 'concerns' of the public, or as an opportunity for these experts to apply persuasion techniques to a large audience. Instead, they should find their place in the overall technology specification, design and assessment process, and associated costs should be included in the technology costs.

Any assessment study along these lines could run the risk of ending up with the relativism and scepticism characterising contemporary scientific thinking. This goes hand in hand with the recognition of the relativity of the various standpoints, as well as that within society science is just another culture (Boulding, 1985),"just another narrative" (Eagleton, 1987), along with other ones (ethical, cultural, folk, ethnic, etc.).

Policy making however requires the designation of a course of action even if epistemological issues have not been resolved. Participation procedures cannot be ruled out as 'inefficient' in technical terms. Formal techniques are available that could take into account the variety of views expressed, which may stem from

different philosophical and cultural backgrounds. Scientific methods for synthesizing literature, such as "meta-analysis", could be employed in developing inputs for discussion panels; formalized methods that allow for structured disagreement with parts of a consensus statement (such as polling) could extend the range and type of issues that can be addressed in public disputation procedures (McGlynn, et al, 1990; Chalmers, et al, 1989). Also, a formal technique called 'ReD' (Veneris, 1992, forthc.) could be applied in order to let all views stemming from different, or even contradictory, value systems to be expressed in a formal and structured manner, analysed/deconstructed and then resynthesized/reconstructed. This provides a serious alternative to conventional practices such as the 'common denominator' or the 'majority rule'. Viable designs and decisions can be produced this way.

3.9 Further issues on technology assessment

Various other issues are involved in technology assessment, in health technology assessment in particular.

Assessment of health technologies should take into account the situation in developing countries. Cost/effectiveness does not appear applicable in this case and Barmes (1990) argues that factors such as adequate quality of treatment and materials, appropriate personnel, simplicity and mobility in equipment, as well as the selective needs for technology in measurement should be considered.

Health outcomes should be taken also into consideration (Schwartz and Lurie, 1990). They can be used in order to: evaluate the effectiveness of medical practices; assess the quality of health service provided; educate providers and patients about the results of treating illness; guide financial policies; and to characterise the health status of a population (see also Kahn, 1990).

Selection of technologies for assessment is not a straightforward procedure. Various criteria should be used such as the health and economic importance of the illness addressed by the technology, as well as its expected health and economic impact; variations of the technology; and factors affecting the production and reception of an assessment (Eddy, 1989). Finding of all the assessment reports concerning a specific technology is a rather complex task, even through data base searches and particular care should be taken to avoid various biases (Chalmers, et al, 1989).

Health technology assessment should not be seen as a technical and professional activity only. Resource allocation involves political decisions, which are determined politically, i.e. by factors such as power and influence. Policy-making should be informed by technology assessment (Banta and Andreasen, 1990).

4 TELEMEDICINE AND TELEHEALTH TECHNOLOGIES, APPLICABLE TO THE ELECTRONIC HOME: AN OVERVIEW

4.1 Categorization of related technologies

A broad spectrum of information technologies are, or may be applicable to health services. A classification scheme is proposed here with a view to examine technologies with reference to the electronic home. The philosophy of this attempt is to devise categories which can 'envelope' technologies in such a way as to make possible assessment of types of technology rather than individual technologies; this could make conclusions valid even for future technologies. An analogy can be drawn between this approach and the so-called "envelop curves" used in long-term technology forecasting (e.g., Kahn and Wiener, 1967).

The following "Systems" are distinguished:

. MCTS, the Medical Care Telematics System
This is an 'umbrella' term referring to the overall telematics environment of telemedicine applications. It constitutes the 'supply side' of medical care, and represents a 'dividing-line' in the overall telemedicine system, although it overlaps with some of the other Access Systems.

. HAS, the Home Access System
This includes all devices which can be operated in the home for health care purposes. From a technical point of view, these devices can operate in one, or more, of the following modes:
. "stand-alone"
. interlinked with other home devices, medical or not
. connected to a network.

. NAS, the Network Access System
This includes equipment and services linked through various telecommunications and/or telematics networks.

. CAS, the Community Access System
This is introduced later in the present Report in order to include applications which are electronic-home-centred and community-based.

4.2 MCTS: Medical Care Telematics Systems: Definitions and examples

Telemedicine brings together a broad spectrum of technologies and applications. Out of these the present Report aims to focus on the ones which could provide medical care in the electronic home. These home systems can work in a 'stand alone' mode; however, larger scale health care can be provided when these are linked with the overall Medical Care Telematics System into which 'smart hospitals' and remote electronic-home care are been integrated.

This 'background' system could be seen as involving the following:

. Distributed databases of medical records and/or patient data cards, including picture/image archiving systems (PACS), electronic document interchange, pharmaceuticals data bases, etc.

. Standardization and/or compatibility of information (e.g., data and medical lexicon) and information systems (open systems interconnection).

. Medical equipment capable of producing output suitable for data communication.

. Integrated medical telematics services, connecting health care institutions, clinical laboratories, ambulatory services, pharmacists, insurance services, and electronic homes; and further medical information disseminators, pharmaceuticals companies, and hospital suppliers.

. Management systems for distributed medical telematics systems systems in central and local health care units which can access home devices.

. Home electronic devices capable of operating in stand-alone and remote-connection modes.

. Availability of networks, including PSTN, PSDN, LANs, WANs, MANs, satellite, IATV, ISDN and further IBCN.

. Expert systems and knowledge bases accessible to patients and medical personnel.

. Ambulatory services supported by telemedical systems.

. "Open hospital care", which would make possible to bring hospital-type care outside the confines of hospital.

. "Customized" pharmaceuticals, which would aim to design patient-specific prescriptions, and modes and rates of administration.

These systems aim to provide mainly illness-orientated medical care. Systems which can comply with the emerging concepts of 'health' and the 'total health environment' are discussed in other Chapters of the present Report.

A number of EC Programs undertake related R&D. AIM (Advanced Informatics in Medicine) plans to form a European market for advanced medical informatics technologies, which would improve health care in Europe, and will promote the European ITT industry, in order to compete with the USA and Japan. "Telemedicine" is an AIM project which involves PSTNs only in

order to promote home patient telemonitoring, through various sensing devices, as well as teleradiology involving compressed image transmission between medical centres.

RACE (Research into Advanced Communications in Europe) includes the TELEMED (R1086) Project, which involves broadband image transmission ("PACS-to-PACS") between various European medical centres; and the MULTIMED (R1042) project, which is developing tools for multimedia real-time and store-and-forward communication (under ISDN 2B+D) between hospital sites.

Other MCTS applications in Europe include various PACS projects: Helsinki and Turku University Hospitals; SIRENE in Rennes and DIMI in Nantes, in France; the Dutch PACS project; the Imtec PAC in Sweden; the RADKOM, MEDIKON, MEDAP, PADKOM, ULKOM projects under BERKOM, in Germany; the Comm-View project in Triest, and the University of L'Aquila PAC project in Italy. Also a program at the Sismanoglion Hospital in Athens provides teleradiology services to 15 regional health centres. PACS programs are run also in the USA (MIR in Washington, DDIMS in Kansas, UNC in N. Carolina, GUHPACS in Georgetown, and in UCLA); and in Japan (Kento Teishin, Tominaga Memorial, and Kyoto University Hospitals).

ESPRIT (European Strategic Programme for R&D in Information Technology), now referred to as Information Technology, involves also related research.

Various related applications are reported around the world.

4.3 HAS: the Home Access System

HAS includes all devices which can be operated in the home for health care purposes. From a technical point of view, these are devices operating in the so-called "stand-alone" mode. A number of such devices could be interlinked in the electronic home, or used for accessing network health services.

A simple example from a familiar technology would clarify the notion. Take the TV set. This device operates as a receiver for the television broadcasting network; actually it was devised for this purpose. However, eventually it came to be used in a "local", "stand-alone", mode of operation for several purposes. The first generation of what they were called "the home computers" used the TV set as a monitor; a conventional tape recorder was also used as a computer peripheral, as an external storage device. TV monitors are still used for this purpose, although to a diminishing extent, since developments in and reduction of cost of personal computers have done away with such systems. In the meantime, another home device made its inroads into the home: the video recorder and player. This uses the TV set also as a "peripheral", as the monitor to display (output device), which is again a local-type operation, as well as a

receiver for broadcasted programs (eventually some videos came to incorporate receiving capabilities). HDTV systems could be used also in this 'nonbroadcast' mode (e.g., Hore, 1990).

HAS thus includes systems capable of operating in the local and the dual local/remote modes.

Local mode devices may be classified further into the ones operating in local mode only, that is "stand alone"; and the ones which require some distribution network, not necessarily electronic. Take TV again. In order to use it with a video player, access to a video tape distribution network is required, which could involve a visit to a local distributor, or the use of the mail service.

Concerning medicine and health, HAS includes a variety of devices.

Medicine
A range of electronic, non-electronic or mixed devices could be explored.

Medical monitoring devices
Generally speaking, these are devices which monitor parameters of the human body (Richter, et al, 1989; Kaihara, 1990; Doyle, 1990; Kullen and Moran, 1991; for review). Non-electronic ones include instruments for measuring blood pressure, glucose, drugs, fertility and pregnancy tests, etc. Many of them are now becoming electronic. For instance, devices are already available in the market which measure parameters such as blood pressure (low and high), heart pulses and body temperature, all in one. They are small size, portable and simple to operate since they require a touch of the finger tip; all related data are then displayed in a liquid crystal display.

More advanced such devices will be becoming available, monitoring more parameters, combining measurements to produce more meaningful diagnostic messages, and, further, with advances in bio-sensors, diagnostic techniques and medical expert systems, they could produce a range of advanced diagnostics, extending home medical monitoring devices into home medical diagnostic systems.

The overall trend for miniaturisation in electronics shall make such devices even smaller, or, further, shall integrate them in other devices such as the wrist-watch; some such instruments are already available.

A trend could be observed from a home device towards a personal one; a reasonable sub-classification scheme for HAS devices should introduce a new category, namely the Personal Access System (PAS). This path of development can be observed in other areas of microelectronics applications. For instance, a parallel could be drawn with the evolution of small computers, from the

desktop, to the portable, the laptop, and now the 'palmtop' and the 'wrist-top', a process not simply of reduction in size but of an immense increase in capabilities, in terms of speed, memory, storage capacity and interfacing possibilities, including modem communication, wireless communication through cellular telephony, as well as emulation of other devices such as the telex and the fax. The most popular variant of PAS devices is the 'personal alert system', which aims to summon help in an emergency situation, either by signalling alarm, or by transmitting a call to a concerned unit (see next Chapter).

Monitoring devices could be interfaced locally to a home computer, for further analysis, as well as for storage in order to create historical data bases. Further, suitable such devices could be connected with a remote medical unit; the HAS device then should be seen as been composed of and playing the role of two types of devices usually referred in network applications, namely, the DTE (Data Terminal Equipment, such as a computer terminal) and the DCE (Data Circuit-terminating Equipment, such as the modem).

Rehabilitation
Other types of equipment which can be included in the HAS are the various categories of rehabilitation and personal assistive apparatuses. The large number of accidents and the better chances of survival increase the number of people either with permanent disability or requiring long-term rehabilitation procedures. A very large variety of disability types appear, differing also in the degree. Informatics technologies are very advantageous in this respect, since they can be more reliable and provide also self-testing, self-control, and sometimes self-repair facilities (e.g. AIM, 7.5.1990). Advances in areas such as rehabilitation engineering, 'in vivo' biosensors and transducers (invasive or non-invasive), implants, neurological stimulation, speech control, prosthetics and artificial limbs, robotics, advanced support tools and various other technologies for disabled people, extend the scope of such devices. The US NASA programme aiming to transfer 'space technology' to civilian applications presents a promising opportunity for new rehabilitation technologies (Rouse, 1988).

Therapy
Home or portable monitoring devices could be linked with treatment devices, probably implanted, as in the case of diabetes control implants which monitor glucose and automatically release insulin. Other devices for home therapy are becoming available, such as haemodialysis systems.

Patient data management systems (PDMS), intended for intensive care units (Collet, et al, 1989), could be used also for non-intensive health care in the electronic home. These systems link 'bedside instruments' with a personal computer in order to

control fluid balance data, medical dosage calculations based on the patient data, and medical observations. The computer could be linked with a remote medical unit.

All above applications comply with the narrow definition of medical care, and address mostly the ill. The emerging concepts of health and the total health environment extend the range of systems which can contribute to health improvement. Environmental monitoring devices could provide continuous monitoring of the home environment and/or adjust controllable parameters. Alarm and security systems could provide the reassurance of living in a safe environment. Intelligent exercising equipment could improve physical fitness. Other types of equipment could assist in the development of new skills.

Elderly and persons with motor impairment could find great help with everyday tasks in the electronic home by various robotic systems such as the 'fetch and carry' remotely controlled robot (e.g., Wilson et al 1990). Advanced technologies are now applied in wheelchairs; in addition to joystick control systems, voice recognition command systems are used, which can operate even in noisy environments; eye-directed or jaw-positioning systems are also been used for command purposes. The so-called 'electronic butlers' could also assist elderly and disabled people.

Automatic control of the functions of the electronic home is of particular importance for persons with special needs. Even simple and widely available devices such as the telephone can be used for this purpose; the 'Vitaphone' of the German Post Office makes possible to use the conventional handset for the control of doors, heating, lighting, TV set, etc. Also the wide availability of microprocessor-controlled home appliances extends the range of remote control, in a way similar to the TV control.

Emerging advanced technologies (MediaLab, 1990) would find their way in health-related HAS applications. Examples in case include: the 'data glove' and other 'cyberspace' equipment which makes possible to move and touch into a computer image; the force-feedback joystick, which can move freely in 3-D space; and 'tactile simulation' which can provide realistic, real-time 3-D tactile simulation of computer-generated objects and environments.

Development of such devices appears to comply with the general trend from services to goods, from health services to health goods in particular.

Seen from the perspective of the total health environment, the spectrum of HAS devices and the range of associated benefits for the promotion of health increase immensely, and it extends even further when other health related applications are taken into account; these are discussed in other chapters. All these provide

an additional reason for moving beyond the narrow confines of institutionalised medicine.

4.4 NAS: the Network Access System

4.4.1 Voice telephony

Use of voice communications networks in telemedicine is reported as early as in 1935 with the establishment of the International Radiomedical Centre in Rome (see also Section 4.4.3)

A broad range of services are run under voice telephony. "Hotlines" is a popular form of telephone health services. Examples in case include VD (Manmouth Medical Centre since 1973; Bryant et al, 1973); sexual abuse (Peirce and Peirce, 1985); poison centres (Purello et al, 1990); telephone and walk-in emergency services (Laffal et al, 1972); drugs (Maguire and D'Arcy, 1988); and cancer (Stirewalt et al 1981). Emergency response services, such as the 'Lifeline' (Dibner, et al, 1982), and physician consultations (Frenger, 1983) can be supplied over the phone. Various phone health information services are provided, such as "Tel-Med" in N. Carolina (Diseker et al, 1980); "Gruppo telemedicina" in Italy (Arcuri, 1989); the "Telidon" health service (MacDonald, 1982); cancer information (Wilkinson et al, 1978; Stirewalt et al 1981, for "Can-Dial"); the "100 Service" in Brussels (Labruyere, 1989); the emergency service in Oslo (Borchgrevink and Bruusgaard, 1981).

Other services are also available, such as the out of hours work in primary care in an urban cooperative deputising service (Soler et al, 1991). Satellite telephone links are also used for remote areas (e.g., Hudson, 1982 for Alaska; see also Sections 4.4.5 and 4.4.9).

Facsimile transmission over telephone lines is also suitable for some applications, when computer-to-computer communication is not available. For instance, it can be used in sending prescriptions, medical records, or even in transmitting medical data from home or clinic devices to central medical units when the monitoring devices cannot be connected directly.

Telephones cannot be used by various categories of people with special needs. These problems are discussed in a following section.

4.4.2 Videotelephony

An extension of the voice telephone, the video telephone is capable of transmitting images along with voice. Although available for almost 30 years, it started diffusing only recently. It may operate in three main forms: transmission of one picture per call; updating of the picture at intervals during the

call; and continuous transmission of pictures. The latter form still presents problems due to the limited capacity of the standard telephone lines, but technological developments in image data compression and the emergence of new networks (ISDN, IBCN) may make videotelephony commonplace. The videophone can be interfaced with a printer, to make copies of whatever appears on the screen and can also keep a screen directory. Many other features should be expected following diffusion of this technology. Some telephone companies (e.g. British Telecom) actually have started advertising mobile videotelephony. Related R&D is taking place under the RACE program.

The videophone may make communication more humane; it may be used also as a serious aid for people with speech and hearing impairment; and/or for the transmission of medical instructions (first aid, physiotherapy, etc.). Generally, it is a promising medium for telemedicine and telehealth: it combines the ease of use and the wide availability and low cost of telephone communication, with the audiovisual capacity of IATV (interactive TV). Although no large scale videophone telehealth applications can be reported, its relationship with IATV applications could be used to comprehend its potential.

4.4.3 Networking HAS devices

Historically, the foundations of related applications were laid as early as 1935 in Italy with the establishment of the International Radiomedical Centre in Rome (Rotondo, 1986). Experience from clinic-to-hospital telemedicine applications is relevant here because home systems draw on their experience. Among the first experiments in this respect are ECG and EEG telemetry over the telephone (e.g., Hanley, et al, 1969).

A range of HAS monitoring and diagnostic devices can be connected with a central medical unit. This sets several requirements.

1. That a suitable medium, (wired/wireless) for establishing the two-way link is readily available. This medium could be the voice telephone network (PSTN), wired and/or wireless (cellular/ mobile), a data network (PSDN), or other telephone related systems, such as satellite.

2. That both the HAS and the central unit are equipped with a computer system capable of implementing suitable communication protocols, which ensure both the establishment of connection, when appropriate, and the integrity and confidentiality of the data transferred. Further, these protocols are essential since it is assumed that several remote units are linked with the central unit.

3. That both the HAS and the central unit have suitable network interfacing devices. In the case of the telephone network such devices are the modems.

4. That the patient, generally considered as a lay person, is capable to operate the system.

Communication of this type is conceptualized by means of the 7-layer model for Open Systems Interconnection, of the International Standards Organization (ISO/OSI). According to this model, the first layer is the "physical layer", which is the medium; the second is the "data link layer" in which the series of data are suitably assembled into "packets" to be transmitted error free; the third is the "network layer", which ensures delivery of packets at the specified destination. These three levels set the minimum requirement for network communication.

Concerning data transferred, related problems include: volume of data, which if large (as in the case of images) it requires pre-processing (data reduction and compression); and integrity of data, to ensure error-free transmission.

The above mean that the HAS should include computer capability, not necessarily provided by the microprocessor probably built into the monitoring device(s). In such a case, the device should be interfaced to a home computer, which would then undertake the communication tasks.

New NAS technologies could be developed which would connect portable devices via the mobile telephony networks, making possible continuous monitoring of persons in serious health risk (e.g., brain or heart attacks), or suffering from dementia (e.g., Alzheimer's disease), or even for children. This would require transmission of the location of the person; advances in "positioning" technologies make possible tracking.

Assuming the above are available, three types of connection can be distinguished, depending on who activates the communication link:

- Patient activated. The patient decides on when to call the remote unit.
- Device activated. The monitoring device of the HAS has the capability of not simply monitoring, but also of distinguishing a critical situation; for instance, a device monitoring a certain biological parameter capable of identifying exceedance of a critical value.
- Central medical unit activated. The personnel of the central medical can initialize communication with the remote HAS device and receive measurements.

In the first two cases, the central unit could use protocols such as: contention, or event-reporting, that is the remote unit when it has something to report sends a message to the central unit; polling, according to which the central unit calls successively all the remote units in some order and receives data collected so

far. In the third case, the central unit initializes an "interrogation" session with a specified remote unit to collect data.

HAS applications in case include ECG, EEG, EMG, respiratory performance, diabetes monitoring, pulse oximetry, 'alarm/alert' systems (they call the concerned medical unit which can know who is calling, has all medical records of the patient and takes appropriate action), uterine activity, pregnancy, hypertensive or diabetic pregnancy, fetal heart rate and neonatal care, monitoring of adults-at-risk and chronic ill. Even tasks such as defibrillation could be undertaken by lay persons at home (e.g., Dalzell, et al, 1988). Therapeutic compliance monitoring is also a potential area of applications.

'Personal alarm systems' is a popular HAS application which can also operate as a PAS device. The system involves a device capable of transmitting a call (using phone or radio) to a concerned unit, which can be a clinic, or a community service; the call carries data which identify the caller, and the unit can use a computerised data base in order to identify the actions required for the particular person. This system thus can be used both for medical and for personal security purposes. Several designs for such devices are available, aiming to make the system simple to use; most of them use a simple button or trigger.

An interesting feature with network linked HAS devices is that the central medical unit can not only control them centrally, but also to test them remotely for proper functioning; the latter is implemented, for instance, by creating a "loop back" test transmission. Remote servicing is also possible in some cases, while many of the common user enquiries could be answered remotely.

The above analysis holds for most cases of remote monitoring.

4.4.4 Telematics applications

Several telematics (telecommunications + informatics) applications are reviewed here. All of them assume computer systems at both ends, interconnected via a communications network (PSTN, PSDN, etc.).

Electronic mail and message handling systems. These make possible the transfer of documents, in one-to-one, or one-to-many modes. Along with the document travels information concerning document handling authorization (read-write/modify), transmission and reception date and time stamps, etc. Documents sent could be either typed-in texts, or scanned pictures, suitably formatted. These systems can operate both on-line and off-line. DBNet is an example of non-professional use of such services by deaf and blind (Ladner, 1988), while the 3I project in the Netherlands involves e-mail for professionals (Hasman, 1990).

Computer conferencing. It is an extension of the above, making possible many-to-many communication, along with some facilities which make conferencing easier.

Existing such telematics services in telemedicine and telehealth address mainly researchers and practitioners. However, it is possible to envisage new applications which would involve the patient directly, accessing them from the home. Some related examples are discussed in other chapters.

Videotex is a facility which allows remote terminal units to "read" (or "view") pages of information stored in a central computer. It may operate in text mode (e.g. ASCII-type texts) for standard terminal devices, or in the "videotex" mode, which uses videotex-mode character sets and requires either special-type terminals (such as the Minitel), or suitable interfaces for standard terminals. Videotex is a promising medium for the dissemination of health information, mainly in textual form, and with some graphics. Various related applications are in use in France. "Domo Sante" is an example involving doctor-to-patient links, dedicated to patients with chronic respiratory diseases. These patients (about 150,000 in Europe) require an everyday breathing- aid/oxygen-concentrator device. A permanent telephone link between the home and a medical centre makes possible to monitor the home patient, as well as the home device (AIM 20.7.90).

Electronic Funds Transfer (EFT) makes possible transfer of credit through computer networks. This can be operated via both standard and videotex terminals. In telemedicine EFT could be used in order to simplify payment and/or reimbursement procedures. "SESAME" in France is such a professional service (AIM 20.7.90) which aims to automate medical financial transactions, including reimbursement of the GP by the patient's insurance company (a smart card is credited electronically), and invoicing of paramedical acts (medical images, biological analysis, chemistry).

New types of networks are diffusing. ISDN, the Integrated Services Digital Network already operates in various countries. A number of related applications are envisaged (see section on 'multimedia'). FDDI (Fibre Distributed Data Interface), ATM (Asynchronous Transmission Mode), and eventually the IBCN (Integrated Broadband Communications Network) would open up new opportunities for the development of radically new types of applications, which would integrate all computer and communications technologies. HDTV (High Definition TV) is also a medium suitable for medical applications since it provides images of high quality.

4.4.5 Satellite communications

Satellite communications may be seen as an extension of other communication systems (e.g., telephone, IATV). For the purposes of telehealth however they shall be discussed separately in order to review related applications.

The potential of public satellite services in health care delivery had been discussed by Burge (1977), who reviews the experience of a decade of telemedicine applications, as a way to extend the coverage of remote health care. Satellite applications were seen as involving biomedical telemetry, emergency medical systems, remote cardiac monitoring and teleradiology.

Rotondo (1986), drawing on the experience of space missions, considers that such systems are capable of dealing with long-distance transmission of data concerning cardiology, neurology, radiology, radiodiagnosis, nuclear medicine, oncology, nephrology, opthalmology, haematology, laboratory diagnosis, etc.

Alaska is an area where satellite applications in telehealth are available for quite some time. Armbrust (1976), Foote (1977) and Hudson (1982) report beneficial application of satellite communication systems in the provision of health services, along with education and teleconferencing for citizen participation; the system involves IATV as well as a computerized health records system. Muller, et al (1977) review successful application of a five-satellite network for primary paediatric health care.

Applications in Canada use satellites to provide telemedicine and distance education through 2-way-audio/1-way-video systems, as well as medical supervision and support to offshore rig medics. Large scale telemedicine projects are also run between Canada, Africa and West Indies. House and Keough (1989) present over 10 years of experience with this system and extensions for the 'Olympus' satellite system. Another application in Japan uses the ETS-V satellite, in order to transmit colour video, audio, ECG and blood pressure signals (Shimizu, et al 1990). The INMARSAT, Hermes and ANIK (A,B,C,D) satellites support related applications (e.g., Richmond, 1984; de Payerbrune and Mughedkar, 1987; Kerr and Chouinard, 1986)

Satellite applications are most suitable in disaster areas (as well as search and rescue operations) in order to support provision of emergency health services and 'mobile telemedicine' (Garschnek, 1991; Murakami, 1990.

Satellites have been instrumental also in the success of the 'Telemedicine Spacebridge' established between (then-)Soviet and US medical care teams for the treatment of Armenian earthquake victims, involving video, voice, fax and telex links. NASA funded the project, considering it as a case of Space Biology and Medicine (Scott, et al, 1990).

EC Programs, such as the RACE 'Telemed', aim also to integrate satellites along with fast terrestrial links in the provision of multimedia services to health care professionals (e.g., Boscolo, et al, 1990).

4.4.6 Broadcasting systems

Systems of this type follow generally the 'one-to-many' principle. The various nonelectronic and electronic media (the Press, radio, TV) are typical cases of such systems. The electronic ones can involve various means of transmission, such as wired and wireless, as well as combinations of terrestrial and satellite systems, discussed in the previous Section.

The media are used for health-promotion and intervention programs; various such applications are discussed in Section on 'Health Information'.

Telematics applications also can operate in the one-to-many mode: teletext, videotex, and broadcast electronic mail are examples in case; these have been discussed in the Section on 'Telematics applications'. Since trends in telematics technologies lead to the Integrated Broadband Communications Network and since printed media are challenged by their electronic counterparts, it seems reasonable to suggest that in future 'broadcasting' will tend to refer more to a mode of operation rather than to a specific type of medium.

4.4.7 Interactive television

IATV, the interactive (bidirectional, two-way) television was one of the first technologies to be used in telemedicine.

Applications in the USA started about 25 years ago, and involved also Puerto Rico, as well as remote states such as Alaska (Park and Rashshur, 1975; Hastings, et al, 1976). IATV has played a central role in telehealth applications because it gives the MD the opportunity to observe the patient 'as if he were there personally', with all the advantages of visual perception and aural input.

The remote service is provided usually in a local clinic staffed by nurses, linked via IATV with a centrally located MD. Such services however could be provided at the electronic home through home IATV systems, either directly to the patient and/or with the presence of a visiting medical practitioner.

Related IATV telemedicine and telehealth services have been established in many countries. The range of applications includes diagnosis, consultation, counselling, psychotherapy and health education (Park and Rashshur, 1975); paediatric primary care (Muller et al, 1977; Cunningham et al, 1978); rural mobile health

units (e.g., Fuchs 1979, for the Papago Indian Reservation); private hospital to university medical centre (Grundy et al, 1977). An example of a nonmedical application is the IATV service for the elderly in the Berks Community, USA (Burns, 1988).

Videophone may take advantages from the experience of IATV and/or take over some of its services. HDTV could extend further the capabilities of IATV (Hori, 1990).

4.4.8 Multimedia

Most R&D in this field aims to produce applications for professional use. Multimedia are appropriate for medical applications since they are capable of integrating text, image (still/moving) and sound. Images are essential for medical care, since X-rays and other related diagnostic technologies, ECGs and EEG all produce pictorial output, which must be displayed and studied in detail. An example is the RACE "TELEMED" (e.g., Boscolo et al, 1990; Mavridis and Weser, 1990; see also Polese and Ravaglia, 1991; and Cappellini, 1991); "Berkom/Radcom" in Berlin is trial project for the interconnection of multimedia workstations through wide band ISDN (B-ISDN) aiming to involve cross-European (about 15 sites) telemedicine applications (Voge, 1990; Kanzow, 1991). Treves (1990) discusses also experience from trial telemedicine broadband communications (see also next Section). Another major project in Emilia Romana, Italy, involves also transmission of medical images; a related application is taking place in Trieste, also in Italy (Scharnberg, 1990; also 4.2).

Multimedia applications could be used in home care, providing user-friendly interfaces, for telemedicine and telehealth purposes, including education, training and self-care. Such services could be provided through networks, or in stand-alone mode (e.g. CD programs on multimedia personal computers). Due care should be taken to make such systems usable by disabled persons (Wood, 1990; Klause, 1988; see also Section on 'Special groups').

4.4.9 Combined systems

It is not necessary for each application to be restricted within the confines of a particular NAS. It is possible, and probably more likely, to see systems which operate different NAS modes in conjunction. This, by definition, would be the case with multimedia systems, operating under ISDN or IBCN environments.

Combined systems could be operated also over conventional PSTNs (called now 'plain old telephone systems'-POTS). For instance, Greenberger and Puffer (1989) discuss "Healthcom", a system which uses a combination of telephone and computerized audiotext

responses to the elderly. Also systems which use an off-line (even non-electronic) HAS device and a NAS to send data to a central medical unit (e.g., through push button phones) could be seen as combined systems. FM systems for radio and telephone transmissions have also been used (Bracale et al, 1974).

Telehealth applications in Alaska, involve satellite IATV and phone communication, together with a computerized health records system (e.g., Armbrust, 1976; Cervinskas, 1984; Richmond, 1984).

Two-way audio can be combined also with one-way video via satellite networks, as in Canada (House and Keough, 1989).

The Loginat project involves digital data and videotelephone signal transmission to provide prenatal care in N. France, where premature births were above the national average. (Duvaux, 1990).

The TND (Telecommunications Network for the Deaf) in Washington DC uses a 'relay' system: the deaf person calls an operator and passes his/her message, along with the number to be called; the operator calls the number and reads the text; and vice versa. Such human-machine 'relay' systems using an 'intermediary' could be used in various applications (see also Section on 'Access interfaces).

EC Programs (e.g., the RACE "TELEMED") aim to provide combined services, integrating satellites, fast terrestrial links (2 Mbits/s and 140 Mbits/s), LANs and WANs, supporting multimedia applications, which include images and text (e.g., Voge, 1990). Polese and Ravaglia (1990), and Cappellini (1991) report related combined services.

4.4.10 Emergency and mobile health care

Emergency services aim to provide quick and appropriate health care in situations which involve various accidents (caused by natural force or failure of man-made equipment) and unpredicted evolution of a latent ('silent') pathological cause. They can occur anywhere, including the home.

These services provide mainly conservative treatment and transport (land, air) to the nearest health care centre. The current situation shows that improvements are necessary. For instance, State emergency medical service systems in the USA are found "fragmented" and "lacking resources" to remedy related problems, especially in the remote areas (OTA, 1989).

Various technologies can contribute to this end. The experience from the development of 'space technologies', initially used for monitoring humans during space missions, along with emerging telehealth systems, make possible provision of more appropriate ambulatory care (e.g., Solheim, 1990; Nicogossyan and Kiselev, 1990; Hjorth, 1989; Rotondo, 1989; also research under AIM, in

AIM 7.5.1990). Satellites are used often by such services. For instance, mobile satellite communications systems are used for an emergency telemedicine station, which could transmit audio, colour video, ECG and blood pressure signals (Shimizu, et al, 1990).

Mobile health units (MHUs) may not focus on emergency situations, but rather, on a broader range of health services. For instance, they can be used in remote rural areas (e.g., Fuchs, 1979, reviews the experience of an MHU in the Rural Papago Indian Reservation, USA).

These units are of immense importance in cases of large disasters in order to provide emergency health care (Garshnek, 1991; Murakami, 1990).

Multimedia applications can be used in the electronic home, for the provision of ambulatory services, and/or by visiting medical professionals who could inspect on-line medical images and text concerning the patient, which are stored in some central data base.

The so-called 'telephone and walk-in' emergency services (Laffal, 1972) in hospitals is a related service which may not involve a mobile unit.

5 SOCIAL ASPECTS OF TELEMEDICINE AND TELEHEALTH

5.1 Health care

5.1.1 Patient Issues

5.1.1.1 Design issues of HAS devices

Emerging HAS devices discussed above cover a broad spectrum. The Report AIM (7.5.1990) states correctly that "such systems are currently in their infancy and Home Care is an approach still to be developed" (p. 60). It is also noted that efforts in developing patient-oriented devices have until now been impeded by factors such as: short-term expediency implying non-optimal design; ad-hoc methods of system design inhibiting the potential for flexibility; lack of rigorous justification for assumptions; lack of proper understanding of the real nature of special needs. Further, they should be designed with the non-specialist user in mind; this issue is being addressed by the AIM Task "Design of Specifications for the non-specialist user operated medical equipment", outlined in the same Report.

Cullen and Moran (1992) argue that a general discriminating tendency can be observed in various designs, which are developed with the "mythical young healthy adult male" in mind; to these attributes one could probably add literacy and language use. HAS devices, however, do not address generally this 'ideal' type.

Design of HAS devices should be based on specifications which do not satisfy technical requirements only, but also social, cultural and psychological factors. The education level of users; ethnic, religious and cultural aspects; the social and economic ability to use the device they who need it; the training and maintenance required and related services and costs; the opportunity to choose among alternative medical paradigms; and patient rights are some factors (discussed throughout the present Report) which should be taken into account. This should occur in the early phases of design, when the priors and the functional specifications of the product are set. If not, then the product could fail in the market, or, which is worse, may 'force' patients to use it as the only available option. This would imply that people adapt to technologies, which leads to an unacceptable reversal of the order of things.

Sections on 'Access interfaces', 'Special groups' and 'Ethnic minorities' discuss related applications.

5.1.1.2 Access modes and interfaces

Selection of the most appropriate interface for telemedicine and telehealth applications is a major issue. Since limited home care is provided currently, experience with related existing systems should be explored. Many such systems connect the patient with a

centrally located physician through a remote service staffed by nonMD staff. The assumption made here is that extensions of such services could be provided in the electronic home.

Telephone and IATV links have been used in various applications. Grundy et al (1982) report experience with a related application. A considerable number (1548) of telemedicine 'visits' over 18 months showed that IATV had greater clinical and educational impact than consultation over the telephone. Other studies also found IATV superior to the telephone (e.g., Muller et al 1977; Grundy et al 1977; Cunningham et al 1978). Moore et al (1975) found that IATV consultations result in fewer immediate referrals than the phone; also although no overall difference in satisfaction was documented, IATV was preferred more by most participants because it allowed more "social interaction" than the phone.

Home care systems should be easy to use without the assistance of an intermediary. Special assessment studies should aim to identify the most appropriate systems in this respect. For instance, Greenberger and Puffer (1989) maintain that the "Healthcom" service, which combines the telephone with a computerized audiotext system, would provide easier access because it does not require an intermediary for communication.

However, the use of an intermediary may be necessary in some cases. First, a telehealth system in an early state of development may not provide a "user-friendly" interface. If this system is the only option available, then the intermediary could become a necessary "supplement" to the system in order to operate it. Second, in some cases a system may be used which has been developed for a different cultural background. The cost/time to adapt it to the specific situation may be prohibitive. The intermediary may be necessary in order to undertake the difficult task of cross-cultural and cross-language communication. Probably, in home care systems, it may not be possible to have such a trained intermediary in each home. A solution to the problem could be a 'travelling medic', not necessarily a doctor, who could visit patients and assist them in operating the telehealth system.

Three types of access interfaces should be considered as more favourable for home applications:

1. Devices directly and automatically linked to the central medical service.

These, for instance, include HAS devices which communicate electronically with the central service through available networks (PSTN, PSDN, etc.). The negative aspect of these is that they 'invade' the personal space and time of the patient, with all related social and psychological implications.

2. Several interfaces to the standard telephone which are, or are becoming available.

Push-button telephones can be used to enter medical data. For instance, Arbogast and Dodrill (1985) describe the use of push button telephones by diabetic patients who perform home glucose monitoring in order to enter glucose data directly into the database of a health service computer. The system decodes Touch-Tone pulses into their digital equivalents, while synthesized voice messages instruct the patient on how to use the service.

Text telephones make possible communication in text form over the conventional PSTN, by attaching suitable keyboard and display interfaces to the phone. This facilitates communication for people with functional auditory and hearing impairment. Since this requires text telephones at both ends, advances in speech processing make possible to interface text phones with ordinary voice phones. The audiotext facility of voice messaging systems can be used in this respect (Blackshear, et al, 1987). Wide availability of low-cost fax equipment makes possible many other combinations of existing technologies; as late as in 1985 fax was so expensive that special devices such as amplified telephone receivers and bone conduction telephones (e.g., 'Meiryo' and 'Hibiki', respectively, Tanaka, 1985) had been designed in order to provide an alternative.

Telebraille telephones are necessary in order to provide phone service to people with auditory, speech and visual impairment. Interfaces to other types of phones are required, as in the case of text phones. Advances in speech synthesis and recognition make now possible text-to-voice, including Braille-encoded text, as well as voice-to-text communication which can then be translated to Braille system, through Braille tactile displays (Bazzani and Mumolo, 1988).

A number of related systems could make possible and/or improve the communication possibilities of disabled persons. Motor disabled individuals could benefit from interfaces using the 'Blissymbols' method, which can further accommodate different languages and idioms; Tronconi et al (1989) present such a system which includes also speech synthesis. TV teletext services which transmit text for the deaf could be interfaced with a PC, which could then translate them on a Braille printer, or a Braille tactile display.

Videophones can be very favourable in a number of cases. They can support patient-doctor communication, extending the experience of IATV. They can be used in various support networks (for patients, elderly, etc.). Further, they could become the most appropriate means of communication between people with auditory and verbal impairment. Videophones should provide the possibility for

turning off picture transmission on demand; this could be useful when anonymity is desirable, for instance in (first) calls to sensitive phone services (e.g., VD and suicide hotlines).

3. Computerised services interfaces

Such services could be provided as stand alone and/or as NAS services. These may require the patient to enter into a dialogue with a computer system. If special commands and instructions are needed, then the home user should be trained, which could constrain the use of the system. Special, user-friendly interfaces should be planned, including:

a. Menu (pull-down/pop-up) interfaces
Many applications already provide such easy to use access. Menus can be constructed both for ASCII terminals (and PCs) and for videotex terminals, such as the "minitel" (although character sets are different, they appear same to the user).

b. Icon-driven, window and "mouse"-operated systems
These are now widely available and experience so far suggests that they are successful with general users. In order to use such systems, terminals or personal computers with graphics capabilities are required.

c. Natural language communication
This term refers to systems which can 'capture' the information required for the system to respond from textual information entered through an alphanumeric keyboard. Emerging developments in related technologies (natural language processing in artificial intelligence) would make them applicable in telehealth applications. A level of literacy on behalf of the user is required so that words are typed correctly (although such systems could 'tolerate' typing and/or spelling errors) as well as familiarization with the keyboard. Further, the natural language 'spoken' by the system is a constraint. To avoid this, the capability of these technologies in providing multilingual options (by changing lexicon and grammar only) should be exploited in full.

d. Voice recognition systems
Such systems can recognise words spelled in natural voice. Applications available so far operate better when single-word commands are issued, while systems which can recognise phrases are becoming available. Sociocultural aspects involved here include the capability of the system to understand different languages, or, even, different dialects and accents (spoken by ethnic or local groups) of the same language. Since such systems are not applicable to people with auditory problems, other special interfaces should be used in such cases.

e. Handwritten input
These systems take advantage of pattern recognition and optical character recognition technologies and could be applied for home health and medical systems. They require a level of literacy on behalf of the user, while they are not suitable for persons with certain impairments.

f. Multimedia and hypermedia
These systems could provide easy to understand combinations of text, pictures and sound. They require, however, computers with rather advanced graphics and processing capabilities. Such applications are especially beneficial for telemedicine purposes (e.g., Polese and Ravaglia, 1990; Cappellini, 1991). The cost of multimedia workstations and the limited geographical diffusion of ISDNs are impeding factors for the wide exploitation of these services, although it is possible to run them under ordinary PSTNs.

Various disabilities create special demands for interfaces. For instance, visually disabled find difficult to read text on keys and controls, to locate keys (especially foil keys), to use the 'mouse', or to distinguish colour coded symbols; physically disabled people cannot easily operate controls simultaneously, twist knobs, or position a 'mouse. Various solutions are technically possible (Ekberg, 1991, for review including related EC RACE and COST Projects).

An overall model for special-type interfaces could be established following research in various related projects such as the COST 212 HUFIS (Human Factors in Information Services; e.g. Orlando, ed 1991). The model perceives human-machine interaction according to the following aspects:

. Physical parameters of the service: sound, tactile, visual.
. Syntactics: wording/commands and conversion;
(e.g. Braille <--> text).
. Semantics: human-machine/user-service dialogue and interaction;
(e.g. natural-language <--> Bliss-symbols).
. Pragmatics: user needs, service efficiency.
. Psycho-social aspects: behavioural situations, influence on user attitudes, user expectations.

All these five aspects should be taken into account in designing input and output systems. Developments in artificial intelligence would make possible to deal also with more complex disorders, such as mental (e.g., misunderstanding and inattention). Further, equipment could be designed with special features which could make it capable of adapting to the needs of a specific disabled user. Multimedia workstations suit better such applications.

5.1.1.3 Patient autonomy

Telehealth and telemedicine systems would give new dimensions concerning patient autonomy vs. medical control.

Various telehealth systems discussed throughout the present report could promote patient autonomy and self-determination. Self-care, self-help and support HAS devices, aids for handicapped persons, home monitoring, instruction expert systems, patient decision support systems, community and social network communication systems, etc., could provide valuable assistance to this end. Simple telecontrolled robots could increase autonomy of motor disabled persons (e.g., the low cost remote controlled 'fetch and carry robot; Wilson, et al, 1990); 'electronic butlers' can be used also for the same purpose. Cullen and Moran (1992) consider that this independence involves a transfer of procedures from the medical professional to the lay person, which raises possible conflicts between individual freedom and right to take risks on the one hand, and the need for professional judgement and control on the other. From another point of view they represent a case of goods for services substitution (see Introduction).

Concerning NAS interfacing devices, Wood (1990) emphasizes that all of them should be designed with the disabled in mind, improving their ability to integrate into society and enabling them to buy the equipment at the same price as everybody else.

However, HAS devices connected to telemedicine systems could increase medical control to a previously unknown degree. This may be beneficial for the health of the patient, especially for critical cases. It may however have negative psychological implications resulting from the feeling of being continuously monitored, as signals measured from body parameters will be transmitted to an impersonal remote system and monitored by machines and/or unknown health service providers. This should be taken into account in designing such systems, since enhancement of patient autonomy is a major aim of telemedicine and telehealth. (See also Section on 'Patient rights').

5.1.1.4 Quality of health care

It is not easy to assess in advance the quality of health care to be provided through telemedicine in the home. However, since many of the emerging systems would provide home access to computerised systems similar to the ones already available either in-hospital or in remote-clinic-->central-hospital modes, valid analogies could be drawn.

MYCIN is a system which has now a long history in diagnosis, prescription and follow-up. More such technologies are becoming available. For instance, successful application of computerised diagnosis is reported for dementia; EVINCE is such a system which

can run even in small computers (desktop). Plugge, et al (1990) found that both the system and the human expert were in perfect agreement on the diagnosis and correlated highly on the diagnosis of dementia of the Alzheimer type and multiple infarct dementia.

The quality of health care through computerised technology has been reported as better even in cases concerning psychiatric diagnosis. The evaluation (Shuman, 1976) of the computerised diagnostic system used in the Salt Lake City Veterans Administration Hospital in Utah, USA, for mental patients discussed already, reports more accurate diagnosis (96%) than the conventional (86%), faster (5 hours compared to 5 days), not so impersonal, while the comprehensive computer tests led doctors to discover organic brain damages, or even schizophrenia, in cases appearing as psychological disorders. Patients found easier to "speak" to the computer, while some of them wanted to have access from the home to consult it when "feeling depressed".

Many evaluations of telemedicine applications discussed throughout the present Report show generally favourable results in terms of health care provision, including life support care. Cayten et al (1984) however report a dissenting view; after a three-year controlled trial of cardiac telemetry in prehospital care, 96% of the 'paramedics' involved reported that telemetry had not helped them save "a single life"; 86% disputed the proposition that it saved them time; on the contrary, they spent more time in the field with the patients exclusive of transport time than did paramedics without telemetry; also telemetry was not found to effect their ability to interpret ECGs in either test or field situations. Although it is difficult to generalise from these results, they indicate that assessment of the real effectiveness of telemedicine and telehealth systems should be studied in detail.

Computerised management of waiting lists in hospitals has been already implemented in various forms. This brings an overall improvement in medical services provision and reduces the time spent by patients. Avoiding unnecessary referral could also be effected through telehealth services. This has a dual positive impact, for it reduces patient's inconvenience and time spent and it decreases the number of "unscheduled drop-in" visits to hospitals, which makes hospital care available to those who need it more; even conventional telephone hotline services are very useful in this respect (e.g., Stirewalt et al, 1981).

Telemedicine applications have a clear advantage in ensuring continuity of care, which is a major quality aspect. Continuous monitoring and assessment of the patients' biomedical parameters and attributes (which vary markedly within diurnal timescales and in different environments) in their own home, "rather than intermittently while they inhabit the alien world of the hospital", is stated as a positive factor in AIM (20.7.90). As the same report states, "this focus upon the functioning patient is the correct one for medicine. It increases the awareness of

the doctor that his or her prime responsibility is to maximise the patient's capacity to lead as full and independent a life as possible".

Computerised medical records provide also new opportunities for ensuring continuity of care. Historical sets of data about parameters and treatment, as compared with observed patterns in terms of a finite and time-specific diagnosis, combined with other patient's characteristics would enable the provision of comprehensive medical care.

Regular automatic screening of patients' medical data is undertaken in some cases already. This would contribute to the promotion of prophylactic and preventive care. However, screening becomes an increasingly complex task with multiparameter analysis so that "the more screening systems are stressed by raising throughput, the less reliable they tend to become" (AIM 7.5.1990, p. 44). This could be seen as a pure technical problem. However, the social impact of inaccurate massive screenings would raise major issues; early failures may "stigmatize" the whole system and lead to rejection.

Telematics applications in Tissue Banks, especially when extended on a European scale, shall improve planning of transplantations, by reducing access and search time.

Measurements of the quality of health care can be effected more easily through computerised systems, since samples of data (concerning tests, follow up, outcomes, etc.) can be drawn at any time from the system and be analysed accordingly. Also, consumer-based indicators of the quality of care could be used (OTA, 1987); computerised systems can assist to this end. Quality assurance and control methods would use such data to identify problems.

Integrated, multilevel medical informatics systems would increase speed, accuracy and efficiency of medical care, which will be to the general benefit of the patient, in terms of diagnosis, treatment and follow-up.

5.1.1.5 Asymmetry in the MCTS-to-patient interaction and discourse

Doctor-patient interaction, sometimes called the "clinical discourse" involves problems even in ordinary talk. Parsons (1951) did a now-classic study of the doctor-patient relationship. He emphasized the role of the physician in the control of illness-as-deviance and maintained, following his overall structural-functional sociology principles (Veneris, 1984 for some discussion), that the asymmetry in knowledge and

authority between the doctor and the patient is functionally necessary to a homeostatic society (see also Chapter on Assessment Methodologies).

This view was strongly criticised (Maynard, 1991, for review) for instance, for ignoring broader sociopolitical structures in which the institution of medicine is embedded and for neglecting the inherent conflict in the doctor-patient interaction; this conflict is identified in the personal and community interpretations of well-being of the patient, and the impersonal, objective and scientific approach of the professionals of biomedicine.

Professional dominance is promoted through the combined effect of several factors, such as professional authority, medical expertise and institutional settings. This allows the doctor to advance a biomedical model of disease and to undermine lay forms of understanding of well-being, which are related with the patients' own life-world concerns, experiences and understanding. New technologies of diagnoses and treatment have also played their part.

This criticism is directly applicable in the case of telemedicine systems, especially with the advent of remote monitoring and surveillance. The doctor-patient relationship is replaced by the system-patient relationship. The latter is far stronger since the authority of the system is strengthened by the fact that a large constellation of telematics services supports the doctor-side. The patient is not confronted simply with a single doctor, but with a whole system, not directly visible to him/her, the strength and authority of which is manifested in each encounter; control of the patient's medical records and one-way telemonitoring systems are examples in case. In fact, this system-patient philosophy permeates the whole conceptualization of the AIM Program (see also Annex I).

Such problems may hinder the diffusion of telemedicine systems, create patient reactions, or, which is worse, make patients accustomed (after realising that they have no better alternative) to the impersonal authority of large medical care systems.

Yet this situation may be improved by transforming the whole conceptualization of the doctor/system-patient relationship. Apparently, Maynard (1991) maintains that the asymmetry in this relationship is not totally a product of the physicians abstract power, but, rather it is reached "interactively". This is a usual comment made by "ethnomethodological" social studies (e.g., Zimmerman and Boden, 1991). What gives a positive prospective for reducing the asymmetry is his finding that sequences of talk in this interaction assimilate ordinary conversational situations. This on the one hand may indicate that the asymmetry may be attributed to factors which transcend the doctor-patient relationship. On the other hand, application of technics for the analysis of talk, such as the perspective-display series used by

conversationalists, may reduce the asymmetry. This means that it is not sufficient to develop natural language interfaces for telemedicine systems; models of talk should be also taken into account in order to avoid the strengthening of professional authority, of its technocratic attitude in particular, which prohibits the dialogue and eventually limits the scope of telemedicine and telehealth systems. After all, these systems are made to serve the people and institutional order is neither the best nor the only means of ensuring stability in the patient-system/doctor interaction.

(See also Section on 'Patient rights').

5.1.1.6 Self-care and decision making skills

Telemedicine applications can help the home patient to develop self-care capabilities and skills. This could be effected through the use of assistive HAS devices for support, rehabilitation and treatment, self measurement of biological parameters, as well as through various educational TV and computer programs which could provide related training.

Preventive telemedicine can be practised by individuals in order to identify and assess their own health risks and related behaviour, and determine modifications in life-styles. Various expert systems accessible in the electronic home can be used to this end.

Other telehealth systems which can assist decision making skills and, further, support decisions are educational programs in various media (radio, TV, videos), as well as interactive services. Expert systems, accessible from the home, could also provide additional information, having the advantage of responding to specific dialogues, as compared to a prepared continuous flow program. They would provide both the knowledge base and the rules necessary to take appropriate decisions.

Legal issues are involved in self-care systems. It is instructive in this connection to think 'backwards'. Assume that a serious health problem has not been identified in a patient who has been 'examined' by a computerised system. Who would be responsible for this? Those who designed the computer program? The health authorities that made it available to the public? The patient for using it improperly? The patient for not following therapy procedures advised? Such questions, however, should not be used as arguments against the promotion of related systems. They should be used, instead, in a constructive way, as constraints in the design phase in order to develop systems which minimize the risks of improper use.

Having defined the limits of medical self-care, the various social, ethical and cultural problems discussed throughout the present Chapter should be taken into account.

The above concern mainly disease and disease prevention. When the total health environment (THE) is taken into account, telehealth systems can contribute in a much broader sense; Section on 'decision making skills and coping' of the next Chapter deals with such issues.

5.1.1.7 Choice of alternative medical paradigms

The modern world experiences a proliferation of different approaches to health care. These are usually included under the general term 'alternative medicine', which designates systems such as homeopathetic medicine, acupuncture, chiropractics, osteopathy, biofeedback, aroma/chroma/crystal/clima therapies, shiatsu, pulse diagnosis, biorhythms, iridology, rebirth, psychocybernetics, synchroenergising, Alpha Stim, Graham's Gyroscope, visualisation, zen, spiritualism, "spiritism", meditation, to name, most likely, but a few.

The above are not generally endorsed by mainstream medicine, the mainstream "paradigm", to use the kuhnean term. Some are discarded as charlatanism, some are explored further (e.g. homeopathy and acupuncture). Many of them contradict with the main tenets of western medicine, as well as with the fundamentals of the dominant epistemology. A number of them have become popular because they provide an 'holistic' approach to human health; this attacks one of the major problems of modern western medicine, namely its overly specialization and compartmentalization. Nevertheless, the fact is that many people follow such health systems and some of them see real or perceived improvement; after all, "placebos" are used sometimes by doctors, while meditation is more preferable than tranquillizers, especially in view of the tranquillizer crisis discussed by Gabe and Bury (1991). Such approaches constitute a 'health behaviour', since they are directed at improving health, irrespective of its effectiveness. In this respect, they may contribute by creating an overall feeling of 'wellness', by influencing lifestyles and dietary habits, or by developing the self-esteem and the sense of 'belonging' to a group. This positive side sometimes is countered by negative aspects, especially when people abandon proper medical treatment in order to follow 'false prophets'.

When it comes to telehealth services, the question arises whether they would or should extend their range in order to provide such options. And who and how is to judge on whether a certain service would be provided or not. However, alternative approaches and their followers grow steadily in variety and numbers. With the expansion of communication systems, as well as with the development of various devices which follow the above approaches, related such services may start operating, following, for instance, the road of similar telephone services which supply zen meditation verses, or tranquillizing music, not to mention

businesses such as the computerised telephone services for biorhythms and 'astrological charts'. This may lead to a 'de facto' expansion, and perhaps the best strategy for telehealth systems would be a 'soft' one, which would leave space at least for those alternative therapies which have the minimum possible negative effect, while controlling the most dubious ones.

The question of choice does not arise in the case of alternative therapies only. Different approaches are found in mainstream health care as well. For instance, various schools exist in psychotherapy and demand for them is identifiable. Would telehealth systems provide the option to choose between behaviourist, Freudian, yungian, adlerian, lacanian, group, drama, etc. therapies?

Experience so far from existing and emerging telehealth applications shows a clear bias towards mainstream approaches. This should and probably shall become an issue for public debate, when "patients" will enter the picture in the assessment of telehealth systems. If no public participation procedures are established, including the "therapeutic moments" approach, in decision taking concerning the variety of telehealth services, then one could predict that the market and/or community projects would eventually fill the gap and start providing independent services; this result would be in agreement also with the "law of requisite variety", discussed in Chapter on 'Technology assessment'.

5.1.1.8 Patient rights

Patient rights is a recurring issue even in conventional, non-telematic health care. As a subject it involves both citizen and consumer rights, which take special meaning when it comes to health matters. The general principles for the protection of individuals with regard to automatic processing of personal data have been set in the Convention of the Council of Europe of 28th January 1981. These concern issues such as: the collection of data by fair and legal means; finality in the storage and use of data; the quality of data; data security; right to access and correction; secrecy and sharing of data. Special provision is made for 'sensitive' data, which include the patient data.

Personal data records and patient data cards (PDCs) also pose patient rights issues. A number of norms have been applied in this case. The Council of Ministers of the European Council has elaborated Recommendations such as R (81/1) (on the regulation of automated medical data banks) and R (83 1/2) (on the protection of personal data used for scientific research and statistics). Related documents have been prepared by organisations such as: the French Commission National Informatiques et Libertes and the Belgian National Council of the Order of the Belgian Physicians (outlined in AIM, 11.12.1990); the World Medical Association (Declaration of Geneva/International Code of Medical Ethics; and

Declaration of Lisbon concerning the Rights of the Patient); the Standing Committee of Doctors in the EC (Statement on Storage of Medical Data; and Declaration of Nurenberg); and the International Conference of Orders (European Guidelines for Medical Ethics). All these set a regulatory framework.

A number of organizations undertake ongoing work on the ethical and legal issues involved in medical informatics, including the Standing Committee of Doctors of the EC, the European Union of General Practitioners, the European Union of Medical Specialists, the Permanent Working Group of European Senior Hospital Doctors, the International Conference of Medical Orders, the European Association of Senior Hospital Doctors and the World Medical Association.

The AIM Task on "Guidelines in Bio and Medical Informatics Legislation" also addresses issues such as: doctor-patient relationship and maintenance-ownership of data; the maintenance of patient anonymity in research; the prior safeguards against unauthorized use of data and linkage of medical data banks with other information banks; as well as patient medical cards related issues (AIM 7.5.1990, T121).

Nevertheless, several questions should be discussed in this connection.

The Report AIM (11.12.1990) stresses that the use of the card "is no neutral matter" (p. 147). This is due to the fact that the patient may not wish the physician he consults to be aware of his whole medical history. The Report sees a solution to this through the patient's choice to give or not to give his card. This, however, would limit the scope of the medical card and could render invalid the whole effort of developing such cards. Further, the patient-doctor "asymmetry" (acknowledged in the Report as "a specialist-uninitiated relation" and "lack of equality") sets barriers to the patient's ability to argue on such matters. This is also recognised by the Report, which states: "In practice, it would appear rather difficult for a patient to refuse his card to the physician who asks for it, inasmuch as such a demand serves a medical purpose and not malicious curiosity" (p. 148). This is a "catch-22" situation: the patient who chooses not to give the card would eventually deprive himself from the medical service; the patient who gives the card gives away his right to privacy.

Perhaps a way out would be a mechanism through which the patient could define authorization to the physician to read a certain region of the medical records contained in the PDC. However, this, in addition to the various technical complications, would require that the patient is capable of reasoning in medical terms, which is not a reasonable assumption in view of the "asymmetry". In addition to this, one of the reasons for computerising medical services is the possibility of taking advantage of comprehensive analysis of medical records, using a

wide range of medical parameters. This also would set constraints on attempts to make data readable according to authorisation codes set during the preparation of the cards. Nevertheless, no significant R&D seems to be undertaken in the direction of devising such mechanisms.

Similar problems emerge in the case of computerized medical records. In this case however the system itself may provide levels of authorisation for accessing the medical records, and it is possible to involve the patient himself in setting the levels. The difference between computerised records and PDCs is that the latter contain all personal records, which can be made available to the physician, while the former would be accessed through the central computer system, which could include access privilege mechanisms.

Confidentiality problems arise also when records and/or cards are used in health insurance. Private health insurers routinely evaluate the health status and risk of developing disease of applicants, who may be declined altogether, charged higher premiums, or have certain illnesses excluded from coverage. Diagnostic and predictive technologies are used in this respect (OTA, 1988b). Would records and cards be used for such 'filtering' procedures? Furthermore, if so, would insurers benefit at no charge from this information, which may have built up at the expense of the individual and of various organizations?

The use of electronic medical information for the purpose of reimbursing health care charges poses also related problems. This possibility is considered as "notably useful" in AIM (11.12.1990) and one should expect that it would be taken advantage of. However, through this many persons would have access to personal medical data, directly or indirectly (e.g., by reference to the paying institution; AIM 11.12.1990, p.148). Similar problems would arise when electronic medical records are used by employers in order to select between applicants and/or arrange the conditions of work according to the health status of the employee. Such confidentiality problems could be dealt with only partially by mechanisms ensuring limited authorization access to the various organizations; such mechanisms should be built into the PDC production system. Nevertheless, this would require to reach a consensus in the definition of what is 'relevant' and what is not in each particular case, which could lead to conflicts of interest.

PDCs may be used to support patient rights in some cases. For instance, since all consultations, treatment, etc. would be recorded, a patient may use them in order to determine the responsibility of the professionals involved in cases of misconduct, negligence, or fault. PDCs could also provide evidence to judicial authorities (AIM 11.12.1990, p.149).

Associated with record keeping is the issue of the patient identification code. Jarman (1991) states that "patients are usually not unhappy to have an identification code if they understand that the use of the number is to improve their health care, whereas they may be unhappy, particularly in some countries, to have a national identification number allocated to them for general, non-medical use".

The doctor-patient "asymmetry", already discussed, takes on new forms and new proportions in telemedicine and telehealth systems. The doctors exercises power over the patient, using professional authority and medical expertise. This power is expressed in the physician's "monopoly" (Maynard, 1991) over matters such as construction of the medical reality of the patient (by simply "judging" on the patient's experience and needs), selection of therapy, surgery and prescription, extending also into insurance and sick leave. Further, doctors are seen as promoting oppressive arrangements in work, family, leisure and other aspects of social life, while the origins of social problems tend to be individualised (Conrad and Schneider, 1980).

These trends have been reinforced in the last century by diagnostic technologies and specialization. Critics (Foucault, 1972; Dreyfus and Rabinow, 1982; Arney and Bergen, 1984) stress that new technologies in the range of telemedicine, such as monitoring and surveillance, by reaching more and more into everyday life, shall become technologies of domination. Even the subjectivity of the patient would be captured by technologies of knowledge and power, while the most trivial things should be "noted, recorded and made the object of analysis (Arney and Bergen, 1984). Further, other critics such as Navarro (1976), see these processes, following the analysis of the "Frankfurt School" of sociology, as stemming from exploitative class relations and the resulting patters of domination, subordination, legitimation and of using science as a mode of ideology.

Telemonitoring of patient's biological parameters can be seen further as a case of violation of "bodily privacy" (a term used in Antony, 1982). Also, it is not obvious how the right to "select provider" could be exercised when the patient is been telemonitored, for he/she cannot know who is at the other end of the monitoring system. Ways should be found also to make possible to exercise both the right to "ask and know" and patient's participation in remote monitoring.

Interactive telehealth services bring about another form of asymmetry. In each 'conversation' it is supposed that each participant has the right to discontinue it. It may be argued that in a telehealth consultation session the patient would rarely exercise this right. But how medical professionals would use their power over the communication link, especially under the pressure of multiple calls? Since this problem arises in all interactive telehealth applications, it seems reasonable to suggest that a proper 'protocol' should be established and that

related telematics and legal measures should be devised in order to safeguard that the protocol is respected. For instance, the session termination control could be with the caller; this may appear as a 'strong' protocol but it is not unusual since it is followed in ordinary phone calls.

Therapeutic compliance telemonitoring raises social concern, since it may exacerbate current problems, described in AIM (7.5.1990): "Problems faced by the home-care patient, particularly in country and remote areas, include the inability to complete complex prescriptions from a single source owing to stock and drug distribution arrangements; in these situations, ranging from post-surgical wound-healing to therapeutic compliance monitoring, treatment is not strictly followed and no-one accepts responsibility for solving the issues" (p. 58). Telemonitoring could increase medical control over the home patient, while a threatening perspective would be to make the patient responsible for ensuing problems. Since it is possible 'to lie with statistics', it is equally possible to lie with telemonitoring data (conveniently interpreted), especially when a bureaucratic organization and an institutionalized profession join forces in order to remove responsibility from them. In order to avoid this, the patient should have full access to related data; even then an expert 'advocate' would be necessary in order to provide technical support.

The right to anonymity is a favourable aspect involved in taking the decision to access telehealth services concerning sensitive personal matters (VDs, suicide, sexual abuse, etc.) at least when doing this for the first time. Some applications provide opportunities for anonymity. For instance, telephone hotline systems can accommodate an anonymous call requesting general information about symptoms. This information could be supplied along with an advice to visit the concerned clinic. Videophones and CATV/IATV services reduce, in principle, this element of anonymity. It appears that the option should be left open for an anonymous call, in order to encourage first contact.

Computer networks supporting health-related activities reduce anonymity. This however does not necessarily restrict use of the system since most of such services would involve a specific group, which by its definition (cancer, AIDS, etc. patients) declares the scope of communication. Further, such services are founded on the possibility of encouraging interpersonal linkages.

"Depersonalization" is a patient-doctor issue, encountered even in conventional health care. The use of remote consultation services contains an element of "impersonality", manifested in the textual or voice synthesized communication with a computer. This is a general problem. However, the use of computerised technology has been reported in some cases as more preferable than conventional procedures. Interestingly enough, this concerns also psychiatric diagnosis. An example is the evaluation of the computerised diagnostic system for mental patients used in the

Salt Lake City Veterans Administration Hospital in Utah, USA, discussed above (Shuman, 1976). Although this was provided as an in hospital service, it is now possible to access such systems from the home through telematics networks. The efficiency and accuracy of the system as compared with conventional systems (5 hours vs. 5 days; 96% vs. 86%, respectively) resulted in less people hospitalized for diagnosis, only to be released later after completion of the procedures. Many people avoided thus the stigma of mental illness. Further, computer tests were considered as less threatening than "sitting down with a shrink", and less impersonal than the "call me next week" of the doctor.

Significance and integrity of medical data is also a major patient rights issue. HAS devices should be tested and approved for conformance with set standards, in order to ensure that they perform their stated function accurately; many errors are "measurement errors", occurring in the source. When such devices are used for self-test purposes ('stand alone'), the required medical expertise in making a diagnosis should be taken into account. Issues related with professional demarcation lines, the rights of individuals regarding access to technologies, and the right to diagnose and treat oneself arise (Cullen and Moran, 1992).

Data shall be transmitted from electronic homes to medical data bases, exchanged between medical centres, and/or carried on data cards. Such "communication errors" could be checked through suitable communication protocols, a large variety of which are already available. Further, received data are subject to interpretation, which may be automatic, or reached by the doctor-computer complex. Any "identification errors" in this phase would be transferred in the records. Erroneous "raw" measurement data could be also entered by the medical personnel. Clearly, such data errors may have hazardous effects on the patient which may involve legal action taken against medical practitioners. Procedures for data checking and correction as well as for the "electronic signature" of the practitioner should be considered as "sine qua non" for the system to gain wide approval. In addition, suitable legislative frameworks should be devised. Such measures would reduce the error margins and reassure the patient.

Life-supporting HAS equipment poses major issues of patient rights, potentially leading to questions of life and death. Examples in case are dialysis and respiratory support systems. Access to such devices and proper functioning, as well as the legalities of initiating, withholding and withdrawing such equipment would have to be considered in this respect. OTA (1988a) provides an attempt at documenting the numerous, serious uncertainties that complicate inherently difficult decisions about the use of life-supporting medical technologies. Such issues include: the outcome of treatment, that is whether the patient will eventually survive or not, and if so, with what quality of life; decision to treat or not, that is whether

circumstances arise in which nontreatment could be considered as legal and ethical; decision making procedures for the above, that is whose judgment to seek, for what, and when and how to resolve the related conflicts; decision implementation procedures, which would ensure that the decision is carried out.

Experience from existing applications should be taken seriously into account in developing such patient-orientated systems. For, it is not only the patient rights involved, but also that costly services may be rendered invalid because they did not create the right "feeling" to users.

5.1.2 Community Issues

5.1.2.1 Democratic control

The issue of democratic control (see also section on 'Patient rights') becomes more important with the size of the telemedical system. Monitoring and surveillance of the patient inside the home, the workplace or even in move (through mobile/portable systems), and the creation of huge data bases with the detailed medical records of the whole population, are trends which could trigger easily orwellian nightmares. Under certain political and social circumstances, these could be used for the purposes of control of the population. A central oppressive power, however, is not the only reason for concern. Such systems could also be tapped by criminal experts in information technologies, who can access sensitive personal data. Since such networks would provide access to a number of health providers, so that they could serve even patients who are travelling across countries, how can it be guaranteed that corrupt professionals would not turn their access to such data into an illegal job?

Computer security systems and measures such as security audits should be implemented. The task "Reviews of Threats to Data Protection and Security" of the AIM Project (AIM 7.5.1990) addresses related issues. However, experience so far with large networks, even in sensitive and well guarded sectors such as Defense or Finance, has shown that no matter how well protected they are, the probability remains considerably high that intruders may either steal data or insert viruses which may create mayhem, sometimes using inside information and/or cooperation.

Personal medical data cards also present major confidentiality problems. They may be lost or stolen, as large numbers of personal credit cards are lost or stolen today, and fall into felonious hands. They can also be forged.

Such problems may stimulate reactions which would question or oppose the introduction and/or wide diffusion of telemedicine and telehealth systems. Measures should be promoted in order to establish democratic control in the administration of such systems; the problem is that no "bulletproof" measures have been devised so far. Further, as the know-how related with the medical information systems would diffuse to larger numbers of people, so will increase potential dangers of malicious actions.

Citizens' committees may be appointed to supervise the administration of such networks. Could such committees have the technical expertise to play their role? Expert advisers to the committee can be appointed, but this would make democratic control dependent again on expert opinion. It is desirable in this respect to devise easy-to-understand approaches to data

security measures and counter-measures; for instance, derivatives of the risk analysis and management methodology (CRAMM) developed in the UK could be considered.

Health quality assurance (HQA) and control (HQC) are also issues of democratic control. The creation of comprehensive Health Information Systems could make easier and faster the production of HQA/HQC statistics.

In order to implement effective democratic control, research should aim to create a Democratic Health Management Information System. The experience from MIS systems could be used in this respect. However, the DHMIS should accommodate the variety of value systems operating in the society (as the 'law of requisite goal variety' would specify); provide all required information inputs; and support community involvement, community development and advocacy.

Data protection and democratic control are issues which should be advanced in parallel with plans to develop and implement large telehealth systems; this would avert the risk of discarding at least some aspects of such systems due to citizens' opposition, after having been financed by large amounts of public funds. This parallel development of democratic control procedures is also technically valid. For it is much more difficult to try to devise ex post control measures; instead, such measures should be built into the priors of system design.

Democratic control is also necessary in order to reinforce access rights. Telemedicine and telehealth at home require both home devices and access to networks. Ordinary telephone networks took many decades to diffuse widely. Even today telephones are not available in every home in developed countries (e.g. Ruf, 1992), while, as said in the Introduction, the residents of 600,000 villages all over the planet have to travel about 30 km in order to find a telephone. With the advent of telehealth, networks are no longer simple communication media; they are turned into health-support systems.

Bulger (1990) argues cogently that the computerization of health care and the development of large data bases will create new forms of the conflict prefigured in the Greek tragedy "Antigone". This conflict between humane concern for the individual and concern for society at large and administrative rules could lead health care into a state of "Creonization" (a neologism coined by Bulger from the name of the homonymous hero of "Antigone").

5.1.2.2 Sociogeographical aspects

Sociogeographical aspects of telehealth could be viewed as involving factors such as: regional distribution of communications networks; health provision in remote areas; social

limitations in accessing health services; and special health risks and needs of people living in particular geographical areas.

Research in various countries has established a strong bias in the geographical expansion of telematics networks towards the more information-rich environments, that is the major business, administration and research urban centres; the same trend can be observed in a global scale, as was pointed out in the Introduction. This is usually justified on market grounds. Regional development policies may not aim to promote new business activities in certain peripheral and semiperipheral regions (e.g., Veneris, 1984, 1986, 1992a forthc.). In addition, rural and remote areas are often medically underserved; for example, in the USA rural areas have high numbers of hospital closures, ongoing problems in recruiting and retaining health personnel, and difficulty in providing medical technologies commonly available in urban areas (OTA, 1989). This applies also in the case of emergency health services (EMS). For instance, in the USA (OTA, 1989) many rural EMS programs lack specialized EMS providers, have inadequate EMS transportation and communications equipment, and are not part of a planned regional EMS system.

Telehealth services are mostly needed in peripheral regions, for information-rich environments are usually equipped with adequate health services. Health-care-poor areas are most often also information-networks-poor; therefore a major change in telecommunications policies is required in order to make possible for telehealth to reach those who need it. Areas of applications could include, EEG, ECG, teleradiology, fetal and pregnancy monitoring, as well as applications addressing the elderly who form a large group of peripheral populations. Availability of telehealth services could improve health care provision locally and reduce the number (and cost) of unnecessary referrals (e.g., Moore et al, 1975). Positive experience in this respect results from the teleradiology system of Sismanoglion Hospital, Athens, Greece, which covers 15 urban and rural sites.

Since terrestrial networks may never reach remote/rural areas, due to cost/benefit considerations, perhaps the most attractive alternative is satellite links. Successful applications, especially in Canada (see Section on "Satellite Systems"), should be examined with due concern. The possibility of providing a broad range of tele-services, in addition to telehealth services, creates also an 'economies of scale' effect, which would make such applications more attractive economically. Also, since telephone communications are more readily available, related applications could take advantage of the various telephone orientated services, which could include transmission of various signals, as well as low-scan (freeze-frame) video (e.g., Hoyle and Jamieson, 1989; Willison,1985); applications in vast countries such as Australia could be considered (e.g., Furness, 1987).

Distribution of health services in urban areas is not also even. For instance, American ghettoes tend to have lower levels of health care. In most major conurbations of the world problems in public transport systems, adverse personal circumstances (elder, working mothers, pregnant women with young children), and physical limitations on personal mobility could prevent the patient travelling. Telehealth could improve this situation. Telephone alert services is also an example of an urban telehealth service which is easy to install and run; positive experience is reported from related applications (e.g., the Hellenic Red Cross 'Alarm' service in Athens).

Social factors impede access to existing telehealth services. An example is provided by the accessibility study for the "100 Service" in Brussels (Labruyere, 1989). The study focused on home callers and established several factors which constrain access to the service. First, the socioeconomic level: belonging to a low socio-economic group appears to be an obstacle to verbal communication; phone calls from poor districts allow a less good evaluation of the state of the victim. Second, language: ethnic minorities do not call because of lack of mastery of national language(s). Third, age: the number of calls grows with the age of the victim, while the under-evaluation of the state of the victim is significantly more important for the elderly.

Age was found to be a discriminating factor between callers and noncallers also in three other case studies. The first researched the utilization of the Can-Dial cancer information telephone service, with callers being younger than noncallers; with age adjusted, no differences are reported in education, occupation, social class, or marital status (Stirewalt et al, 1981). The second explored calls to the VD hotline of the Monmouth Medical Centre, USA; the "typical caller" was identified as a 20-year-old employed male who heard about the hotline from a friend, and wanted information about clinic hours and about symptoms of VD. The third examined an urban sample of "frail elderly"; 65% accepted the "Lifeline" telephone emergency alarm system (Dibner, et al 1982). Elderly people also accept the telephone alert service of the Hellenic Red Cross in Athens, Greece.

Social discrimination patterns are observed also in the "urban cooperative deputising service", in Glasgow, UK. A review by Soler, et al (1991) analysed several thousands of calls (6834), received from a "catchment" population of 37,000, which made for 183 out of hours calls per 1000 patients per year: 23% of these calls were considered as "unnecessary", 65% as "reasonable" and 12% as "emergency". People living in deprived areas were more likely to call, and more likely to make an "inappropriate" call.

Awareness about telehealth information services is also socially biased. A survey (Diseker et al, 1980) among households for the use of the "Tel-Med" system in North Carolina, USA, found that larger percentages of adults with lower income and educational levels were not aware of the service than were the adults in

upper income and educational levels. However, among individuals who knew about the system, income and education were unrelated to the use of the system.

Geographical and socioeconomic factors, which determine the total health environment of a particular area, influence the assessment of health risks. This leads to a social epidemiology, which can estimate not only proportions of people exposed to specific health risks in a geographical area (region, settlement, urban area), but also the combined effect of income distribution, environmental factors (air pollution, water quality, etc.), living conditions (including quality and safety of housing), psychiatric geography and working conditions, all disaggregated per geographical area. (e.g., McCance, et al, 1987; Stefansson, 1984; Milio, 1981). Computers and computerised health data bases could play a central role in this type of research since they make possible multivariate analysis of large data sets as well as spatial disaggregation.

Telehealth systems should aim to adapt to the variety of the situations identified through such studies. This could be effected in a number of ways. In areas showing environmental problems, systems of environmental monitoring could be used in order to provide real-time information on trends in critical environmental parameters; these should be accessible from the home, through various media (telephone information service, TV-systems, telematics services). Furthermore, appropriate measures should be prepared in advance in order to be implemented immediately.

Social and economic status determines also the capability to respond to actions suggested by health information services. For instance, a children's home safety information campaign was found to lead to 'practical difficulties' in converting information into action in disadvantaged families (Colver, et al, 1982).

Access to critical life-support HAS equipment (e.g., dialysis and respiratory support) is also a major issue. This equipment is still costly, which if correlated with ability to pay would result in social inequalities reaching the extreme when issues of life and death are involved. Provision of such devices as well as duration of support should be explored.

Telematics applications aim to provide upgraded health services to previously underserved areas and social groups; this is also the 'raison d'etre' of most telemedicine and telehealth programs, including AIM, as discussed in other chapters. Since no full scale such systems have been established it is difficult to investigate this on empirical grounds. Rural community telematics services is also the aim of COST 3.1.1 Task.

However, persistent regional and social disparities, of which health care is one aspect only, suggest that although the 'golden age' of telehealth may be a technological possibility, it can be

restricted by social factors; technology is thus only an 'enabling factor'. Furthermore, Milio (1986) judges that telehealth services will not only accelerate health expenditures but also that "those disadvantaged by income or living in low income 'markets' will have poor access to services, pay higher out-of-pocket costs, and obtain late or no care, with consequent health effects". This undesirable effect would probably be the result of a 'market-orientated' health policy, which would supply health services according to narrow microeconomic considerations of 'returns'. Remote areas and provision of health services to those who do not have the ability to pay would not maximize 'profits' and would score low in 'cost/benefit' calculations.

5.1.2.3 Telematics services for special groups

Special social groups concerning health could be defined in a number of ways; depending on definition, these groups include large percentages of the population. For instance, disabled people form a large special group: 10% of the population in industrialized countries and often much larger in developing countries (Lindstrom, 1989). Another categorization includes what is called 'the naive, aged and disabled'; according to Klause (1988), 30% of the population fits into this category. People with hearing problems sufficient to impair ordinary communication are also a large group including as many as three out of five of people who are over-seventy (Brooks, 1984).

Special services (along with special HAS devices) required for such groups could draw on and expand the experience of services already provided. AIDLINE is a voice mail which uses audiotext to provide information to the disabled (see section on 'Health Information'). The "Vistacom" videophone is also used for handicapped persons in Finland (Tampere Innovation Centre; AIM 20.7.90). A number of applications could assist greatly persons with hearing impairment. An example is provided by the TND service (Telecommunications Network for the Deaf), in Washington DC (Familant et al, 1990). This services operates in a 'relay' mode: the deaf person calls an operator-staffed center, types-in the number he/she wishes to call along with the message and the operator calls the number and reads the text; reply follows the reverse path. Privacy problems arise in this application, which can be overcome when computers are used. For instance, an application for blind persons in Italy involves a Braille-supporting PC (keyboard and display); typed text is voice-synthesized for output and received voice is Braille text-converted (Bazzani and Mumolo, 1988). DBNet is a related application which aims to provide network services (e.g., electronic mail) for the deaf-blind people (Ladner, 1988).

Visually handicapped people face many day-to-day problems. For instance, they cannot fill-in bank forms and other documents; they have always to be assisted by someone, which creates dependency and violates privacy. Telebanking using Braille terminals could solve this problem (van den Breed, 1989)

HANDYNET is an European information system for disabled people, promoted by the Bureau for Action in Favour of Disabled People, DG V of the EC. The system aims: to provide the disabled access to broad range information and to databases on various related topics; to be widely available; to supply information in the native language of users; and to be accessible both by viewdata and text terminals (Pierre, 1988).

COST-219 and RACE 1054 Projects aim to explore related advanced telecommunications and telematics services (e.g., Ekberg, 1989). Wood (1990) argues cogently that such services should take into account the disabled people already in the design phase.

Related applications should not aim to provide simply health and communications support to impaired persons. They could be designed also with a view to provide job opportunities to them. This is desirable both for income generation as well as for the improvement of well-being. A teletext to PC to Braille-printer interface, for instance could assist blind people in doing jobs involving market data analysis, capturing financial information transmitted through teletext systems (Mizuno et al, 1989); direct access to computer or videotex services could serve the same purpose.

The number of elderly people increases as the life span is prolonged following improvements in food, living and sanitary environments. A large variety of HAS technologies could assist the elderly with age-related health problems (Cullen and Moran, 1991). Special network services, such as the 'kind home welfare network' could address specifically the needs of the elder (Kanekawa et al, 1991).

5.1.2.4 Ethnic minorities

As the ethnic and racial mix of "catchment populations" for telehealth services would become increasingly more complex, such systems will have to overcome cultural communication barriers.

Language is the first example. The asymmetry already discussed enters the picture. But it is intensified in the case of ethnic groups, even if communication could take the form of "ordinary conversation". For, the ethnic caller may not be as proficient in language as to state his/hers case successfully. Would then the service providers be capable of extracting medically-meaningful information from such a communication? For instance the analysis of home access to the "100 Service" in Brussels (Labruyere, 1989)

found that some ethnic groups don't call (or call infrequently) the service, due to lack of good knowledge of the national language(s).

Equally strong communication barriers are set by cultural background. Quesada (1976), for example, found that communication between health providers and a community of impoverished Mexican Americans was constrained by concepts such as "the cosmology of destiny", "dignidad", as well as family relations, perceptions and social structure.

Cultural and religious factors have been found to influence psychiatric treatment. For instance Harwood (1977a,b) argues that "spiritism" plays the role of psychiatric therapy among Puerto Rican populations. He considers possible to draw an analogy between the ways spiritism and psychiatry treat causes of psychological problems: the former by "removal in space" (attributing them to remote "spirits"), the latter by "removal in time" (attributing them to remote "social causes").

Ethnic factors also influence acceptance of health-related information disseminated by the media. A study among Mexican Americans in Texas (Hsia, 1987) found that although they were well exposed to mass media information programs which periodically provided information on the availability and very low cost of available medical services, they relied almost exclusively on relatives and friends for health information; this resulted in underutilization of medical services. Newspapers were considered as the most promising medium (compared to the radio and the TV) for informing this ethnic minority. Further, education and income were found correlated with newspaper reading and radio listening. These results agree with the more general cultural problem in using medical facilities; Chaudhuri (1986) reports that rural people (Munda, West Bengal, India) frequently do not utilize the medical facilities available to them.

5.1.2.5 Local community health care systems

Telemedicine could upgrade services provided by local community medical care units (see Section on 'Levels of medical care'), staffed mostly by nonMD personnel. The new level of services, the personal links which are developed with local patients, and the easier provision of ambulatory care are reasons which favour local care schemes, both in terms of medical efficiency and from a social point of view.

Services could be provided in three ways: the patient visits the clinic, where telemedical systems can make possible remote consultation from a central medical institution; a home telemedicine system connects the patient with the local unit; the staff of the local unit visits the patient at home, taking also advantage of telemedical systems. Of these, the last two involve

directly the electronic home, while the first is a favourable extension. Further, electronic transmission of prescriptions to local pharmacies could be included.

Connecting HAS and NAS devices of the electronic home with the local medical unit has several advantages, including: reduced network-use costs, in the case of distance-dependent network services; installation of devices, training, support and advice on 'problem-shooting' by the local unit staff; easier provision of 'back-up' service in cases of equipment malfunctioning; to some extent, customization of services and equipment to the characteristics of the local population (age structure, language, culture, etc.). Further, the capabilities of home devices could be extended by portable/transportable equipment carried over by visiting local medical staff in order to provide more advanced medical services in the electronic home, when necessary.

Related issues about the structure of the medical system, and the roles and skills of medical staff are discussed in the Chapter on 'Health professionals'. Since the above concern telemedicine applications, broader telehealth applications are discussed in the Section on 'CAS'.

5.1.2.6 Costs of telehealth

Cost-benefit, or cost-effectiveness methods (Phelps and Mushlin, 1991 for their mathematical equivalence; Drummond, 1990, and Luce and Elixhauser, 1990, for applications; Le Gales and Moatti, 1990, and Weinstein, 1990 for critical assessment) are used extensively in conventional technology assessment. Knowing their limitations (since they ignore various important factors), it is possible to use some of the related estimates within the broader assessment framework. Many of the applications discussed in the present Report are either not widely used, or in the process of development and/or experimentation, and thus detailed cost estimates are difficult to establish. Discussion here draws on a sample of existing applications. In order to avoid invalid generalizations, one should take into account several cost-determining factors: experimental applications have generally higher costs due to organizational and technical reasons; applications involving networks are subject to changes in the structure of network charging schemes and are not easily subject to time-adjustments such as discounting; equipment used could be special-purpose at the time of the application, only to become widely available later (e.g., facsimile copiers, or video players).

A survey (Maguire and D'Arcy, 1988) of the Drug Information Services in four major British cities (London, Cardiff, Belfast and Edinburgh) has shown that the cost of answering an enquiry varied between pounds 5.36 and pounds 10.80.

The VD hotline, started in 1973, in the Monmouth Medical Center, Long Branch, NJ, was evaluated by Bryant et al (1976). The cost per call was estimated at $14.70 (1973 prices).

The costs of an IATV application in telemedicine have been estimated by Muller et al (1977). Their study concerned a paediatric primary care unit staffed by nurse practitioners linked to a remote physician consultant, using a five-satellite system; the application was successful. The cost was $18.50 per hour, of which $5.30 was the cost of using the IATV system; this cost was found to be 2/3 of the cost of a physician providing direct care. Further, if IATV costs are compared to the cost of transporting a patient to a central place "the implicit value of transport time and disutility required to justify using IATV is $7.55 per consult in a five-clinic network". Certainly, geographic and other barriers to physician availability add to the advantages of telemedicine.

Reduction in costs are reported also by Watson (1989) in an application in Queensland, which involved primary health-care teams in remote areas, linked with their base hospital, regional hospitals, a teaching hospital and an aerial retrieval team by means of AUSSAT 1. Similar conclusions were reached by Hastings, et al (1976) for an IATV application in a prison; as high as 45% of the patients who might otherwise have been referred to the sick call physician of the backup hospital, were managed on site by one of the nonphysician staff. Fewer immediate referrals are reported for IATV consultations than for those over the phone by Moore et al (1975).

Psychiatric applications of information technologies are also reported as cost-efficient. Shuman's (1976) review of computer tests in psychiatric diagnoses in the Salt Lake City Veterans Administration Hospital in Utah, USA, is an example. Although this report concerned an in-hospital service, newer developments in telematics since then make his conclusions relevant for remote applications. The computerized tests took 5 hours and cost $120 per patient, compared to the 5 days and $500 of the conventional procedures (1976 prices). Because results were produced fast, only 45% of the people examined were hospitalized, compared with the previous 75%; this was not only more cost effective but had clear overall positive social effects since less people were "labelled" as 'mental patients', only to be released after completion of diagnosis. (It is notable that computerised tests were also more accurate and more preferable by patients in most cases.)

Computerised clinical audit systems also reduce costs. Thomas et al (1983) compared computerised with conventional audit systems and found that physicians responded to the automatic audit at a rate of 50.2%, while in the conventional at 37.3%, with an associated reduction in costs of hospitalization by one-third.

McAdam et al (1990), reviewing 12 years of experience with computer-aided diagnosis in Airedale DGH, UK, report 15% saving in surgical bednights with a notional cost of 120,000 pounds.

Personal alert systems reduce various health care costs. Fewer admissions and stays in hospitals and less home nursing (1 day compared to 13 by non-users) is one category of costs. When combined with a mobile health care service (as in Denmark), annual costs per patient are near 70% of the cost of nursing care; US estimates show that for every $1 spent on such systems, $7.19 is saved on long term care (Dibner, 1990; Cullen and Moran, 1992).

It should be noted here that assessment of the cost of a new telehealth technology should include also the cost of the assessment itself (Borchgrevink and Bruusgaard, 1981); this information is not reported usually.

Costs of specific applications may appear high. However, as more such services would become available, it is possible to provide several services jointly; for instance, this could be applied in the case of telephone hotlines (Bryant, et al, 1976). Overall costs will then tend to decrease due to 'economies of scale' and 'external economies'.

Other health care costs could also be reduced through the use of computerised records and patient data cards. An example is the costs of managing reimbursement.

Would ease of access and availability of telehealth services create higher consumption and thus increase costs? The so-called 'Parkinson's Law' would suggest that demand would expand to cover available supply. Only 'ex post' studies could establish the amount of increase in consumption. Nevertheless, evidence from existing applications is relevant. For instance, experience from the North East Deputising Service in Glasgow suggests that 23% of calls were considered 'unnecessary', while the rest were 'reasonable' (65%) and 'genuine emergencies' (12%). Such percentages could be judged as favourable. Further, it could be expected that unreasonable use would tend to decrease as people will be becoming more acquainted with such services.

The above concern the supply costs of NAS telemedicine and telehealth services. The costs of accessing these services from the home involves several electronic devices. The costs of emerging HAS devices are difficult to establish now; an indication could be provided by prices of PC-interfaced pulse measuring devices currently marketed, which range between $300-400. Experience shows that ongoing advances in microelectronics reduce constantly the costs of such devices, especially when they are produced in large scale; the prices of PCs is an example in case. Network terminating devices include apparatuses already available in the home, such as the telephone and the television; suitable low-cost interfaces can be used in

order to access videotex and teletext systems. Ruf (1992) provides data on alternative scenarios for the availability and distribution of such systems.

A major question is who and how shall pay for all associated costs. Devices and associated operating costs may be covered through the reimbursement schemes of each country. However, many home devices involved in telemedicine and telehealth are not dedicated to medical use only (see next Section).

Can telematics eventually reduce the costs of health care? All related small and large scale programs, including the EC AIM, are justified on the ground that overall costs will drop. Milio (1986), however, argues that overall health expenditures will not be contained but it is likely to accelerate.

5.1.2.7 Insurance and reimbursement issues

Telehealth charges should be viewed according to the technological elements involved. Two main cost aspects could be distinguished:

. HAS devices
. NAS services.

Reimbursement for HAS devices is a complex issue and many variations are observed between countries; also in some countries reimbursement for various assistive devices, in particular, is oriented towards the return to work situation. Variations are reported also in the per capita national expenditures on assistive devices, ranging from $0.6 in Japan to $30 in the Nordic countries; and in the relative public investment in R&D in various health areas: in the USA, for instance, in the early 1980s they varied from $220 per cancer patient, to $76 per cardiovascular patient, to 50 cents per visually handicapped (Cullen and Moran, 1992).

Further, accessibility of information on related devices, distributors, as well as support and maintenance should be considered as relevant issues; all these incur expenses which should be taken into account by reimbursement policies.

Some structural limitations of reimbursement policies are relevant in this respect. For instance, Cullen and Moran (1992) report research which identified the following barriers in eleven European countries: more favourable reimbursement attitudes towards older technologies, negative financial incentives for medical professionals, the existing medical-legal framework, and an active pro-institutional provider system.

HAS devices could be either purchased by the patient or supplied after the prescription through a national health system. This applies to chronic illness devices, or to the ones used for

normal medical tests, which could be available in the home for the family. They could also be rented, or provided for a certain period, in non-chronic cases. A complication to this is that a number of telehealth-related HAS devices (e.g., phone, TV, PC, modem, fax, etc.) can be used for non-telehealth purposes and it is difficult to discriminate between the various uses.

Related problems arise when networks are involved, either for the interconnection of HAS devices to a central medical unit, or for the provision of other NAS services. Here reimbursement policies should take into account the various aspects of NAS services, as well as that many related networks and services can be used for various purposes, including leisure and telework; the question is whether and in what way related costs could be split between the home user and the health system. Experimental and pilot applications usually do not consider such issues since emphasis is been put on development and trial utilization of the system and/or service.

The following three aspects of NAS services should be considered. First, the medium of communication; this has to be available, or to be supplied for the purpose of telemedicine and telehealth applications. Second, the network interfacing devices (DCEs, such as the modem) and the network access equipment (DTEs, such as a terminal or personal computer). Third, network access costs, the charging schemes of which vary according to the type of network. For instance, PSTNs charge according to time and distance; PSDNs charge according to volume of data and time, irrespective of distance; IATV networks may charge subscription fees, or according to time. Fourth, charging may also depend on the type of service, which could be rated according to the specialist health service provided.

A variety of pay schemes can be envisaged, including fee schedules, cost-based reimbursement, prospective payment and diagnosis related groups, payment for 'packages' of services, etc. (e.g., OTA, 1985b, 1986c). IT applications in health provision would probably require new remuneration policies for medical services rendered available through various telecommunications links.

However, evidence from existing health care systems indicates that possible flexible pay schemes are not necessarily the most cost-effective ones. For instance, OTA (1985a) reports that the Canadian system, which is a federal-provincial system of universal and comprehensive public reimbursement for the costs of hospitals and medical care of the whole population, provides services at a cost which is substantially lower than that in most other developed countries and in particular much lower than that in the United States.

Insurance schemes and pay modes vary according to the country, as the following table shows:

Insurance schemes in various countries

Country	Financing System	Physician payment
Austria	S.I.	FFS
Belgium	S.I.	FFS
France	S.I.	FFS
Germany	S.I.	FFS
Greece	S.I.	Sa/FFS
The Netherlands	S.I.	Ca
Switzerland	S.I.	FFS
Spain	S.I.	Sa/Ca
Italy	C.T.	Ca
Portugal	C.T.	Sa
UK	C.T.	Ca/FFS
Denmark	R.T.	Ca/FFS
Finland	R.T.	Sa/FFS
Sweden	R.T.	Sa

S.I. Social Insurance
C.T. Central Taxation
R.T. Regional Taxation
FFS Fee-for-Service: physicians receive a fee for specific service
Ca Capitation: physicians receive a fixed amount per patient
Sa Salary: physicians receive a salary.

(Source: Gervas, 1991; added data for Greece by author)

5.2 Health promotion and total health environment

5.2.1 Health information and health education

Health education is increasingly becoming a major aspect of health promotion and concerns the public at large, patients, as well as the professionals.

For the public and the 'normal healthy citizen', health education is being recognised as a strategic aspect of health promotion. As AIM (1991-Workplan) stresses:

"Knowledge about hygiene has been as effective in promoting health as almost any advances in diagnosis and treatment, and it can be assumed that the same will apply in the future - to give a topical and important example, in the prevention of AIDS."(p. 26).

Also the Strategic Plan of the Health Education Authority in UK states its objective as follows:

"To ensure that by the year 2000 the people of England are more knowledgeable, better motivated, and more able to acquire and maintain good health." (Hagard, et al, 1991).

Health education programs address issues such as coronary heart disease, cancer, smoking, alcohol, nutrition and dietary habits, and family and child health. Use of tranquillizers, a popular 'remedy' for various psychological problems, should also find a prominent place in such programs, due to large scale population dependence and lack of positive effects (e.g., Gabe and Bury, 1991).

From a social point of view, low socioeconomic groups need more health information (Milio, 1990) and special programs should be prepared for them.

Broadcast information systems can transmit health information to the general public. The radio, TV and the Press are used already. Health intervention programs of this type may transmit short health-related messages and/or take the form of campaigns addressing the entire audience, concerning issues such as AIDS, hysterectomy, risk factors such as smoking, drinking, drugs, as well as dietary habits. Children home safety, including the electronic home, could also be improved through media campaigns (Colver et al, 1982).

The use of media for such purposes should be evaluated, using various available methods (e.g., Salmon and Jason, 1991). Overall, these intervention programs are successful (Wewers et al 1991; Milio, 1990, 1991; Sogaard and Fonnebo, 1991; Beck et al 1990; Domenighetti et al 1988; McCluney, 1988). Nongovernmental action is desirable to this end (Kunze, 1990). An example is outcomes of a media campaign concerning hysterectomy in a region,

compared with those of a region where no campaign was made. In the first region the annual rate of operations per 100,000 women dropped by 25.8% (33.2 for women aged 35-49), while in the second they increased by 1% (Domenighetti et al 1988). Such results show the potential of health information programs. Hearing impairment is also a type of illness which could be prevented or deterred by early referral and treatment; health education can play a vital role (Brooks, 1984).

It is essential to estimate the relative balance of influence of the various media, in order to choose the most appropriate for diffusing health information. For instance, Stroman and Seltzer (1989) report that newspaper reliant people tend to be more knowledgeable about AIDS than those who are TV reliant, and also express different attitudes towards AIDS policy issues. Newspapers are also considered as a more promising medium for health information dissemination in an ethnic population, compared with the radio and the TV; however, the primary source of health information for this population were relatives and friends (Hsia, 1987). It follows that careful selection of appropriate media is an essential social aspect of telehealth programs. Further research is required in order to estimate the comparative influence of the various telematics information dissemination systems.

The impact of broadcast media on health should not be assessed only in relation with outspoken messages and explicit campaigns. The portrayal of 'healthy' behaviour, as well as of illness and health care is also a major issue. Turow and Coe (1985) made an interesting research on the portrayal of health care in TV programs. They found that within two weeks only, 723 interactions involving ill persons appeared on the programs of the three major US networks. An overall 'image' of health care was implicit which presented illness as acute and amenable to biomedical treatment; the hospital was the dominant location for the professional treatment of illness; the physician and the nurse were the most often appearing health professionals, while allied health professionals were sparsely and indistinctly represented; medical care was portrayed as an appropriate, nonpolitical and unlimited resource; further, only 78% of biomedical orders and/or tasks presented were clearly correct. More research would be useful in this direction in order to establish the extent and the impact of this type of indirect health information, which influences lifestyles and health-related behaviour.

Nevertheless, it is evident that this portrayal of health care is very conservative and limited, and contradicts directly the diffusion of total health concepts, promoted by institutions such as the World Health Organization. These do not provide a positive background for the emerging telehealth services and may indicate that institutionalised medical care has established itself into society in a way that bounds health care within very narrow confines. Even failed mass 'therapeutic' methods, such as the tranquillizers (e.g., Gabe and Bury, 199I), are not only

prescribed by doctors but also portrayed in the mass media. Clearly, telehealth information and education should not follow this path; along with changes required in various fronts, the portrayal of health care in influential public media should be probably one of the first to be remodelled.

Other technologies could be used for the dissemination of health information. AIDLINE is a voice mail application which uses audiotext technology in order to provide information on assistive devices and procedures, government rehabilitation programs and other helpful information to the disabled; its advantage is that it requires only a telephone to access it (Blackshear, et al, 1987). The Berks Community IATV service in the US provides also information as well as contact to elderly people; the network is run by the people themselves (Burns, 1988). Another type of service is the AMS in Tokyo which provides on-line informational and educational data for people interested in the medical field (AIM 20.7.90).

For the patient, health education is important for home and self care, including monitoring, treatment, rehabilitation, chronic illness, as well as for the handicapped and elder persons.

Health education can be provided through various information channels, such as audio, video, satellite, teleconference, etc. Existing applications show favourable results. For instance, House and Keough (1989) discuss the experience of the Memorial University of Newfoundland, Canada. This service runs since the late 1970s. Other related services in Canada include Telemedicine Quebec, Telemedicine Ontario and Telemedicine Senegal (Mukhedkar and Hoyle, 1987). Pawlicki (1983) evaluates oncological telephone information services in Poland.

Multimedia systems is an emerging technology which is very promising for health education purposes, both in the stand-alone and/or network-access modes, taking advantage of their integrated image/text facilities (e.g., Polese and Ravaglia, 1990; Cappellini, 1991).

Further advantages would be provided by developments in expert systems, using friendly and attractive interfaces. Such systems could be used by chronically ill and severely handicapped patients (e.g., AIM, 7.5.1990).

Health education, however, in order to be successful, should take into account several social and cultural aspects. Access to the information transmission system should be examined: often these systems do not cover the areas and/or groups which most need it; sometimes special networks should be used, such as satellite networks for remote areas. The proper medium should be chosen in order to reach the specified "target group". Language barriers should be overcome in order to extend the range of health education. In many cases it may be needed for the same topic to prepare different educational programs for different groups,

since the concept of the 'normal healthy person' may prove to be too broad, or even misleading. The experience of educational systems such as the Open University and development under the EC DELTA Program are relevant.

Health education programs should not necessarily aim for the 'hi-tec' solution. The capabilities of more conventional technologies, such as the telephone or the TV, have not been explored fully, although related programs were made already in the 1960s (e.g., Smith and Smith, 1969).

'Hi-tec' information technology could assist the preparation of health education programs, even of 'low-tec' type. Advanced technologies such as the multimedia and hypermedia could be used to this end. Of particular interest in this respect are a number of emerging technologies (MediaLab, 1990). 'Micro-movies' can provide multiple small moving images in window systems. 'Desktop movies' could make possible the creation of movies automatically from an ensemble of archetypal images, including actors and backgrounds, under control by a computer process. 'Paperback movies' can make movies available in CD form. 'Open Architecture TV' can intermix and display images from various media. Advances in holography would also make possible holographic video.

5.2.2 Decision making skills and coping

As was seen in Section on 'Self care', telemedicine applications can help the home patient develop self-care capabilities and skills, and practice preventive medicine. All these derive from the conventional conceptualization disease-orientated care, which includes disease prevention. When the total health environment (THE) is taken into account, it can be seen that telehealth systems can contribute in a much broader sense. Some examples are given here.

Comprehensibility and coherence are strong health determinants (e.g., Antonovsky, 1984). Hypermedia and expert systems could assist various groups in order to make 'cognitive sense' of the various stimuli confronted in the THE. Further, they could support life-decisions and advise on how to 'cope' with circumstances. Positive experience is already available from the development of educational media; negative experience is provided by the limited diffusion of computerised instruction.

Job-selection and job-seeking strategies are becoming major issues in view of increasing unemployment. Expert systems accessible from the home could assist persons in identifying types of jobs which fit their qualifications, using human-machine dialogues, and/or suggest possible developments of skills. Following this, the service could suggest appropriate job-seeking strategies. Further, the service could be linked with data bases of jobs available and provide user-friendly search interfaces as well as facilities for putting through applications.

Coping with personal, social or broader environmental problems could be supported by expert systems. Such systems could use human-machine dialogues in order to infer the type of problem and its background in the knowledge-attitude-behaviour chain ('problem definition'), to assist in raising consciousness and to proceed with suggestions in terms of decision-making and alternative courses of action, including even 'simple' things such as arrangements in the (electronic) home itself.

Expert systems and hypermedia could also assist individuals in developing communication skills, for instance through techniques of gaming-simulation/role-playing. Related experience could be transferred from existing computerised games as well as from various courses (e.g., by the Open University).

These systems could provide facilities for the establishment of computerised social networks through communication media such as the electronic mail; the COST Task on "Services and Applications for Public and Community Services" addresses related issues.

The technology needed for the development of related services is already available. R&D is required in order to develop the application software, including a management system easy to run by interested social groups.

5.2.3 CAS, the Community Access System: Home-centred community telehealth systems

Community health promotion projects should be seen as including a variety of applications.

Broadcasting media already support telehealth community intervention projects concerning issues such as antismoking, AIDS prevention, drinking, oral disease prevention, dietary modifications to avoid cardiac problems, etc., which address the "general public".

Such projects generally exert influence, although as Mackay and Davies (1991) observed, few have undergone specific evaluation. This is surprising because on the one hand such programs are rather costly, on the other, as the authors note, evaluation need not be elaborate, expensive, or overly time-consuming. For instance, antismoking interventions could be evaluated using data on tobacco trade, taxation, mortality and morbidity, and published data from tobacco companies; they also suggest indirect evaluation through the reactions of tobacco industries.

Other projects address specific communities such as ethnic and minority groups. These cover a variety of applications, including telephone information services and telephone hotlines, which are discussed in other sections.

New telematics services are opening up opportunities for many new varieties of community telehealth projects, which can address specific groups of the community. Videophones, CATV and IATV, videoconferencing, electronic mail, etc., can be used by special groups, such as patients of a specific illness (cancer, AIDS, etc.), handicapped, elderly, etc., in order to exchange experiences, provide mutual support, as well as medical information; an example is the Berks Community IATV service in the US, which is run by elderly people (Burns, 1988). Various other communities could run themselves such services, involving also central medical advice. Further, services which use special interfaces (discussed previously) could be provided, for instance to people with visual, auditory, etc., impairment; these could operate for a "closed user group", if interfaces are not available for communication with users of conventional telephone equipment.

Community projects could also aim to promote a comprehensive view of health. For instance, programs and technologies could be employed in order to train handicapped people to do a job at home. Various networks (CATV/IATV, videophone, electronic mail) accessible from the electronic home could be established in order to promote social interaction and 'healthy lifestyles', to create the feeling of 'belonging', and to advance 'well-being' and 'wellness'. Conceptual approaches and emotional support promoting 'coping' could be provided through such systems. Target groups in case include the handicapped, the elderly, unemployed, special categories of young people (unemployed, parentless, etc.), victims of AIDS, etc. Nongovernmental action should be developed to this end (e.g., Kunze, 1990). Concerning preferences of the elderly, Straka et al (1988b) report field research on CATV programs. Findings indicate that greater importance is attached to types of broadcasting which offer possibilities of active participation, and to a form of presentation which creates social nearness; preferred programs include local news and contemporary history.

Such systems are within the immediate technological possibilities and do not require sophisticated telemedicine equipment. They demand comparatively limited resources, but they could contribute greatly to the broad concept of health promotion and well-being, as defined previously. It is notable however that such projects are under-represented in research programs. This probably reveals a bias of these research programs towards the conventional model of medicine, despite the seemingly general agreement on the comprehensive health concept. This bias seems to be so strong as to constrain technological applications which could enhance the scope of "advanced informatics" applications in medicine and contribute to the general well-being of the community.

New research projects are needed which would aim to develop easy to use and to manage community telehealth systems. For instance, Paegle, et al (1982) have reported the "mechanics" of producing

health education series via CATV for a local community, as well as a subscriber survey of preferences for topics. More such "guides" are needed, along with other types of technical information such as criteria for selecting appropriate technologies. The cost of such research projects appears to be a small proportion of the funds spent in "big science" (and big industry) telemedicine systems, while the benefits would be at least of equal importance.

The broad concept of 'primary health care' could be also advanced greatly through community health projects. A number of them do not involve information technology: nutrition and sanitation, for instance require improvements in the income of people. Other factors such as safe water and environmental control could, at least, be monitored through suitable informatics systems, both in the local area and inside the home, through the use of monitoring devices. Family planning could benefit from community information projects, entering the home through the various available media. Medication, provided sufficient pharmaceuticals are available, could be administered through home information systems. Various applications could also improve maternal and child care. Most physical parameters of the 'THE', the Total Health Environment, could be monitored and/or controlled through applications of suitable environmental monitoring telemetry systems.

Community projects could involve electronic home alert devices, in order to reduce the strain of frail persons. These could include security and fire systems and alarms; 'push button' alert systems; passive alarms which monitor daily activities and are activated when an unusual event occurs (e.g., an appliance or light not switched on for a certain time); and special alert systems for 'wanderers' (e.g., Alzheimer disease patients). All these systems aim to call automatically a concerned central unit (medical or other) and transmit the call and the identifier of the caller. The unit then can use a computerised system in order to select appropriate action. Variants of such systems are already in operation in many countries. Although they are rather easy to install and run, diffusion is limited: only 1% of persons over 65 in the USA and Canada have them; when used, admissions to, and stays in hospitals are fewer; home nursing is lower; and overall costs are lower (e.g., Dibner, 1990; Cullen and Moran, 1992).

Computerised systems can assist in raising the consciousness both of the community and the individuals with respect to the THE. Expert systems could support communities in identifying those variables in the THE which affect most their overall health. Selection of possible courses of action could be assisted by IT; perhaps a new variety of such systems could be called Community Health Decision Support Systems (CH-DSS), which would take advantage of technological developments in the area of DSS. Computer simulations could show the dynamics of THE parameters, in order to provide a view of possible scenarios under existing constraints, and/or explore alternative community health

futures. Health agencies should aim to develop and make available such computerised models to the community. These models should be capable of responding to the variety of value systems operating withing the community, as the 'law of requisite variety' discussed in Chapter on 'Technology Assessment' would specify. Alternatively, health advocacy scientists could produce such computerised models as part of their contribution and in order to support advocacy actions. Related research in other fields has made available at least two alternative computer models (Herrera et al, 1976; Veneris, 1984, 1990). Computerised educational ecological games provide also a related background. This experience along with the wide availability of powerful personal computers could produce socially useful results.

Total Health Environment interest and action groups can be formed through the use of such systems. They can use expert systems in order to identify problems. Electronic mail and especially computer conferences could be used in order to establish 'e-mail groups', that is electronic communities of interest. Computerised formal methods for consensus-reaching and value systems analysis, (such as meta-analysis and the ReD, respectively; see Chapter on 'Technology Assessment') could be employed in order for such groups to bring their views to the level of an alternative proposal. Through teleconferencing systems, these groups could also seek expert advice on selected matters.

5.3 Health professionals, telemedicine, telehealth

5.3.1 New roles, new skills

Telemedicine and telehealth would eventually transform the roles of the medical professionals. A general trend has been identified, according to which junior medical personnel (nurse practitioners, physician assistants, certified midwives) are increasingly involved in the provision of primary health care; this is paralleled by a decrease of the proportion of physicians practising in primary-care specialities (e.g., OTA, 1986a).

Furthermore, a number of studies have indicated that the roles of medical personnel tend to change when telemedicine systems are being utilized. Higgins et al (1984) review what they are calling "the provider acceptance of telemedicine systems" in the case of an IATV application for the rural residents in the Sioux Lookout Zone, Ontario. This application, started as early as in 1977, involved the use of low-scan video, which connected the local health facilities to remote medical expertise. The system attributed new roles to the nurses, who were more positive than physicians towards the system. This was due to the physicians' having had more extensive training than the nurses, and thus not feeling the same need for medical backup and support.

Other applications also emphasize the change in roles. Cunnigham et al (1978) review an off-site paediatric consultation scheme via IATV which was established to provide backup for nurse practitioners in treating sick and well children in a small primary-care clinic. This system also upgraded the role of nurses, who became capable of functioning without on-site physician 40% of the time. Fuchs (1979) reports the experience with STARPAHC, which involved space technology applied to a telehealth application in the rural Papago Indian Reservation, in Tucson, Arizona. A mobile health unit was used, linked with IATV, radio and telemetry systems to remote hospital. The unit was staffed by non-MD personnel who through the support of the system could provide adequate medical services and considered thus the system to be a major benefit. MD personnel however considered the system inconvenient because consultations were judged as lengthy, although they appreciated the obvious fact that the system made possible health provision in a previously medically unserved area. District nurses provide upgraded services in Swedish telephone advisory services, providing telephone consultations, home visits and clinic services. Nurses assisted by a computer system were also successful in care planning (Norris et al 1990). Hastings et al (1976) evaluate a project of the University of Miami, USA, which involved an IATV application in a prison health system. The system gave a new role to nonphysician staff: 45% of patients who might otherwise have been referred to the physician were managed on site by nonphysician staff. Computer-aided diagnosis was found also to improve the diagnostic accuracy of junior medical staff by 10-15% (McAdam et al 1990).

A dissenting view is reported by Cayten et al (1984). A cardiac telemetry application aiming to provide life-support prehospital emergency care in Philadelphia, USA, was not found to affect the ability of 'paramedics' to interpret ECGs in either test or field situations, and that "not a single life" was saved by them despite the telemetry system. Such negative results show that each particular telemedicine application should take always into account the limitations of staff and personnel, and define the precise services that the various levels of medical professionals can provide.

New roles for nonMDs are also envisaged under the AIM Project. For instance AIM (7.5.1990) states: "Many situations do not need to be dealt with by the highly specialized staff and technology available at a hospital. A nurse-practitioner, a registered nurse or, even, a well trained aid could assist the patient in solving his or her problem" (p. 9). Further, Milio (1989) argues that the emerging new role of the nurses should become an aspect of public health policy.

Professionals who monitor home patients remotely should develop new skills. They should learn to operate telematics systems and develop a good understanding of related technologies. They should be able to retrieve, examine and analyse collected data, judge for possible measurement or other data errors, supply information to patients concerning the use of such systems, identify potential errors during the utilization of the remote monitoring devices and provide first level advice, as well as to be capable of describing related problems to telemedicine system support staff for further corrective actions.

Communication with remote patients requires development of new communication skills. Many such services would address the general public and an obvious issue is language problems. As developed countries tend to become more multinational, and as some systems may aim to function on a virtually international scale, language problems shall become critical.

Medical terminology is a problem even between professionals and standardization is attempted by methods such as the ICPC (International Classification of Primary Care), ICD-9-CM and the ICD-10-CM (International Classification of Diseases, Clinical Modification codes; Iezzoni, 1990 for critical evaluation), and the James Read coding system used mostly in the UK; related research is undertaken also under AIM.

The problem is more complex in the case of professional-to-lay person communication. Here it is not only that the patient may not be proficient in the national language spoken by the service providers, but also that he/she should have to give a rather accurate medical description. And since this problem cannot be dealt with, such systems would aim to solve the dual problem: how the professionals who run the system would develop the skills to elicit the necessary information from the caller. Various methods

could be used in this respect (e.g., meta-analysis; see also Maynard, 1991 for review and discussion). Computerised aid could be also provided, both for training and for on-line support.

Even more difficult, and probably more serious is the cultural problem in such a communication. A professional operator of a health information system would have to communicate with people belonging to different ethnic groups, whose culture in general and with particular reference to medicine, would probably be radically different from his/hers own. For instance, Quesada (1976) studied and proposed a theoretical explanation for problems involved in the communication of health providers and a group of impoverished Mexican Americans. It was found that perceptions, family relations, norms, social structures, as well as more abstract concepts such as the "cosmology of destiny", or "dependency dignidad" set real barriers in communication. Such perplexed communication problems are also reported (Harwood, 1977) in psychiatric therapy for Puerto Rican ethnics, who follow religious "spiritism". It is questionable whether any technical or educational factors would remove such cultural barriers and thus special communication skills would be required if telehealth systems are to address multinational audiences. Further, this would eventually lead to culture-specific applications.

The anonymity, at least in the first moment, of this type of communication does not pose a problem for the caller only. Professionals who respond to the call should also develop special skills in order to be able to encourage the unknown caller. Here the experience of systems already available, some of them for quite some time, becomes relevant. In Italy SIP, the public PTT, provides since 1982 medical information to callers. The fact that such a service is provided within a large bureaucratic nonmedical organization is a problem in its own. Arcuri (1989) investigated the behaviour both of the group of professionals of the medical information service and of the people who deal with this service on behalf of the PTT. It was found that in order for the mission of the service to be fulfilled it took a very united group, with anticonformist approaches, mental flexibility, informality, ability to fantasize, and willingness to run risks. Such a mix of skills is certainly difficult to teach and establish.

The experience of providers of "hotline" phone services is also relevant; specialized training seems to be a requirement in most cases (e.g., Pierce and Peirce, 1985, for sexual abuse hotlines; Diseker et al, 1980, for Tel-Med; Bryant et al, 1976, for VD hotline).

Communication problems would probably become more complex in IATV or videophone applications. Telephone involves only voice communication and allows for anonymity. Videophone, even if the name of the caller is not revealed, would reduce this anonymity factor. This would make the call more "personal" eventually, but

at least initially it would increase reluctancy to call the service. It follows that service providers should be trained to develop the skills necessary for audio-visual communication.

Professionals who handle emergency telemedicine applications, should be trained to undertake a number of emergency actions over the available telematics services. Many such applications would put the demand on the central medical staff to deal with a number of cases, probably simultaneously, some of them of an emergency status. This would create the demand for persons with special skills, capable to act positively under the stress created in such environments. Although most medical professionals would consider emergency situations as part of their ordinary job, telehealth systems involve technologies and actions which would inevitably require familiarisation. Here experience from other telematics systems which serve emergency or near-emergency situations should be taken into account. Also, new job-related health problems would arise, such as the usual problems resulting from working with VDUs.

Maxmen (1976), is one of the authors who have suggested that a new type of medical personnel is emerging, who would be trained to function under telehealth systems (see also next Section). According to his view, emphasis on their skills should not be towards the basic understanding of health and disease concepts, but, rather, in the direction of developing interpersonal communication skills; sensitivity and tolerance during communication with people suffering physical and emotional disorders; sufficient level of understanding of computer interfaces and the technology of supportive care; as well as operational knowledge of psychology of illness, family dynamics, group processes, medical sociology, medical terminology, medical ethics and patient administration.

The curricula of medical educational institutions should also change along these lines, to include subjects such as large medical data bases, knowledge bases and expert systems, data analysis and problem solving techniques, as well as basic knowledge of telematics technologies. On-job training and continuous education schemes should be envisaged.

What would probably have to change is the very definition of what is a 'health professional'. Telehealth services could bring together many other professionals, as well as non-professionals, aiming to make each individual an 'expert' in matters concerning his/hers personal health and well-being. Large amounts of health-related information should be de-institutionalized and de-compartmentalized in order to diffuse to the general public, aided by adequate computerised services and social support (tele)networks. Trends in interdisciplinary science (e.g., Veneris 1984) show that this is not a requirement for the expert-to-public interaction but also for the expert-to-expert communication.

Throughout these changes one could see a transfer of skills in the human-machine interaction process. Medical skills are transferred into technical systems, which are then used either by lower level medical personnel, and/or by the individuals directly. This trend agrees with the overall process of 'mechanization', or services-to-goods, discussed in the introductory Chapter. Knowledge and skills are 'removed' from people in order to be 'objectified' into the machine, which in turn can replace people in their previous roles. A primitive reaction to this was 'ludditism'. Cooley (1988) provides a broader conceptualization of the problem, according to which these trends represent a process of "deskilling" and "knowledge obsolescence"; expansion of taylorism into the intellectual sphere; loss of job security; subordination of the human to the machine and its work tempo, which increases alienation in work and causes loss of control of the work environment; increased physical and mental stress; and domination of the subjective value judgements by the 'objective' decisions of the system.

'Mechanization' in all sectors of the economy has resulted in work restructuring and job displacement. Technology forecasts should inform related research, which can now draw on the effects of new technologies in other sectors of the economy. At least some parts of the medical care system, such as administration, present valid analogies with managerial functions (the 'secondary information sector'; Veneris, 1984, 1986) in other sectors, while 'thinking by analogy' could be applied in other aspects.

5.3.2 Levels of medical care

The traditional hierarchy in the medical profession had physicians in the main role, while nurses and related staff, the nonMDs played an auxiliary role. Telemedicine and telehealth applications and the associated new roles and skills discussed already indicate that this hierarchy is in a process of transformation. In many applications, remote health care is, or is intended to be, provided by nonMD personnel, while MD personnel is located in a central health institution. However, with present education and training patterns neither the former nor the latter appear prepared to function in the emerging framework of telehealth. NonMD staff are found by some studies to be more enthusiastic about the new situation, while MD personnel sometimes see these trends as a challenge to their authority both within the medical hierarchy and with respect to the patient.

Several authors have addressed these issues. An early report by Park and Bashshur (1975) identified a transformation in the levels of medical personnel in telehealth systems. They stated that the absolute authority of the physician in medical work tends to be replaced by a senior role in a "health team". Two more broad-scope approaches shall be discussed here. Lesse (1978) saw a double shift occurring in the era of telemedicine. First,

medicine should reject the disease-oriented approach, which waits for the patient to become ill in order to administer therapeutic procedures directed at abnormal behaviour or syndromes. This is seen as anachronistic, inefficient and costly, continuing a primitive concept concerning the causes of illness. Further, medical education encourages students to specialize early in their studies, thus eliminating the traditional practice of educating the young physician to be a generalist before he/she becomes a specialist. Medical sciences should be superseded eventually by health sciences.

Second, Lesse (1978) envisages two new types of health scientists, namely the medical academicians (MAs) and the medical technical experts (MTEs). The MAs are trained in the understanding, expansion and pragmatic application of a comprehensive approach to the human being, and shall be the teachers, leaders and programmers of the medical profession. The MTEs shall be trained to function in conjunction with sophisticated health and telehealth informatics systems. The "MTE-computer combination" would take over many tasks performed by today's highly skilled physicians, including most routine diagnoses and therapies. They would be highly trained to undertake very specific and limited tasks. Only cases which are "obscure" or "refractory to treatment" would be referred to higher medical levels. A major function of MTEs is to apply "prophylactic" health services, aiming to prevent latent illness to become overt.

These changes shall be reflected also in a new hierarchy of health science institutions: district general medical clinics would supplant the general practitioner as well as in most cases the current types of medical specialists; these clinics shall be structured around the MTE-computer team. Regional speciality centres, headed by MAs would deal with more complex cases, while other centres may deal with long-term treatment and serve as research and training institutes. A related hierarchical structure is proposed by Allan (1976).

Maxmen (1976) also proposed a new level of medical personnel, the "medics" who are trained to operate in cooperation with information systems; this definition is close to that of the MTE, above. He makes particular reference to videophones, IATV, home computer systems and sensing/monitoring home devices (referring also to the then expensive such device developed by the Boeing Company). He suggested that training of a "medic" would take 12-18 months, compared to the 8 years of the modern doctor. Maxmen further quotes reports which suggest that "nonphysicians" assumed primary clinical responsibilities which was accepted by patients.

What these authors saw in the 1970s as futuristic is now becoming increasingly relevant. A multi-level structure for health care and personnel is also envisaged in related research under the AIM Project. For instance, Venters (1990) defines the following levels of care:

. Home
. GP/Community Clinic
. Low technology "cottage" hospital
. District General Hospital
. Regional Reference Centre.

It is instructive to view these in conjunction with the medical care systems in Europe. Primary Health Care (PHC) has been established in many European countries (e.g., Denmark, Holland, Sweden, UK), or attempted, as in Greece. Generally, it is provided by one or more GPs, nurses and nurse assistants, who provide health care to people living in a defined area, and comprises medical treatment, preventive care as well as home visits; maternity, paediatric care as well as care for the elderly are often included in the list of responsibilities.

Various IT technologies aim to support PHC, including telematics access to medical records and to higher level health care institutions; a number of such systems have been successful (e.g., medical records, appointment scheduling, history taking), while some other have not survived in the market (e.g., bar coding for finding medical records and light pens for sending drugs prescriptions to the pharmacy; Malmberg, 1991). Since PHC aims to relieve hospitals from certain of their functions, information technologies will be used increasingly, in order to link the patients with the PHC, as well as the PHC with the other levels of health care. The PHC medical staff would have to be educated and continuously trained to use related systems.

General Practitioners play an important role as 'gatekeepers' in the health care systems of many European countries (e.g., Denmark, Ireland, Luxembourg, The Netherlands, Portugal, Spain and the UK). Computer links between them (working in teams, or 'solo') and the other areas of the health care system is a viable policy (e.g., Teschke, 1991; Souhrada, 1990; Gervas, 1991) which could upgrade their services and improve coordination with hospitals, pharmacists, etc.

However, IT is only one of the factors affecting PHC. A general problem is the small percentage of doctors functioning as GPs; an approximate figure is 15% (Malmberg, 1991). Furthermore, GP involvement in home care is declining over the past 50 years despite the growing supply of physicians (e.g., OTA 1986a; Keenan and Hepburn, 1991), while at the same time both demand for home care and pressures in hospital services create a pressing need for increased physician participation in home care teams. This situation may be due to career expectations (perhaps it is not by chance that family practitioners are older; Keenan et al, 1991);

overspecialization and research orientation; and dissatisfaction with reimbursement (Keenan et al, 1991). Irrespective of reasons, this appears to be a persistent problem and it is one of the reasons that telemedicine and telehealth are promoted, especially with reference to the PHC.

Any hierarchy would differentiate access authorization to the central medical computer system, which would result in a stratification of medical professionals. This situation could be also reached through distribution patterns of medical card reading devices, which would divide physicians into those who own such a device and those who do not.

Most reports as well as the rationale behind large projects such as the EC AIM and the RACE "TELEMED" favour telemedicine. However, Milio (1986) presents a critical view; telematics applications in health care are considered as a trend towards minimisation of responsibility, while the overall system is seen as favouring the "middle-level practitioners" who are willing to be "company players".

5.3.3 Communication in the Age of "Telescience"

The work environment of the medical professional is being increasingly filled with new devices. First, in the hospital, new medical instruments come to be added to old ones. Second, telemedicine systems extend the range of services to reach remote patients. Third, medical professionals along with their colleagues in science and technology enter the era of "telescience" and associated systems. The first are outside the range of this report. The second have being dealt with in other sections. This section focuses on the third issue.

Telescience is a term originated at NASA in order to describe the geographically dispersed groups of scientists who communicate intensely via computer networks, electronic journals and teleconferences (Aborn, 1988; Lievrouw and Carley, 1990).

Following Lievrouw and Carley (1990), scientific activity can be viewed as a communication cycle which has three progressive stages, namely conceptualization, documentation and popularization. They argue that as more fields enter the telescience era, the distinctions among these three types of activity will begin to "blur". For discussion purposes as well as for the purpose of comparing telescience with more conventional communication channels, this distinction shall be followed here.

Stage 1: Conceptualization

In telescience, groups of scientists formed are larger, more homogeneous in terms of shared knowledge or specialization, last longer, operate both in one-to-one and in one-to-many modes of interaction, develop more intimate links (due to various

possibilities of contact), exchange information in larger amounts and of wider variety, and are characterised by interpersonal links which are essential in this stage.

Further, cross-disciplinary communication is increased since it is easier to communicate directly with a person or a group of another field through a network than it is to have a paper accepted in a journal of the other field.

Problems may emerge if scientists develop links only with their colleagues who have access to the same channels of communication.

Stage 2: Documentation

The ease of communication in telescience encourages more frequent distribution of documents, while the possibility of electronic journals may create a totally different situation (easier to "start" a new journal, cross-indexing, etc.), reducing also the need for intermediaries who do electronic searches. Audiences of electronic publications would be wider.

Electronic publication however may be considered by scientists as less rewarding than publication. When publications are provided both in electronic and non-electronic forms, then electronic subscribers have the advantage of receiving the "journal" faster, which is a disadvantage for those who, for some reason, do not have access to the electronic dissemination channels.

Stage 3: Popularization

Technologies used in previous stages are mainly computer network based. Popularization however involves all possible electronic and nonelectronic channels.

Fields which have good access to popularization channels may develop an advantage in raising research funds, especially from public sources.

Overall, telescience increases:

. The potential 'sphere of influence'.
. The collaboration potential.
. The paths for the diffusion of ideas.
. Thoroughness of knowledge shared with colleagues.
. The amount of 'messages' exchanged.
. The degree of overlap among the three stages of scientific communication.
. Possibly, the controls to prevent 'premature' diffusion of information.

5.4 Information on health information services and coordination

A major issue with telemedicine and telehealth systems is information on their existence and availability. For it is one thing to set up and run such a system, it is another to inform interested parties that such a service exists and to give them all information and possibly training needed to use it. These should be disaggregated further by categories of users, social and education levels, etc. The experience of running such systems has to be taken into account in this respect.

Diseker et al (1980) analysed the Tel-Med system in North Carolina, USA. They found that less citizens of low income and education knew about the system, while those of them who knew were using it properly. They suggested that the poorer and lesser educated should be informed better in order to make good use of the service. An evaluation of the Can-Dial cancer information telephone system (Stirewalt et al, 1981) found also that noncallers included persons who did not know the system.

Colver et al (1982) evaluate a campaign for the home safety of children. They found that as many as 55% of families with young children in the study area did not watch any of the television programs, although they were aware of the importance and preventability of children's accidents. However, in another group, which received also a home visit at which specific advice was given, 60% took action to make their homes safer.

Coordination between various agencies providing telehealth services to the home is necessary, not only in order to avoid duplication of effort, but also in order to take advantage of 'scale economies'. Cross-information of customers could also improve diffusion of related services.

Modes, strategies and costs for the dissemination of information on telehealth information services, as well as for all other types of telehealth services, should be an integral part of the telehealth system. All available media could be used to this end. Further, issues discussed in the Section on 'Health information and education' of the present report are relevant in this respect.

5.5 The learning process

The time-lag between making available a telehealth service and the development of experience on how to use it appears to be a major issue.

Evidence shows that the learning process involved should be taken seriously into account. For, a good system may become available, but proved to be under-, or improperly utilised for a certain

period. An early assessment may indicate problems in the use of the system, which may influence decisions on continuing provision of the service.

Here experience from existing experiments should also be taken into account. Higgins et al (1984) reviewing the use of slow-scan video in remote areas of Ontario, found that initial reactions of involved parties were not enthusiastic, but more positive attitudes were developed after experience was gained with the system. Cunnigham et al (I978) found a similar initial reaction in the case of an off-site paediatric consultation scheme involving IATV backup for nurses providing paediatric primary care. Although the system allowed paediatric nurses to function without on-site physician 40% of the time, they were reported as "initially sceptical" and only "ultimately favourable". Grundy et al (1982) discuss an application which linked via IATV a local hospital with university-based critical care physicians. After a good number of remote consultations (1548), and although the system proved to perform far better than telephone consultation and to extend the availability of specialist expertise, full exploitation was not achieved.

The learning and acceptance curves would be different for each involved party. For instance, in the above review by Higgins et al (1984), nurses were more, while physicians less enthusiastic with the system. This was due to the fact that nurses extended their role with the support of the system, while doctors saw it as a substitute for their own knowledge and role, feeling that they already had the required background. Only experience with the system changed this attitude.

Further, lay persons using telemedicine for home care should undergo a process of training, which may delay use of available systems. (See also Section on 'Access modes and interfaces' of the present Report.)

This learning process can be paralleled with the initial delay observed in the diffusion of most innovations. Indeed, even innovations which finally diffuse successfully show this initial delay, which, in the case of acceptance, is followed by a more or less steep ascending trend; this eventually levels-off (saturation phase) as the innovation diffuses, reaching asymptotically the level measuring its market niche. This process is described overall by the so-called 'sigmoid curve', taking its name from its S-like shape; computerised diffusion prediction models could be constructed accordingly (e.g., Veneris, 1984, 1990, for review and discussion).

5.6 Public policy issues

Public policy is a major and essential factor affecting the formation of the total health environment, as well as the production and consumption of health goods, services and information. This is true for health in general, as well as for telehealth and telemedicine.

If an overall statement can be made about promotion of telehealth and telemedicine, this should be that they require large scale restructuring of the entire health care system; public policy becomes thus an imperative.

Public expenditures in health is one serious matter of public policy, since most developed countries spend between 8% and 10% of their GNP on health (USA, Canada, Sweden, France, Germany; Japan 6.7% and UK 5.8%; Jarman, 1991). Implementation of telehealth and telemedicine systems would require to reset the priorities of public health financing, in order to deal with new types of expenses.

Public policy sets the odds for the promotion of the well-being and wellness of individuals, the development of health decision making skills and the creation of valid health choices. As was seen, many applications of telehealth systems can be envisaged along these lines.

Considering the creation of the total health environment, Milio (1985) argues that it requires a "two-pronged effort", namely developing policies that provide incentives to producers and consumers to make more healthful choices than they do today; and creating a social and political climate that will encourage policy-makers to choose more healthful policy options.

A comprehensive health public policy would inevitably influence various sectors of the society and the economy. For instance, anti-smoking intervention programs are part of health promotion policies in many countries; information media reaching the home are used extensively to this end. Such programs aim to reduce smoking-induced illnesses which have high social and economic costs. However, smoking is related with tobacco industries, tobacco primary production, the paper and printing industries, as well as with other activities constituting what is termed (Veneris, 1984, 1986) the 'information sector', including research, management, marketing, etc. Reduction in smoking (no matter how desirable) would affect strongly the business activities and jobs in these sectors, which in turn may cause various reactions. Redirection of activities of tobacco-related industries to countries with relaxed anti-smoking practices, as is now happening, is also an undesirable outcome of incoherent policies. Another related example is dietary modification intervention programs.

Many health promotion policies may induce large scale economic restructuring which would inevitably require strategic planning in order to take into account these factors along with other ideological and political aspects (de Rezende, 1984). As the definition of health and health promotion moves beyond the confines of institutionalized medical care, health policies would also extend their range from the medical-care/industry complex to many other sectors of the economy.

Diffusion of telehealth and telemedicine in the electronic home depends on a variety of factors influenced by public policy. National as well as EC telemedicine Programs are examples in case. Four major groups of factors are discussed here; all of them are of vital importance, the 'sine qua non' for a telehealth system to come into being.

First, telecommunications networks. The social and regional disparities discussed already should be addressed by suitable public policies in order to make telehealth services accessible to those who need them. These regional policies should be supplemented by urban telehealth policies, especially in large population centres, in order to serve social and local groups of reduced mobility. Since market orientation of public policies would tend to attach low priorities to actions which show low 'returns', it is to be expected that community action would have to play a major part in promoting equity. Regionalisation schemes would define "catchment areas" for telehealth care centres, taking also into account the dynamics of the urban system in each country (e.g., Veneris, 1984, 1992, for discussion).

Second, MCTS, suitably equipped, structured and staffed. If this system were to cover all regions and all social groups, then public policies should aim to establish it as a national system. This may not necessarily be more costly than other 'flexible' schemes, as discussed above (Section on 'Reimbursement issues').

Third, HAS devices. A number of them may become cheap enough, which may make possible wide diffusion. Other devices may be expensive to buy. Since some of them are true life-supporting apparatuses, ability to pay should not restrain use. Public policy should aim to make available such equipment to the concerned people.

Fourth, technological developments should take into account all aspects of democratic control of health systems and the total health environment. The inertia of established structures, practices and authority privileges would tend to reproduce a technocratic model of medicalised health care. Comprehensive public policies are required in this respect, in order to avert the risk of seeing diffusion of health programs deterred by the agents who were supposed to promote them. Further, the specific requirements of people with special needs should be kept always in mind, especially since, as discussed, telehealth aims to support people with chronic illness and disabilities.

R&D public policies should be informed by social requirements, which do not necessarily agree with the orientations of large IT corporations. The next Section provides the basic items of a socially sensitive research agenda.

6 DIRECTIONS AND FOCAL POINTS FOR FURTHER RESEARCH

Further research is needed on the social aspects of telemedicine and telehealth. Throughout the present Report we have identified several directions, which are summarized here.

Technological developments could include:

- Democratic Health MIS, which would facilitate public participation in the management of health information systems.
- Modelling and decision support systems, broaching various aspects of the total health environment. A CH-DSS, a Community Health Decision Support System, could be developed along these lines.
- Public participation technologies, including formalized methods for analysis and consensus-reaching of issues raised during debates.
- Patient control and participation in home telemedicine monitoring systems.
- Patient control in interactive telehealth systems.
- Easy to manage telematics networks for health groups.
- Information systems for the dissemination of information on health-related telematics systems.
- "Lay person" technologies for the preparation of health information and education community systems.
- Appropriate interfaces for various groups (cultural, children, disabled, etc.).

Technology assessment topics could include:

- Patient rights (confidentiality, bodily privacy, etc.).
- Social and regional accessibility of telehealth services.
- Deskilling, work restructuring and job displacement effects concerning health professionals, in relation with telehealth services.
- New skills for the health professionals in order to function within telehealth systems.
- Payment and reimbursement schemes vs. comprehensive public reimbursement.
- Communication problems concerning various groups of the population in interactive telehealth systems.
- Portrayal and remodelling of health and health care in mass media.
- Comparative influence of various media for the dissemination of health-related information.
- Economic sectors (e.g., tobacco, food) and promotion of healthy lifestyles.
- Alternative medical paradigms in telehealth services.

Systems to be evaluated and assessed could include:

- Home medical telemonitoring applications, including 'Alarm' EMS (e.g., Red Cross, Athens).
- The "DOMO SANTE" service, Paris.
- The European "HANDYNET" service.
- Various 'Hotlines' in Europe.
- TND, USA.
- DBNet, USA.
- The Berks Community IATV, USA.
- The "kind home welfare network", Japan.
- The "AIDLINE" service, USA.

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AND
RELATED BIBLIOGRAPHY

7 GLOSSARY OF TECHNICAL TERMS

ASCII (American Standard Code for Information Interchange) A widely used system for coding characters (letters, numbers, etc.) in computer systems.

Bandwidth The range of frequencies in a channel of communication (e.g. a voice phone channel) which can be used for transmitting information.

Bit A binary unit of information, usually 0 or 1.

bps Bits-per-second is a common measure of binary data transmission speed, not necessarily equivalent to the 'baud-rate' which measures rate of symbols transmission.

Channel Path for the transmission of information. A 'physical' channel, such as a wire, may support many 'logical' channels, using suitable techniques (e.g., packet switching, multiplexing).

Circuit switching In networks, when a continuous path is established between the two communicating ends for the whole duration of the call. An example is the PSTN.

Coding (or encoding) The 'translation' of symbols into strings of a more narrow range of symbols. For instance, coding the letters of the alphabet into strings of binary symbols.

DCE (Data Circuit-terminating Equipment) A device installed near a DTE in order to interface it with a network. An example is the modem which connects digital terminals to PSTNs and PSDNs.

DTE (Data Terminal Equipment) The DTE is the source or sink in any computer network. Installed at the two ends are interconnected via DECs to the network. Examples are terminals and computers.

EFT (Electronic Funds Transfer) Systems allowing financial transactions via electronic media.

Encryption Special type coding prohibiting understanding of symbols to unauthorised parties.

ISDN (Integrated Services Digital Network) PSTNs carry data in analog, non-digital, mode; modems interface digital DTEs, transforming digital data into analog signals. In ISDN all data are digital at the source, including digitalisation of voice; switching is also digital. Variants of the ISDN include the B-ISDN (B-channel at 64kbps for voice and data) and the D-ISDN (D-channel at 16kbps for signalling information and data packets); combinations such as 2B+D-ISDN are common.

IBCN (Integrated Broadband Communications Network) It represents the next step integrated electronic networks (such as the -ISDN) to integrated optical networks, in which signals and data are transmitted through fibre optic channels; asynchronous transfer modes shall replace the synchronous ones. Its bandwidth (>140Mbps) shall make possible transmission of video images, along with voice, data, ISDN, satellite and mobile. Related R&D is undertaken under the EC RACE program.

ISO (International Standards Organization)

LAN (Local Area Network) Short range computer network (max. few km).

Modem (modulator-demodulator) A DCE providing serial digital interface to a DTE, over a voice/analogue network (e.g. phone, radio).

Network A set of channels allowing end-to-end communication, for instance of a population of DTEs. 'Network' is also called the third layer of the ISO/OSI reference model.

Node See Switch

OSI (Open Systems Interconnection) A 7-layer model introduced by ISO in order to provide a reference for the description of data network protocols.

Packet switching A network carrying digital data in the form of 'packets' (blocks of data with header information concerning destination, etc.) from their origin DTE, through a number of switches, to their destination DTE.

PACS/IMACS (Picture/Image Archiving and Communication Systems) Special purpose systems for storing and transmitting still images. Used in telemedicine for the transmission of medical images such as X-ray images.

PSDN (Packet Switched Data Network) A network implementing packet switching.

PSTN (Public Switched Telephone Network) A term designating the ordinary telephone network, including both the analog and the digital switching technologies.

Real-time Computer jargon, meaning that the time between an event and a related computerised action (monitoring, processing, etc.) is sufficiently short.

Switch A device capable of controlling the traffic of data coming through several channels of communication.

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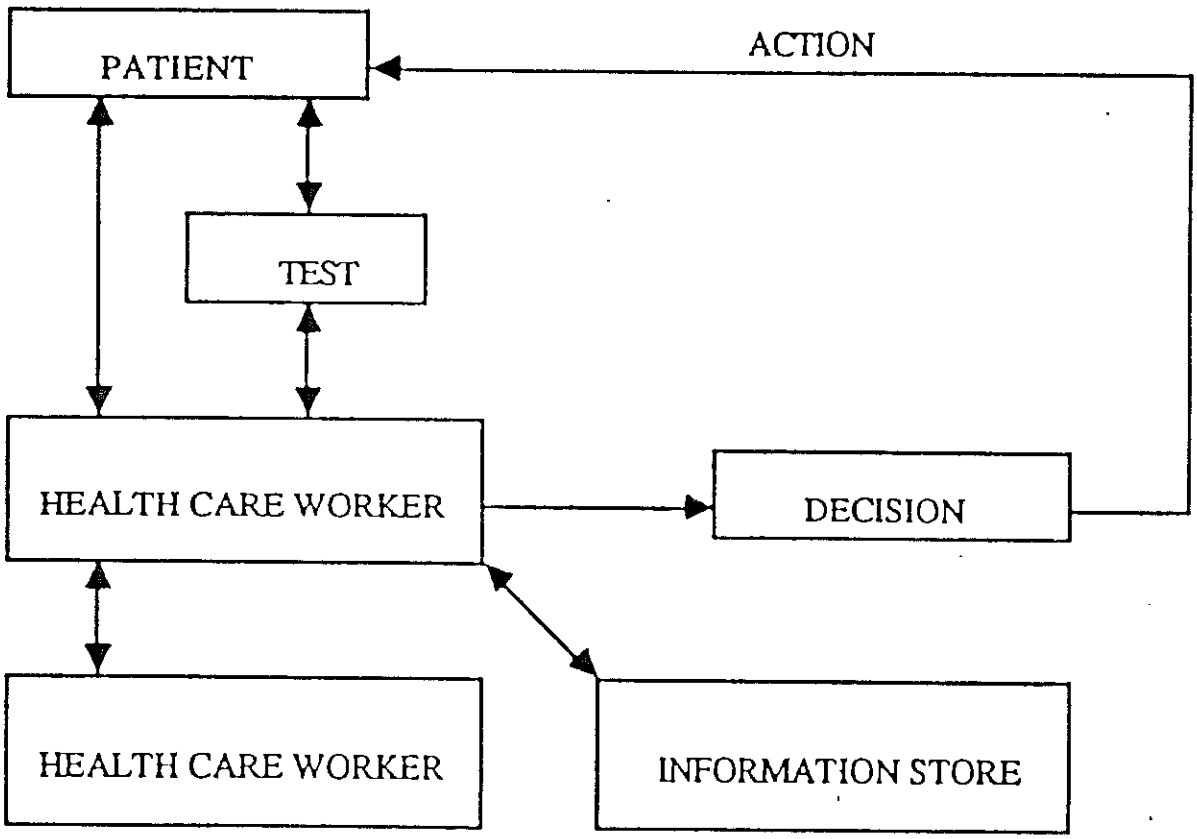
ANNEX I

THE MODEL OF INSTITUTIONALIZED TELEMEDICAL CARE

(Source: Williams, MH, 1990)


PATIENT
ACTION
TEST
HEALTH CARE WORKER
DECISION
HEALTH CARE WORKER
INFORMATION STORE

ANNEX II

CROSS-REFERENCE TABLES ON MAJOR EC PROGRAMS RELATED WITH TELEMEDICINE AND TELEHEALTH

(Source: AIM, JAN91)

POSSIBLE LINKS WITH OTHER PROGRAMMES

REF.	AREA OR TASK	POSSIBLE LINKS
I.	STRATEGIES FOR THE USE OF TECHNOLOGIES, TELEMATICS SYSTEMS AND SERVICES AND	
	CONTRIBUTION TO THE DEFINITION OF COMMON FUNCTIONAL SPECIFICATIONS	
I.1.	Identification of user needs, regulatory tools, incentives and criteria for appropriate use	AIM Exploratory
	of technology in health care	
		DG V, DG XII Monitor
T111	Assessment of User Needs, Market Viability and Economic Possibilities for Applications of	
	IT&T Technologies to the Health Care Sector	DGIII & V
T112	Strategies, Guidelines and Codes for Data Protection and Computer Security in Health Care Informatics	DG XII Monitor
T113	Telematics for Health Care Quality, Safety and Medical Technology Assessment	
I.2.	Harmonisation of medical and health care management data and technology, common functional	AIM Exploratory
	specifications, standards and communication protocols	
		ESPRIT OBS
T121	European Medical record Architecture	
T122	Telecommunication Services for Health Care Added Value	DG XIII/E
T123	Standardization Monitoring and Promotion	RACE, ESPRIT OBS
T124	Protocols for Transfer of Information	
T125	Use of Machine Readable Cards in the Health Care Sector	DG XII
T126	Development of European Data bases	
T127	Management Accountancy and Econometric Models of Health Care Costs	
T128	Management of Resources in the Diagnostic Environment	
II.	DEVELOPMENT OF TELEMATICS TECHNOLOGY APPLIED TO MEDICINE	AIM Exploratory
II.1.	Alphanumeric data and coding standards	
		ESPRIT OBS
T211	Definition of Accurate and Significant Patient Data Sets	
T212	Data Standardization, Classification and Encoding	

POSSIBLE LINKS WITH OTHER PROGRAMMES

II.2.	Images and biosignals	AIM Exploratory
T221	Analysis and interpretation of medical signals	ESPRIT KE
T222	Modelling, Representation and Interpretation of Medical Images	ESPRIT KE
T223	Image analysis for diagnosis and therapy management	
		AIM Exploratory
II.3.	Integrated instrumentation and devices	
T231	Management and quality assessment of biomedical technology	
		AIM Exploratory
II.4.	Knowledge based and decision support systems	
		ESPRIT KE
T241	Knowledge capture	ESPRIT KE
T242	Architecture for Medical Knowledge Based systems	
		AIM Exploratory
II.5.	Medical use of multimedia workstations	
T251	User Requirements and Ergonomics for Medical Workstations	ESPRIT OBS
T252	Human-Machine Interfaces for Health Care Information systems	
II.6.	Health Care Communication systems	
		RACE, ESPRIT OBS
T261	European Medical Communications Backbone and Telemedicine Services	AIM Exploratory, RACE
T262	HIS and Integrated Communication Networks	
		AIM Exploratory
II.7.	Telecommunication systems for medicine	
		RACE, STAR
T271	Telematics for Primary Health Care	DELTA
T272	IT&T Based Education and Training in Medical and Health Care Activities	DELTA
T273	IT&T Based Health Education and Training for Specific Groups of Patient and for the General Population	

POSSIBLE LINKS WITH OTHER PROGRAMMES

II.8.	Modularity and integration of medical information and archiving systems	AIM Exploratory
		Eureka 51
T281	HIS and the Smart Hospital Concept	
T282	Integrated Picture Archiving and Communications Systems (PACS)	DG XII
T283	Distributed Medical Multimedia Databases	
II.9.	Technologies and services for the handicapped and the elderly	
		AIM Exploratory, RACE
T291	Systems and Tools for Distant Functional Evaluation of Handicaps and Monitoring and Support of Home Care	Eureka 278 & ESPRIT
T292	Advanced Support Tools for Making Technology more Accessible to Disabled People	
III.	VALIDATION AND INTEGRATION	AIM Exploratory
III.1.	Pilot for integrating medical equipment and information systems	
T311	Computer Aided Therapeutic Systems	
T312	Architecture of an Integrated Biomedical Laboratory	RACE, Eureka 198, DRIVE
T313	Uses of Mobile Telematics for Emergency Health Care Situations	ESPRIT OBS
T314	Telematic and Information Systems for Departmental Environment	ESPRIT OBS
T315	Development of a pilot for a decentralised Hospital Information System (HIS)	
T316	Development of Pilot for the Use of Smart Card for Patient Data Card and Access Control	ESPRIT IPS
T317	Development of Medical Software Engineering Tools	
		AIM Exploratory
III.2.	Applications for validation	
		ESPRIT IPS
T321	Clinical Evaluation of Integration of KBS with Databases and HIS	
T322	Pilot Evaluation and Certification for Advanced Informatics Systems in Health Care	
T323	Integration of National Medical Information Systems	RACE, ESPRIT OBS
T324	Telemedicine Network Management Systems (TNMS)	RACE
T325	Inter-Hospital Telematics	ESPRIT, RACE
T326	Data Protection and Confidentiality	

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