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Millennium medical changes

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If we want things to stay as they are, thing will have to change
Guiseppe di Lampedusa, The Leopard

Medical and technical knowledge in medicine has increased more in the last 50 years than in the previous five centuries. Many factors have contributed to this dramatic change, including developments in pathophysiology, genetics, molecular biology and basic science. There is no reason to fear that this daunting progress will be halted in the third millennium. The practice of medicine in the present and next decades will also change rapidly because of new perceptions and demands of the patients, and evolution in society. In this article, some factors affecting medicine and the drivers of change in health are discussed. Expenditure for health cure and care is increasing faster than the financial income. On which criteria should one re-allocate resources and decide between difficult choices? Medical doctors, sociologists, philosophers, economists, politicians all have different views of needs in a world of uncontrolled rather than controlled liberalism. Some issues are identified here, but no solutions or recommendations are offered.

Introduction

One can safely predict that, in this century, medical progress in at least four domains will be prominent: the treatment of myocardial infarction and hypertension; the cure of some blood and other cancers; the correction of a few hereditary disorders by gene therapy and the prevention of infectious diseases, such as hepatitis C, malaria and bilharziasis; and the ageing process will be better understood. Further predictions on health technology are more speculative but not unrealistic[1] (Table 1).

A number of changes in the practice of medicine are unavoidable, and some others are desirable but will require difficult and critical decisions. They are all the consequence of technical and other progress in the medical field, and of new perceptions of patients and the evolution of society. Among these numerous items, only a few have been selected for this review, in particular those that concern the cardiovascular field.

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Table 1. Predictions of Health Technology

Year	
2000	Artificial blood
	Full electronic records on smart cards
2005	Personal wearable health monitors
	Determination of whole human DNA
2010	Artificial heart
2012	Artificial sense
	Robots doing routine hospital tasks
2015	Genetic links to most diseases known
	Individual genome part of medical record
	Artificial lungs
2016	Artificial brain cells
2017	Artificial liver
	Extension of human life span

Factors affecting health

Major factors affecting health can be intrinsic, social and economical, environmental or due to lifestyle (Table 2).[2] In this section, demographic, environmental and societal changes, which have a significant bearing on health care and medical policy, are discussed.

Globally, life expectancy at birth rose between 1980 and 1995 by 4.4 years for men (to 80 years) and 4.9 years for women (to 85 years). At present, about 380 million people worldwide are aged 65 and over, and this figure is predicted to rise to 680 million by 2020. In Belgium in 1950, the ratio of the population that was older than 65 years to that of employable age was 28%, but in 2030 the corresponding figure will be 67% (Figure 1).

Life expectancy increases with age as the fittest survive, and for this reason this does not necessarily imply a higher medical cost. Indeed, death at an advanced age is, in general, fast and thus does not imply a long period of costly institutional care. The total expenditure for health care does not correlate with life expectancy: one reason for this is that improved nutrition has a significant role in prolonging life expectancy. The maximum life span (i.e. the age at

Table 2. Factors affecting health

1. Fixed
Genes, sex, ageing
2. Social and economic
Poverty, employment, social exclusion
3. Environment
Air quality, housing, water quality, social environment
4. Lifestyle
Diet, physical activity, alcohol, sexual behaviour, drugs

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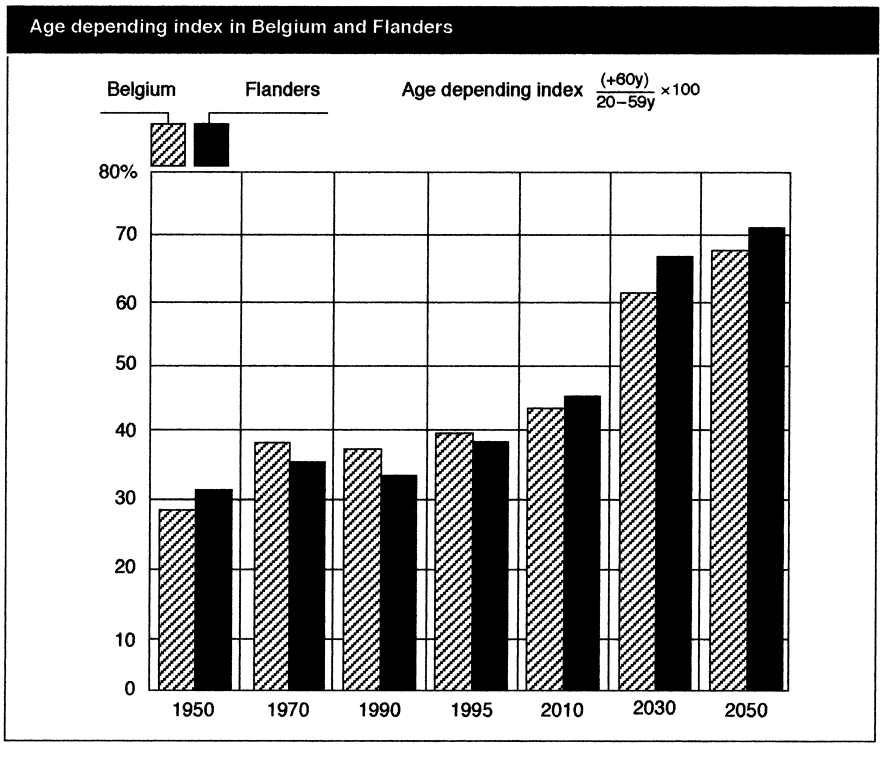


Figure 1. The ratio between the elderly and the population potentially in employment expressed as a percentage. Source: Belgian National Institute of Health.

which mortality is calculated to be 100%) has not changed in the last 40 years, while mean life expectancy has increased remarkably, even between countries with large differences in lifestyle.[4] This points to genetic intervention as the only possible way to increase the maximal human life span. In fact, it is unlikely that life span can be prolonged by genetic manipulation, in part because of the different rates at which organs age.

As life expectancy is still increasing in developed countries, there will be a greater need for medical and other help at home or in medical institutions for the elderly. It is to be expected that, with an older population, the incidence of cardiovascular, malignant and degenerative diseases will increase, as will multiple pathology. The corresponding cost has to be defrayed by younger people still at work and the proportion between the two groups has a growing imbalance (Figure 1). Another problem concerns the economic dependency of the older generation. Changing demography, prolonged education and changes in the labour market have all increased the dependency ratio dramatically. Demographic and social changes have led to more and more elderly people living on their own rather than with their families, and they have become an object of government policy.

There is worldwide a re-emergence of infectious diseases, partly due to increased international travelling as well as the widespread decline in living standards associated with

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war. In addition, the incidence of preventable diseases such as poliomyelitis, typhus, diphtheria and measles is increasing due to a negligent decrease in vaccination. There has been an increase in tuberculosis, malaria and cholera and other infectious disorders (e.g. the ebola virus) and the AIDS pandemic reminds us that, although we can win battles, the prevention campaign is likely to be never ending. There is also the threat of multi-resistant micro-organisms, partly due to the improper use of antibiotics.

Inequalities within countries continue to take their toll on health – egalitarian societies are healthier than those with large income differences between groups. The fall in life expectancy of Russian men from 64 years in 1989 to 59 in 1993, has resulted from a reduction in real income, increased stress, and stress-related behaviour (e.g. alcohol consumption), as well as a breakdown in health services.[5] Worldwide employment opportunities have diminished in most industrialized countries, partly due to globalization of trade. The result is the 40:30:30 society, in which 40% of the working population are in full-time, long-term employment; 30% are in part-time, insecure jobs; and another 30% are unemployed or working for poverty wages. The term 'social exclusion' is increasingly used to highlight the implications of long-term unemployment and the move from universal to targeted welfare provision.[6] Several studies have confirmed the relation between inequality of income and mortality.[7–9] Smoking is the single most important preventable cause of death in Europe.[10] Higher rates of smoking in stressed and depressed people and among those with the lowest incomes means that the burden of disease due to smoking is highest in these groups. Three quarters of adults in families receiving income support smoke, and one seventh of their disposable income is spent on cigarettes.[11] By exacerbating the poverty of those on the lowest incomes, the health effects of smoking go way beyond the direct effect of tobacco fumes.

Increased expectations of patients and relatives

The media, including magazines, books and television, and the growth and wider availability of the internet, greatly increase patients' immediate access to health information. Already, over 10,000 health-related websites exist, and over a third of internet users access the web to retrieve medical information, e.g. on available medical facilities and less expensive care ('medical tourism') and also about prescription drugs that have not been approved by national drug monitoring bodies.[12, 13] As a result, the modern patient has assumptions about medical care and takes a number of things for granted. In discussing patient attitudes to health care, assumptions are often referred to as 'rights'. This is certainly correct with regard to receiving timely quality health care in a climate of consideration, respect and courtesy, regardless of age, gender and race. The increased access to medical information, however, does not mean understanding its full implications. It is the doctor's task to fill the gaps, to inform his patient about the risk versus benefit concerning diagnostic procedures and treatments and to explain in simple terms the complex leaflets inserted into drug packages. Patients do not wish consultation to be merely token, they expect their views to be taken seriously by less paternalistic providers of medical care.[14] Better informed patients will find out which unit, department or hospital has the best results for specific problems. They are able to ask for and make choices and, in doing so, to share in the responsibility for their own treatment and health

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and to be, with their doctor, 'partners in care'. In the new information age it is the public themselves who will be a partner in driving the agenda.

Explosive development of new medical technology and information

New technologies are offering enormous potentials to improve diagnosis and treatment. To name just a few: genomics, organ transplantation, telecommunications, minimally invasive (keyhole) surgery, automation and miniaturization.

In the genome project, numerous genes are being identified that are associated with disorders. It is vexing that it is the relative rare single gene defects that have proved most amenable to molecular study, such as those responsible for Marfan's syndrome, familial hypercholesterolemia, and hypertrophic cardiomyopathy. Knowledge of these genetic defects has provided important insights into the pathogenesis and improved diagnostic accuracy. Ultimately, the cure requires replacement of the defective gene by some form of gene therapy. The main obstacles to successful gene transfer are both delivery of the gene and regulation of its expression in the target cells, e.g. the smooth muscle cells of an atherosclerotic coronary artery.

For badly damaged myocardium, cardiac transplantation is currently the only realistic prospect. The main problem is the limited availability of suitable donor organs. Xenotransplantation (organs transplanted across species) are subject to hyperacute rejection due to complement-mediated vascular endothelial cell destruction. In homografts this is prevented by the presence of a surface glycophospholipid called the 'decay accelerating factor'. The aim at present is to find a way to express the human decay accelerating factor on animal organ endothelial cells. Transgenic pigs are already available in which human genes code for complement regulatory proteins.[15]

With the present radiological techniques many organs can be visualized, but this is now complemented with ultrasound, computer tomography and magnetic resonance, and infrared imaging. Not only anatomical but functional changes can also be diagnosed.[16] The integration of imaging information into comprehensive online medical services and the ability to communicate imaging services over distances (teleradiology) opens a world of multimedia communications. It is obvious that the new techniques are multidisciplinary. With internet access, many physicians can have access to the same images without needing to meet physically, and the opinions of experts can be obtained by networking in cyberspace.[17] Appropriate imaging cases can be added to teaching files that can be posted on the internet and world wide web. This has already led to telemedicine in military medicine and the ability to treat patients by endoscopic telesurgery.

Since the volume of medical knowledge at present doubles about every seven years, it is more important that students learn how to consult the vast body of knowledge available than to try to memorize it all. More acquisition of factual knowledge is not enough to practice medicine properly; doctors must have the understanding and ability to handle knowledge and information.

Traditional methods of teaching are still retained despite evidence of how little information is remembered and in defiance of modern education theory. It is necessary to move the ethos from 'teaching' towards 'learning'.[18] Further, it is no use redesigning the curriculum yet

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retaining conventional examinations. The 'assessment' needs to test the new skills and attitudes. Education adapted to the new millennium underpins quality, but much needs to be done to support lifelong learning for health professionals, to develop medical audit methods and to review systems of professional self-regulation.[19]

Shrinking financial resources

It is a major challenge to select optimal interventions and to guarantee their access to the overall sick population. It is a rather novel situation when the authorities governing the health care system have to make choices and establish priorities. If more heart transplantations are to be performed, some other expenditures (e.g. coronary bypass surgery in elderly people) will need to be limited as the overall health care budget cannot increase indefinitely. Society will have to observe critically the ongoing changes in the health care system, which is being called the 'third medical revolution'.

Despite cost containment measures, medical expenditure in Belgium rose from 10 billion Euros in 1995 to 10.5 billion Euros in 1996. The cost of health care ranged in industrialized countries from 6.9% to 14.3% of the gross domestic product in 1991[20] (Figure 2). Medical advances and demographic changes will continue the upward pressures on costs. As the cost of health care increases faster than the gross domestic product, one wonders how long the system can cope, bearing in mind that, to a large extent, public money foots the bill.

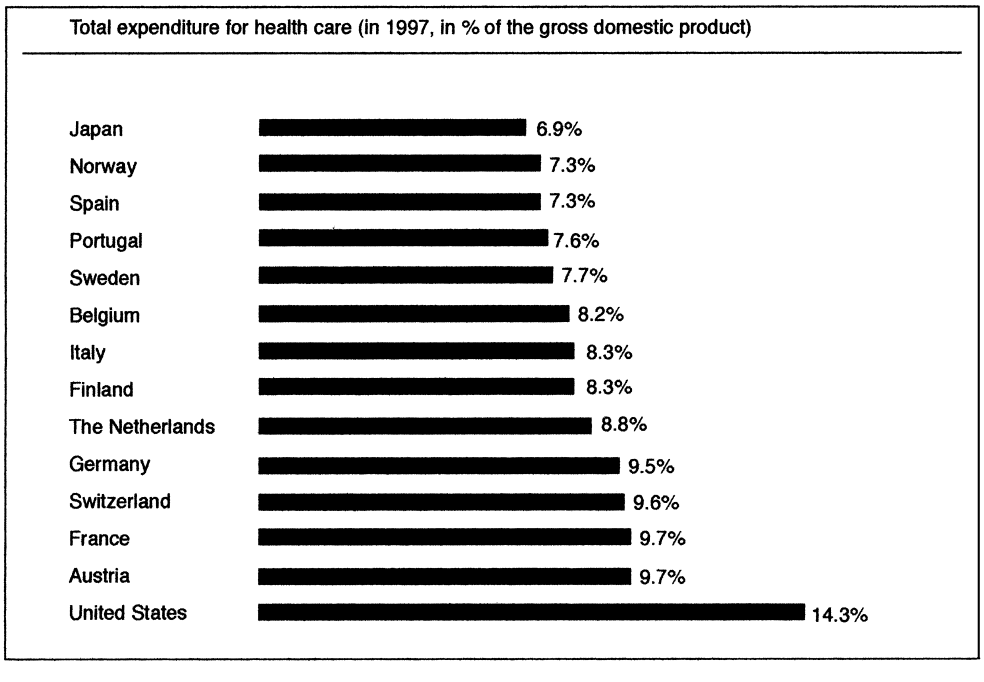


Figure 2. Total expenditure on healthcare in various countries in 1997.[20]

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Several factors contribute to the cost escalation of health care expenditure. Many of the new diagnostic procedures – such as computerized tomography, nuclear magnetic resonance, organ catheterization, and the use of radioisotopes – are expensive, as are such therapeutic procedures as chronic dialysis, balloon dilatation, brain, heart and vascular surgery, organ transplantation and some drugs (antivirals, antibiotics, lipid-lowering statin drugs).

The national cost in the UK of one pharmacological treatment for hyperlipidemia (prescriptions for simvastin) has risen from 28.5 million Euros in 1993 to 161.1 million Euros in 1997.[21] The cost of a year of life gained from simvastin is 1032 Euros, whereas a dietary intervention (the 'Mediterranean diet') gives the same benefit for 256 Euros. Other large spenders are related to new diseases such as AIDS or circumstances linked to health (infertility, anticonceptives, impotence in elderly males, obesity, aesthetic surgery, etc).

Supply side factors may be as important as demand. The number of health care professionals, the capacity of hospitals and other health institutions have also added to the intensity of treatment and the growth of health care expenditures. There is also over-consumption due to the demands of better(?) informed and more demanding patients and relatives. In addition, there is a 'defensive medicine', encouraging doctors to request tests for fear of complaints from dissatisfied patients.[22, 23] Not to be underrated is the cost inherent due to elderly people, a costly segment of the population sometimes perceived as the 'greedy geezers'. As a group, the elderly are regarded as gobbling up resources, crowding out other categories of government spending and threatening economic growth. Based on long term extrapolations, it appears that if the current burgeoning expenditure for the elderly continues, the social security system will go broke. This fear is shifting the emphasis from affordability of social security to intergenerational justice, as consumption by the elderly is siphoning financial resources from the young.

The aim of this review has been to identify problems and complex issues, not to propose possible solutions. This is the task of policy makers and politicians who have also to take into account societal changes in reframing the national social security system. For instance, there is a shift from curative to preventive medicine, which may be more effective and less expensive. A redistribution of resources according to updated priorities seems to be imperative and a larger application of medical audits desirable. Doctors, sociologists, philosophers, economists and politicians all have different views of what needs are in a world of uncontrolled rather than controlled liberalism.[24] The difficult question of which criteria thorny choices are to be based upon, will remain.

Drivers of change in health care

Clinical guidelines are systematically developed statements designed to help practitioners and patients make decisions about appropriate health care for specific circumstances. In evidence-based medicine, the facts are ranked according to a hierarchy of study designs and criteria that relate to the internal strengths of a study. By definition, such evidence comes from population studies, and the results relate to what happens in groups of people, rather than in an individual.[24, 25] Decisions are based on interpretation of the evidence by objective criteria. The importance of research evidence is weighted with mathematical models, including statistical significance of the mathematical likelihood that the result did not occur by chance.

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Clinical significance describes what the results would mean if applied to a population similar to that studied. Personal relevance is a dialectic between a contribution from the practitioner, who outlines the concept as he sees it and the patient who receives and evaluates the proposal. The evaluation process by the doctor includes both cognitive and intuitive components and he or she has to tailor the message accordingly. Indeed, the patient is not a passive recipient anymore waiting for doctors but contributes to the decisions The key clinical decisions are making a diagnosis, estimating prognosis, assessing relevant outcomes, and finally, weighing up the consequences of different treatment options. Successful guidelines involve bringing together the relevant, valid evidence that clinicians need to make informed decisions at each of the key decision points. The increasing interest in evidence-based practice and guidelines has highlighted the huge gaps in the evidence.

One of the cornerstones of evidence-based practice (and evidence-based clinical guidelines) is the requirement that the evidence is relevant to the individual patient.[26] Much of the evidence is presented in formal overviews, which although comprehensive and valid, are not in a form directly relevant to individual patient care. For example, overviews typically summarize treatment effects in terms of relative risk or benefits, whereas treatment decisions, where possible, should be guided by the absolute risks and benefits of treatment. These measures can be presented in units, such as events per 100 patients treated (or untreated) per year, or the number of patients who would need to be treated to prevent an event (the inverse of absolute risk reduction). The cost-effectiveness of treatments needs to be incorporated in a relevant form into the guidelines, which need to be condensed into a concise, accessible format.

Changing attitudes and behaviour, such as stopping smoking, avoiding overweight and better sporting habits, would prevent numerous disorders if the profession and the public recognized their importance and if it were not so difficult to convince people to act accordingly and for long-term. Smoking is not decreasing in the adult population, as the number of youngsters (15 years old) who smoke at least once a day has increased from 15% to 32% over a 4 year period. On continuing to smoke, the chance of dying from a smoke-related disease is 50% and average life expectancy is decreased by 22 years. Smoking is virtually responsible for the total mortality of lung cancer and contributes strongly to the mortality due to coronary heart diseases, stroke and chronic non-specific respiratory affections. In the USA, second-hand smoking causes a higher mortality (53,000) than the effects of AIDS (31,000), traffic accidents (25,000), fire (4,000), drugs (5,700), homicide (22,000) and suicides (31,000). Further restrictions on smoking in indoor environments should become a non-smoker's right.[27] The decision of the European Union to support the banning of tobacco advertising, promotion, and sponsoring is a long awaited major breakthrough. In recent years, the progress in reducing tobacco consumption in the developed world has been disappointingly slow, and the growth of consumption in the developing world has been alarming.

Numerous intervention studies have shown that targeting risk factors reduces the incidence of coronary heart disease. Why then, do so many people continue to smoke, remain overweight, eat too much fat, and take no exercise? Risk-lowering interventions cannot be effective unless they are offered and their offer is accepted. It is estimated that only half of individuals at cardiovascular risk are given the appropriate advice.

Visits to doctor's offices may not be the most propitious occasions for offering health advice.[28] A new approach is needed and deserves the hard sell, in supermarkets, sports centres

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and where people congregate, with the verve and commitment usually applied to encouraging people to spend money on fizzy drinks!

Experts and advertising specialists should advice public health officials how to achieve the hard sell for better health.

There is mounting awareness that, in terms of efficacy at the level of the population, preventive medicine is considerably more effective and less expensive than treatment. Vaccination is still by far the best way to prevent disease and there are vaccines to prevent more than 75 different diseases in man.[30] But efforts to prevent HIV and malaria with new vaccines or to improve a less than optimal vaccine (BCG) for tuberculosis continue to fail. Together with the provision of clean water, vaccines have contributed the most in preventive health care, at least in industrialized countries. Oral vaccines would make vaccination programs considerably cheaper and one way is to make transgenic plants, the fruits of which could be used as an oral vaccine. These may involve the integration into the host plants of the chromosome of a microbial gene encoding an antigenic protein or the expression of the foreign gene incorporated in the genome of a common plant virus.

A better knowledge of risk factors related to cardiovascular disease and a deeper understanding of its pathogenesis has allowed the development of effective strategies in the primary and secondary prevention of coronary heart disease events. LDL-cholesterol reduction by dietary modification or by cholesterol-lowering drugs is effective in both primary and secondary prevention but there is still some dispute about optimum blood pressure reduction in patients with coronary heart disease. Secondary prevention includes aspirin, oral anticoagulants, beta-blockers and angiotensin-converting enzyme inhibitors (in patients with left ventricular dysfunction). In addition, physical activity, a diet high in unsaturated fat, and salt and calorie reduction, are effective in primary and secondary prevention of coronary disease events.[31]

By 2030, a third of the population will be of pensionable age.[3] Maintaining the independence of the elderly should be the goal and more resources should be directed towards prevention and early intervention so as to keep people in their own homes. Palliative care, with an emphasis on the care of patients whose prognosis is limited, on quality (not quantity) of life, and on a multidisciplinary approach may benefit several groups of patients, notably those with cancer. Notwithstanding some successes, the global mortality due to cancer increased by 7% between 1875 and 1990. More than half of all cancers occur in patients over 65 and this underlines the importance of improving the treatment of cancer.

Another group of patients who will greatly benefit from palliative care are those with heart failure at the end of their lives. With age-adjusted mortality from cardiovascular disease declining and the size of the elderly population growing, the absolute number of individuals living with severely compromised cardiac function is expected to increase dramatically over the next few decades. Modern treatments for heart failure slow but do not arrest progression of the disease. There needs to be better provision for palliative care services for patients with end-stage heart disease (and for other life threatening diseases) with an emphasis on good communication and psychology.

The last few decades have witnessed an increasing interest in studies of the care of dying patients and efforts have been made to improve the training of physicians and other health care and social workers in this area. The media, which used to shun reporting on death and dying

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as being too negative, have changed their attitude and now deem them suitable for news and features.[32]

The moral dilemma for the responsible practitioner is that s/he wants to do as much as possible for each *patient's* health, while as a responsible citizen s/he must wish to do as much as possible for the *population's* health within the available resources. Is a balanced commitment to fairness feasible? To paraphrase Andre Malraux who wrote that 'the next century will be moral or not', the next few decades in medicine will focus on prevention or miss its main public health target.

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