The World Medicines Situation 2011
3rd Edition

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SUMMARY

- This Chapter provides information as to how future health systems and medicines supply organizations will have to adapt to demographic and disease burden changes, more specifically to the global increase in chronic noncommunicable diseases.

- Increases in life expectancy, changes in fertility and disease risk factors will contribute to a change in pharmaceutical use and health-care delivery over the next 20 years.

- The DALY burden of chronic disease already outweighs that for acute disease and will do so over the next 20 years. Low- and middle-income countries in the WHO African Region are the only group of countries in which mortality rates due to acute disease are expected to remain in excess of those for chronic disease.

- The relative contribution to the global burden of disease of HIV/AIDS, of TB and malaria, is relatively low. However, the regional impact of these three infectious diseases is still huge, specifically in the WHO African Region.

- Mortality for chronic conditions is expected to increase over time due to increases in mortality rates in the WHO Regions of the Americas, South-East Asia and the Western Pacific, as their populations age.

- The implications for the delivery and use of pharmaceuticals are profound, as there will be a continuing increase in demand for chronic disease medicines, regularly provided and used for the lifetimes of individuals with these chronic diseases.
1.1 INTRODUCTION

Most countries are currently facing a shift in their disease burden, away from one that is dominated by acute diseases towards one dominated by chronic diseases. This change has profound implications for medicines supply and use. The reality of the changing disease burdens, which are entirely predictable, will require suppliers and providers of health care to adapt their current operating models and systems. A key challenge for health systems and medicines supply organizations will be to find better and more cost-effective ways of delivering medicines and related health care to the growing number of people with chronic conditions, especially in the rapidly urbanizing centres of the developing world.

The focus of this Chapter is an analysis of the key drivers behind the shifting patterns in the burden of disease and the consequent health system and medicines demands. These drivers are both demographic and epidemiologic, such as the ageing population and changes in risk factors leading to increased chronic disease (e.g. smoking and obesity). Many countries will face a double burden, in that health systems will have to be responsive to both infectious and noncommunicable chronic diseases. This Chapter also speculates about the key issues for medicines in the next few decades that need to be addressed if countries are to meet the challenges created by these demographic and epidemiologic shifts, particularly leading to increasing noncommunicable chronic diseases.

1.2 PRESENT SITUATION AND FUTURE TRENDS

1.2.1 The key drivers of the increasing burden of chronic diseases

Demographic changes

Figure 1.1 shows projected changes in population in different WHO regions of the world, separated according to income level. It is evident that whereas most WHO regions can expect continued population growth up to the year 2030, the group of high-income countries (HIC) and the low- and middle-income countries (LMIC) of Europe are likely to experience a stagnation or even a decline in the size of their population in the decades to come.

The divergent patterns of population growth shown in Figure 1.1 stem from regional variations in two key demographic drivers, namely declining fertility and increasing longevity. The number of births per woman worldwide has dropped from an average of 5.0 in 1955 to 2.7 in 2005 (1). In the developed world (exemplified by the category of “high-income countries” in Figure 1.1), the already low fertility rate of 2.8 dropped still further over this same period, to just 1.6, a rate which is below the replacement rate of 2.1 births per woman.

In the less developed countries, fertility has dropped by more than half, from an average of 6.2 in 1955 to 2.9 in 2005. Within these regions, however, there are large variations in the rate of fertility declines. The world’s countries with the youngest populations (e.g. in Africa and some countries in Central America) continue to have high fertility levels that have only recently begun to decline (1).

At the same time, life expectancy has increased significantly almost everywhere, and continues to drive population growth. In 1955, worldwide, people could expect to live to be 46 years old. By 2005, the average lifespan had increased to 66 years (2). Gains have been especially dramatic in developing country regions, but even in the more developed countries (e.g. Japan, the USA and countries in Europe), life expectancy has steadily increased, reaching 76 years in 2005, with an 82 year average lifespan projected for 2050 (2).
There are also substantial differences in lifespan between men and women. A man’s life expectancy remains, on average, 7–8 years shorter than that of a woman (3). The female life expectancy advantage can be as great as 12–13 years in some countries of the former Soviet Union (3) but averages slightly less than 5 years in most developing countries. Projected gender gaps in life expectancy vary depending on the models and assumptions used to make such projections, making it difficult to say with any certainty whether the female advantage will increase or decrease in developed and developing countries in the coming decades (1).

The combination of worldwide increases in life expectancy and sharp declines in fertility rates is producing rapid population growth and an increase in the proportion of the population among the older age groups. Some experts are predicting that by 2050, 16% of the projected 9 billion people comprising the global population at that time will be aged 65 years or over (2). This means that within 10 years, and for the first time in human history, the number of over 65s will exceed the number of under fives (4). While people aged 80 years and over currently represent a relatively small proportion of the global population, they are the fastest growing population segment. Northern, western and southern European countries have the largest proportion of such “oldest-old” people, while China has the largest absolute number (5).

The fact that the world’s population is growing steadily older has huge social and economic implications. For our purposes, however, it is sufficient to appreciate that as a country’s population ages, demand for health-care provision and demand for medicines increase, and so too will overall health-care costs.

The fact that the world’s population is growing steadily older has huge social and economic implications. For our purposes, however, it is sufficient to appreciate that as a country’s population ages, demand for health-care provision and demand for medicines increase, and so too will overall health-care costs. Moreover, the ratio of the number of working-age citizens (who contribute to social service funds) to the number of elderly citizens (who do not) will decrease (the so-called “age-dependency ratio”). Unless there is a dramatic fertility increase or some innovation that saves labour, the decreasing age-dependency ratio will over time inevitably result in an increase in the unit costs of health-care outputs (6).
Urbanization

Urban growth is driven by a combination of factors, among them geographical location, natural population growth, rural-to-urban migration, infrastructure development, national policies, corporate strategies, and other major political, social and economic forces, including globalization. Urbanization, and rapid urbanization in particular, is significant because it affects not only the pattern of diseases experienced but also the way in which health services, including pharmaceuticals, are delivered and used.

The pace of urbanization has progressed to such an extent that, for the first time in human history, half of humankind now lives in cities (8). Urban growth is currently most rapid in the developing world, where all cities combined gain an average of 5 million residents every month (8). By 2050, the urban population of the developing world is expected to reach 5.3 billion (8). Asia alone will host 63% of the world’s urban population, (or 3.3 billion people) while Africa, with a projected urban population of 1.2 billion in 2050, will be home to a further quarter of this total. In sharp contrast, the urban population of the developed world, including the countries of the Commonwealth of Independent States, is expected to remain largely unchanged, rising only slightly from just over 900 million in 2005 to 1.1 billion in 2050. This trend is attributed to relatively low rates of natural population increase in these countries coupled with more decentralized patterns of urban development (8). The projected trends mirror those shown in Figure 1.1 for total population.

The process of “urbanization” can take several forms. In sub-Saharan Africa, for example, urbanization is characterized by slum formation. In Asia, a new trend is seen, especially in large Indian cities, in which urban populations are relocating to suburban locations or satellite towns linked to the main city through commuter networks. Urban development in Latin America and the Caribbean, currently the most urbanized region in the developing world, means that one fifth of the region’s urban residents now reside in cities with populations of 5 million or more (8).

1.2.2 Changes in health risk factors

In addition to changes in the size and distribution of human populations, there have been a number of changes in certain risk factors that affect the health of populations and that have a bearing on the distribution of the disease burden. Addressing these risk factors, either through prevention or treatment activities, may well impact on morbidity and mortality patterns, but will certainly impact on the way in which medicines are delivered and consumed (see also Section 1.3.2).

Obesity

Obesity has been identified as a risk factor for many chronic diseases. The risk of coronary heart disease, ischaemic stroke and type 2 diabetes grows steadily with increasing body mass, as do the risks of cancers of the breast, colon, prostate and other organs. Chronic overweight contributes to osteoarthritis – a major cause of disability. Globally 44% of diabetics burden, 23% of ischaemic heart disease burden and 7–41% of certain cancer burdens are attributable to overweight and obesity. In south-east Asia and Africa, 41% of deaths caused by high BMI occur under age 60 compared with 18% in high-income countries (10).

In a 2011 Lancet article, Finucane et al., reported that between 1980 and 2008 age-standardized mean global BMI increased 0.4–0.5 kg/m² per decade in men and women. Quoting data from 2008, they reported that the BMI in men was highest in North America and Australasia. The lowest rates were in sub-Saharan Africa (apart from southern Africa). Women
in the USA, New Zealand and Australia had the greatest increase in BMI in high-income countries.

Age-standardized prevalence of obesity was 9.8% in men and 13.8% in women in 2008, almost double that found globally in 1980. An estimated 205 million men and 297 million women over age 20 were obese in 2008, with the greatest prevalence in North American men and southern African women. Female obesity prevalence was over 30% in North America and in three low- and middle-income sub-regions. South-Asian men and women had the lowest prevalence of obesity, followed by central and east Africa for men, and high-income Asia-Pacific and central and east Africa for women (11). For more detailed information and analysis of obesity trends see Kelly et al. (9) and James et al. (12).

Smoking

Although estimates are fraught with uncertainties, it is considered that as many as 5.2 million deaths worldwide are attributable to smoking (estimate based on 2004 data). Of these, just under one third (1.5 million deaths) occur in HIC, while the remainder (3.7 million deaths) occur in LMIC (10).

Currently, more men than women die as a result of smoking. In 2004, there were 3.6 million smoking-attributable deaths among men (2.7 million in LMIC and 0.9 million in HIC) and 1.6 million among women (1.0 million in LMIC and 0.6 million in HIC) (13). The leading causes of death due to smoking include cardiovascular diseases (1.7 million deaths), chronic obstructive pulmonary disease (COPD) (1.3 million deaths) and lung cancer (0.94 million deaths). In the year 2000, smoking and oral tobacco use accounted for 4.1% of all healthy life years lost in 2004 (13). (More recent estimates suggest that, globally, smoking causes about 71% of lung cancer, 42% of chronic respiratory disease and nearly 10% of cardiovascular disease). It is responsible for 12% of male deaths and 6% of female deaths in the world.

Based on an analysis of current data and trends, morbidity and mortality associated with smoking is expected to rise substantially in the decades to come. Current projections indicate a doubling in the number of deaths every year from tobacco use, from around 5 million in 2005 to 10 million in 2020 (7). Recent data for adolescents (i.e. those aged 13–15 years) from 131 countries plus the West Bank and Gaza Strip (14), revealed surprisingly small differences between boys and girls in their patterns of tobacco use in many regions of the world. If the similarity in smoking rates by sex persists as these young people age into adulthood, this shift in behaviour compared with older groups will have important implications for the global burden of chronic diseases (14). Other features that emerged for this age group was a high use of tobacco products other than cigarettes, a high susceptibility to smoking among never-smokers, and widespread exposure to second-hand smoke (14).

At present, men in industrialized countries of Europe, North America and the Western Pacific have the largest accumulated hazards of smoking. Young men and middle-age men in many regions of the developing world also have large smoking risks (15). This shows that as people (mostly men) who began smoking over the past three decades in developing countries become older, mortality caused by smoking is likely to rise further. Indeed, the current risks caused by smoking in this setting were highly concentrated among men (15).

Given that most of the growth in global population is expected to take place in the developing world (Figure 1.1), the health losses associated with smoking look likely to escalate (15). Tobacco use has already been labelled as one of the most important global health hazards, and the future outlook, in terms of the scale of adverse outcomes caused by smoking, is not encouraging.
encouraging. To avoid a massively increased burden on health-care systems, there is clear need for effective prevention and treatment interventions, such as pharmaceutical cessation support. There will be an increased demand for nicotine replacement therapy as people try to give up smoking.

1.2.3 The global disease burden: the continuing epidemiologic transition

We can visualize the impact of changing demographic patterns and health risk factors by looking at the burden of disease disaggregated according to “acute” and “chronic” conditions. Table 1.1 lists the world’s five most common acute and chronic conditions, ranked by DALY rate (i.e. the number of years of potential life lost due to premature mortality plus the number of years of productive life lost due to disability per 1000 persons). Data refer to 2008. Annex 1 contains the raw data used to create Table 1.1.

### TABLE 1.1 Top five global acute and chronic conditions by DALY rate (DALYs lost per 1000 persons), 2008

<table>
<thead>
<tr>
<th>Condition</th>
<th>DALY burden (DALYs lost per 1000 persons)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acute conditions (communicable)</strong></td>
<td></td>
</tr>
<tr>
<td>Infectious and parasitic diseases</td>
<td>39.24</td>
</tr>
<tr>
<td>Perinatal conditions</td>
<td>17.49</td>
</tr>
<tr>
<td>Respiratory infections</td>
<td>12.18</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>9.65</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>8.35</td>
</tr>
<tr>
<td><strong>Chronic conditions (noncommunicable)</strong></td>
<td></td>
</tr>
<tr>
<td>Neuropsychiatric conditions</td>
<td>30.60</td>
</tr>
<tr>
<td>Cardiovascular diseases</td>
<td>22.84</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>20.13</td>
</tr>
<tr>
<td>Sense organ diseases</td>
<td>13.64</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>12.37</td>
</tr>
</tbody>
</table>

Source: WHO (7). Figure 1.2 is a ‘stacked’ column to save space.

While HIV/AIDS are communicable diseases, they are also chronic diseases in that there is no cure yet.

Figure 1.2 reflects the distribution of the burden of acute and chronic disease across income groups (expressed in terms of the total number of DALYs lost per 1000 persons) over time. These data indicate that, globally, the total DALY rate is expected to rapidly decrease over time for acute conditions but stay relatively constant for chronic conditions. This means that, relatively speaking, chronic diseases will account for an increasing share of the global burden of disease worldwide. The WHO African Region is the major exception; in this Region it is predicted that acute/infectious conditions will continue to predominate, at least up to 2030 and possibly beyond (see Annex 1). Box 1.1 provides a brief summary of how WHO makes these estimates and projections.

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1. DALYs = Disability Adjusted Life Years: The sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability. One DALY can be thought of as one lost year of “healthy” life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability.
Table 1.1 and Figures 1.2 and 1.3 show the preponderance of chronic diseases. The relative contribution to the global burden of disease of HIV/AIDS, and certainly of TB and malaria, is relatively low. However, the regional impact of these three infectious diseases is still huge, although not uniformly distributed.

Figure 1.3 shows the percentage of total DALY burden (in 2008) for HIV, TB and malaria for all countries (all incomes), for all HIC, and for (LMIC) in the various WHO regions. This figure clearly shows that, globally, these three infectious diseases are infrequently associated with HIC. In contrast, the LMIC of the WHO African Region have a disproportionate share.

**WHO’s Global burden of disease estimates and projections**

Global projections of future health trends rely on relatively simple models, partly because of the lack of information on the many separate direct determinants or risk factors for diseases that more complex models would require. The projections presented here are based on models which employ projections of economic and social development, coupled with historically observed relationships between development and cause-specific mortality rates to estimate disease rates (16). The models consider the following socioeconomic variables, all of which are considered to be indirect determinants of health:

- average income per capita, measured as per capita gross domestic product (GDP);
- the average number of years of schooling in adults (referred to as “human capital”);
- time, a proxy measure for the impact of technological change on health status.

The “time” variable includes a component which takes account of the impact of accumulating knowledge and technological development.
of the DALY burden of these conditions, especially HIV/AIDS, relative to the other WHO regions. As AIDS is treated for life this implies that the demand for antiretroviral therapy (ART) is likely to continue to increase. TB, malaria and HIV/AIDS will continue to be key problems in many developing countries, particularly those in Africa, and are thus widely acknowledged as global priorities. Moreover, the emergence of multi-drug resistant strains of the infectious agents which cause these diseases, especially malaria and TB, will demand newer and more effective medicines to bring them under control in these areas of the world.

Figure 1.4 compares projected trends in mortality rates (deaths per 1000 people) for acute and chronic conditions in all HIC and all LMIC. Broadly speaking, the implications of the mortality analysis are similar to those of the DALY analysis (Figure 1.2), apart from the fact that the global average mortality rate caused by chronic conditions is expected to increase over time, in large part due to increasing chronic disease mortality rates in the LMIC of the African, South-East Asia and Western Pacific Regions (see Table in Statistical Annex). However, the number of deaths per 1000 people from acute conditions is expected to decrease. In large part this is due to the improving situation in LMIC, in particular in the WHO African Region (see Annex 1), and notwithstanding the general increase in the Region’s population (Figure 1.1).

Figure 1.4 also shows that in HIC mortality rates due to chronic diseases far outweigh those caused by acute diseases. In fact, LMIC in the WHO African Region are the only group of countries in which mortality rates due to acute disease are expected to remain in excess of those for chronic disease over the next 10–15 years. However, the projection is that by 2030 this difference will essentially disappear (see Annex 1).

Box 1.2 is a short case study showing how the demographic and epidemiologic changes will drive up the chronic disease burden and increase demand for medicines, as exemplified by the growing global epidemic of diabetes.
FIGURE 1.4

Mortality rates due to acute (Group I) and chronic (Group II) conditions, by income group, 2004–2030 (deaths per 1000 persons)

Sources: WHO (4), WHO (7).

BOX 1.2

Case study: Diabetes and pharmaceutical consumption

Along with population ageing and rising levels of obesity, the anticipated increase in the world’s urban population (8) is expected to be a key driver of a projected rise in global diabetes prevalence from 2.8% in 2000 to 4.4% by 2030 (17). The link between diabetes and urbanization is likely related to lifestyle factors such as changes in dietary patterns, physical activity patterns and lifestyles. These in turn are probably a function of socioeconomic developments associated with a rise in car ownership, increased consumption of high-fat, calorie-dense foods, refined sugar and salt, and higher rates of smoking. Even if the prevalence of obesity remains stable until 2030, which seems unlikely, it is anticipated that the number of people with diabetes will more than double as a consequence of these interrelated drivers.

Such rising rates of disease will drive up production and consumption of selected pharmaceuticals, not only oral hypoglycaemics but also medicines for treating the other co-morbidities that are frequently associated with diabetes (e.g. hypertension) in patients who fail to control their diabetes. Figure 1.5 shows actual consumption of oral hypoglycaemics in LMIC for 2000, 2005, 2006 and 2007 (light blue) and projected consumption in 2008 and 2015 (blue diamonds). The burden of diabetes in these countries (expressed in terms of the DALY rate) in 2004, 2008 and 2015 (projected) is also plotted (black triangles). (See also Annex 1 for data tables). Ironically, better access to pharmaceuticals, and therefore increased rates of survival, may actually contribute to the increasing prevalence of diabetes in the future, especially in the more developed countries (17).
Chronic, noncommunicable diseases currently account for more than 60% of all deaths worldwide, of which the vast majority occur in LMIC (1). Anticipated demographic and epidemiologic changes are likely not only to increase the share of chronic diseases in the global burden of disease further but also to drive up the cost of health care. Add to this the possibility of promising but costly new medical technologies and the fact that suppliers of health care have more market power than those on the demand side (6) and policy-makers everywhere are faced with several dilemmas as they plan health-care provision and delivery. How will end-users (e.g. the uninsured and those on fixed incomes, such as the elderly) and their governments afford chronic disease medicines in the future? How should governments allocate scarce funds among prevention and treatment programmes? Which low-cost interventions are best for chronic conditions?

The rising burden of chronic diseases puts pressure on suppliers of medicines to find more cost-effective treatment options and more efficient supply strategies. All of this translates into a need for innovation, not just in medicines, but also in health-care delivery models/systems. These are briefly discussed in the following sections.

For some developing countries, especially those in Africa, the challenges are even more acute. Low-income countries face the prospect not only of an increase in the burden of chronic diseases, but also the ongoing burden of treating illnesses such as AIDS, TB, malaria and other infectious diseases, the so-called “double burden”. In countries with high rates of these infectious diseases (see Figure 1.3), the proportion of health resources that is spent on anti-infective medicines is likely to rise as patient numbers continue to rise and resistance to treatment expands. Furthermore, as new medicines are developed and better health systems are established, the continuing demand for anti-infective medicines will create even more competition for limited resources.

**FIGURE 1.5**

Oral hypoglycaemic consumption (DDD) and diabetes burden of disease

Sources: WHO (5), WHO (7), Wild et al. (17), Volman (18).
1.3.1 Innovation in noncommunicable chronic disease medications

Great opportunities exist for developing and introducing new and innovative therapies for many chronic diseases and conditions. The development of multi-component fixed-dose combinations for the prevention and treatment of cardiovascular disease represents one such opportunity. Indeed, the development of multi-component combination drug therapies (19, 20), especially high-volume, low-cost products based on proven, off-patent generic agents, is supported by scientific evidence and has potentially sizeable public health benefits. Development of heat stable insulin and drug-based therapies for improved obesity control would also be important advances in public health. At present, development of drug treatment for obesity is compromised by severe side-effects and the consequences of regulatory withdrawals from the market. Development is also challenged by the lack of long-term data on the effect of medications on obesity-related morbidity and mortality (21).

Depression is another high burden disease for which pharmaceutical treatments often have severe side-effects. Efficacy of these treatments in adolescents and the elderly is especially problematic. Longer-lasting, sustained release versions of medicines for depression would be another public health advance (22). Two other chronic conditions, both set to become increasingly prevalent, largely as a consequence of the demographic transitions outlined here, are osteoarthritis and Alzheimer disease, neither of which have particularly effective drug treatments at present (22).

There are three groups of patients for which the need for innovation in medicine warrants special mention, namely, the elderly, women and children. Polypharmacy is a well-recognized problem in the elderly. There thus exists a need to develop formulations for medications to be used by the elderly which might, in some circumstances, be fixed-dose combinations. Certainly, there is a need for pharmaceutical care programmes to be tailored to the needs of the elderly (22). It is important to improve the knowledge of drug effects in the elderly by including them in clinical trials, something that is rarely done today. Special guidelines or regulatory requirements should be drawn up to stimulate the inclusion of people aged 70 years and over in clinical trials.

Women, like the elderly, are often underrepresented in clinical trials thereby weakening the knowledge base relating to how medicines affect women, particularly in terms of safety and efficacy. Gender-specific analyses are required to detect gender differences in the effects of pharmaceutical interventions, but these too are seldom performed. Women’s health care is also often compromised by the lack of sex-specific information about dosing of medicines and the uses of certain drugs unique to women, such as contraceptives. There are, however, several opportunities for innovation in this field; current research is exploring the potential of alternative targets for intervention (23), chemical compounds that have estrogenic effects such as tibolone, a synthetic steroid (24), and new drug delivery systems (e.g. vaginal rings, injections) (24). Given adherence is a major determinant for effective contraception, the development of long-acting or controlled-release formulations is another worthwhile aim, as are investment and innovation in other methods of contraception that give women more choice and control.

Children are subject to many of the same diseases as adults and are often treated with the same medicines. However, doses are often simply adjusted to account for a smaller weight, ignoring the fact that children not only differ from adults in pharmacokinetic and pharmacodynamic aspects, but also in adherence to therapy and other factors that influence the effectiveness of medicine use (25). To improve medicines development for children, there is a need to invest more in basic paediatric research, to increase the participation of children in clinical trials and to reverse the underfunding of research on child-specific medicine formulations.
clinical trials, and to reverse the underfunding of research on child-specific medicine formulations (25). There is also a need for more information on drug safety and efficacy in children and adolescents, especially with respect to drugs used to treat mental disorders, which account for a high burden of disease (e.g. depression and anxiety disorders) in this group.

1.3.2 Delivery of health care, including medicines

Innovation in medicines development will only go so far in countering the challenges posed by demographic and epidemiologic transitions. Parallel development and innovation in health care and pharmaceutical supply systems will also be required. Many urban areas serve as referral centres for surrounding communities, and as such there is often greater availability of health and social services in urban areas. Thus, at first glance, it may seem easier, and cheaper per capita, for governments and other agencies to provide health services (however limited) to people living in cities than to the rural poor who are often dispersed over vast geographic areas (26,27). Indeed, some services and interventions, such as early childhood vaccinations, may well be more readily available to an urban population (28). However, the inherent complexity in the relationships between the health, social and environmental aspects of cities means that any analysis that isolates a feature of urban living and health is inevitably going to be too superficial. Specific features of some cities may affect certain diseases adversely, while other features may offer protection (27).

One distinguishing feature of urban health systems is the prominence of the private sector with various fee-for-service arrangements. Rural services on the other hand are often provided at nominal fees using public health-posts and clinics (29). Notwithstanding the fact that, even in the poorest countries, cities tend to have more health and social services (30,31) in practice, services often have different and sometimes even divergent goals. Moreover, the existence of well-equipped and well-paid private practice opportunities in a city may well decrease the likelihood that service providers will work in lower-paid, public service clinics. As a consequence, the urban poor without cash in hand tend to be at a disadvantage when it comes to gaining entry to hospitals, clinics and well-trained providers. As a result this sector of the population often presents with conditions that are more clinically advanced than they would otherwise have been (29), and are often missed by health development programmes, both public and private.

Thus, health-care delivery in a crowded urban area may not be any easier or more efficient than in settings where the population is relatively less dense. The fact remains that health and social services for disadvantaged or marginalized populations in any country are at the mercy of changing fiscal realities irrespective of where they reside (32).

There are several challenges to overcome in this regard (33). First, health-care resources have to be better aligned with the needs of the patient, especially for underserved patients and this includes systems of payment at the level of the patient visit, practice, and in the hospital. Second, systems of primary care should be created that provide sufficient time, space and the interpersonal relationships necessary to ensure high-quality care (33).

Thus, for current systems to adapt to the positive and negative effects of rapid urbanization, and the growth of NCDs, a more fundamental change in approach to health-care provision needs to take place, from reliance on reactive acute care systems towards chronic care systems which perceive the patient as an empowered, active participant rather than a passive recipient of acute health care. Underpinning most chronic care models is the notion that health care should facilitate an ongoing relationship between provider and patient which...
helps patients to make full use of their own and their community’s resources for health (28). In principle, treatment of chronic conditions rests on continuing care delivered by a well-functioning team that creates active patients and professionals working together to improve functions and clinical outcomes (34, 35).

However, for the vast majority of countries, especially those in the developing world, an acute care model of health-care delivery still predominates, providing fragmented care that is primarily reactive, not proactive. Moreover, many regions have to contend with the double burden of both infectious and chronic diseases, coupled with limited resources and inadequate access to medicines. The need for this shift in focus from acute to chronic health-care models comes at a time when advances in information technology, particularly mobile telephones, are reaching every corner of the world. In the context of facilitating the implementation of chronic care models, the role of mobile phone technology, together with several other recent developments relating to the supply of pharmaceuticals, is briefly considered below.

Self-monitoring and over-the-counter preparations
Many patients with chronic conditions self-manage their illnesses. The unfortunate truth is that most people, left to their own devices, will not and/or cannot adequately manage their own conditions, with poorer health outcomes being the inevitable consequence (36). Reversing problems associated with incorrect use of medications and poor adherence to treatment requires a new form of patient–professional partnership, one which involves a programme of collaborative care and patient education (36, 37). This in turn requires health-care staff suitably trained and equipped to support patients in managing their long-term diseases. Unfortunately, today’s health-care systems often lack the capacity to provide lifelong preventive and promotive care (via health education and patient empowerment) and treatment to an entire population. Selling chronic disease medications without a prescription, i.e. “over-the-counter” (OTC), is one possible solution to this lack of capacity. Although compelling, provision of OTC sales of medicines is not without difficulties. Countries will have to deal with the possible lack of data on benefits and risks in the target population, the inability of consumers to make appropriate self-selection decisions, a lack of ability to pay for the poorest families, a lack of appropriate monitoring, and inadequate regulatory control over advertising and marketing. The latter two concerns are especially pertinent to LMIC (38).

Issues of access and re-supply for chronic disease medicines
The distribution of pharmaceuticals for communicable and noncommunicable diseases within many developing countries is inadequate to meet the health-care needs of large sectors of the population. A major obstacle confronting individuals who need pharmaceuticals is availability – the drug delivery infrastructure is often inadequate (see the Chapter on Supply Chain Management). Problems exist across the entire range of drug management, from procuring medicines at the national level, to ordering medicines at lower levels of the health-care system, to receipt, storage, distribution through to re-supply. If there is to be a shift away from reactive care models for acute conditions, it will be critically important to have well functioning pharmaceutical management systems in place. Reliable re-supply of medicines is especially important for chronic conditions which are not intended to be treated episodically. Improved methods of tracking and logistics will also need to be developed.

Role of information technology
In HIC, the use of electronic medical records and other information technology (IT) systems is now routine. Extensions of the application of such systems to improve management of
chronic diseases in LMIC are easily imagined. For instance, diagnostic support systems that allow for automated introduction of clinical care pathways tailored to the needs of the individual (and fed with information about vital signs and pharmacological and physiological responses to therapy) already exist. In hospitals, information about the patient’s medication needs can be fed directly to the pharmacy to facilitate supply and treatment.

Mobile phone technology, in ready supply in most LMIC, (39) may make these same or similar scenarios a less daunting proposition in these LMIC. A clinician might use a mobile device to access digital health records, write and transmit prescriptions, and interact with patients. Medicines administration can be streamlined by allowing patients who are capable of self-medication to do so and auditing their drug administration through use of a bar-code scanning system using mobile phones. Prescribers wishing to deviate from the predetermined care pathway can access all the information necessary to ensure their choices are evidence-based from a smart phone linked into a web-based virtual library.

In principle, IT-based systems have the potential to reduce medication errors, ensure appropriate re-supply and by checking medicines and patient details against prescription records, help minimize risks to patients. Cell phones and other information technologies are already transforming health-care service delivery in some parts of the world. For example, a mobile phone medicine authentication method is in use in parts of Africa (40). Box 1.3 summarizes other examples of the use of IT technologies to exchange information (so-called “telemedicine”) in the clinic, in education and research, which is likely to expand. Mobile telephone-based primary health-care management systems are within reach. The impact of the economic savings alone from using mobile IT in the treatment of chronic diseases could be enormous. However, scaling-up and sustaining these so-called “m health” services will require a sustainable health-care business model and the collaborative participation of the telecommunications, health-care and insurance industries.

**BOX 1.3**

**Transforming health-care delivery using mobile technology: case studies**

In South Africa, a mobile phone system has been developed, in the first instance to support the provision of antiretroviral medicines to patients with HIV/AIDS. However, the system could easily be modified for other conditions. The system relies on text messaging services (SMS) and cell phone technology for information management, transactional exchange and personal communication. The cell phone makes use of a normal issue SIM card across any existing cell phone network.

In a geographically diverse region of Indonesia, existing Internet communication equipment is used for telediagnosis, remote consultation, and collection and recording of patient information. There are two linked units: the mobile telemedicine unit on the patient side, and a hospital/doctor unit at the medical service centre. Telediagnosis is facilitated through provision of instruments for monitoring blood pressure, an electrocardiogram and Doppler fetal-diagnosis equipment at the patient end. Exchange of data between the patient and the hospital is performed via cell phones and fixed-line telephones. In this way, people living in rural areas or remote settlements can benefit from periodic medical examinations without having to make a long journey to a distant hospital.

Further examples of these and similar technologies can be found at:

REFERENCES


http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(06)68192-0/fulltext

http://tobaccocontrol.bmj.com/content/12/1/79.full


http://care.diabetesjournals.org/cgi/reprint/27/5/1047


20. Wald N, Law M. A strategy to reduce cardiovascular disease by more than 80%. *British Medical Journal*, 2003, 326:1419–1425. Available at: 
http://www.bmj.com/cgi/reprint/326/7404/1419


40. MPedigree web site: http://www.mpedigree.org/home/
ABBREVIATIONS

AIDS  Acquired immunodeficiency syndrome
AFRO  African Region (WHO)
AMRO  Region of the Americas (WHO)
ART  Antiretroviral therapy
ARV  Antiretroviral
BMI  Body mass indices
COPD  Chronic obstructive pulmonary disease
DALY  Disability-adjusted life year
EMRO  Eastern Mediterranean Region (WHO)
EURO  European Region (WHO)
GDP  Gross domestic product
HIC  High-income countries
HIV  Human immunodeficiency virus
IT  Information technology
LMIC  Low- and middle-income countries
OTC  Over-the-counter
SEARO  South-East Asia Region (WHO)
TB  Tuberculosis
WHO  World Health Organization
WPRO  Western Pacific Region (WHO)