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The Health and Care Professions of the Future

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In English:

1. *'A Truly Golden Handbook': The Scholarly Quest for Utopia*, Leuven: Leuven University Press, 2016
2. *A European Social Union after the Crisis*, Cambridge: Cambridge UP, 2017
3. *Dementia and Society*, Cambridge: Cambridge UP, 2022

In Dutch:

1. *Wat met de verkeersknoop?* Leuven: LannooCampus, 2013
2. *Wat met genetica?* Leuven: LannooCampus, 2013
3. *Wat met psyche en pillen?* Leuven: LannooCampus, 2014
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8. *Wat met ons voedsel?* Leuven: LannooCampus, 2017
9. *Wat met recyclage?* Leuven: LannooCampus, 2017

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10. *Hoe word ik Einstein of Da Vinci? Een inleiding tot wetenschappen vandaag voor de homo universalis van morgen*, Leuven: LannooCampus, 2015
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EXECUTIVE SUMMARY

SOCIETAL DEVELOPMENTS

A number of current societal trends are raising difficult challenges for the health care system.

- The changing composition of the population and the increasing prevalence of chronic diseases and of multimorbidity require a better integrated health care and a better integration between health and social care. This can only be realised by accounting for the life goals of persons with care needs in care planning.
- Prevention is not only about behaviour, it is also about the natural environment as a disease factor. Global warming will raise new challenges for the health care system, which are difficult to predict.
- The trend towards patient empowerment is leading to a change in the interpersonal relations between care professionals and persons in need of care. Improving the health literacy of the population will become even more important in a setting in which different sources of information are competing and there is an increasing share of fake news.
- Respect for persons implies respect for a growing cultural diversity. Moreover, socioeconomic inequalities and the resulting health disparities remain significant.
- Without changes in the organisation of work, the present scarcity on the labour market for the care professions will persist in the future.
- The legal context, including the rigid regulation of the medical professions and the privacy and liability regulations, makes it difficult to introduce structural changes in the health care system.
- The organisation of health care is (slowly) moving in the direction imposed by these societal developments: better integration between health and social care, changes in the position of the hospital and the gradual introduction of new remuneration schemes for providers.

TECHNICAL SCIENTIFIC EVOLUTIONS IN HEALTH AND SOCIAL CARE

Interaction between engineering and medicine has changed profoundly over the past fifty years and is expected to shape the future of health care (professions) in an unprecedented way.

- Key in the development of future medical technology is that it should be based, as much as possible, on expert knowledge and biological insights, justifying an approach to the development of medical solutions moving 'from biology to technology'.
- The patient perspective should also be better accounted for, not only to contribute to assessing technology from the clinical perspective, but also from the psychological and social point of view. In this way, patients could significantly contribute to health technology assessments (HTA).
- Genetic technologies have become a core factor in clinical practice as they link with many medical professions and services, such as oncology, paediatrics, neonatology, metabolic diseases, pneumology, dental health, pathology, neurology, gynaecology, gastro-enterology, fertility, etc.
- Genetics is making predictive and preventive medicine possible, which implies that a different organisation of health care may be needed in the future. In light of these developments, one might argue that we also need centres for healthy people, spaces for preventive health care

where genetics and epigenetics come together to present the person with the best options to promote and consolidate a maximised healthy future.

- Due to the vast amounts of information being generated by medical technologies such as genomics, surgical robotics, medical imaging and health monitoring and telemedicine, a more statistical approach is strongly recommended.
- Processing the big data streams generated by these technologies has become big business, driven by artificial intelligence (AI). However, we should be aware that AI also raises important challenges when applied in the medical field, such as the need for digital literacy on the part of both the patient and caregiver, the need for data analysis skills in the decision-making teams, knowledge on how to collect, organise and pre-process the generated data using the appropriate infrastructure, the need to solve interoperability issues and satisfy all GDPR regulations in data handling and sharing.
- Due to this evolution, there is a growing need for medical technologists, ranging from biomedical or human health engineers (or any subareas such as bioelectronics, biomechanics, biorobotics and biomaterials) to data analysts, biostatisticians, and bioinformaticians. These technologically trained people should complement each decision-making team. Adequate answers to the identified challenges require specific competences and roles of the professionals involved, which need to be provided through well-aligned educational programmes.
- A shift towards a closer collaboration and even integration of medical and technical professions in health care is essential and must be implemented as early as possible in future health care curricula.

MAXIMIZING THE HEALTH POTENTIAL OF EVERY PERSON

An outlook on future care professions is strongly linked to the concepts and perceptions of health. Some operational characteristics of health are discussed:

- Health is considered as a multidimensional concept that is scalable rather than binary and of which the meaning, e.g. healing versus adapting, may change with age.
- The individual and society share the responsibility to fulfil a person's health potential.
- An integral approach towards persons in health and disease and a preference for people with fewer opportunities for healthy living will be crucial for a high-quality, accessible and affordable care, i.e. care that maximises the chances of a long and healthy life for everyone in society.

This framework has important implications for care professionals.

- Their training and professional activity should be aimed at ensuring that the person/patient can live independently and meaningfully for as long as possible, free from preventable diseases, disabilities, and accidents. Care professionals should therefore learn to adopt an integrated view of the person/patient and balance individual elements (genetics, behaviour) with social determinants. They should be aware of the socio-economic gradients and disparities that impact health and disease and strive for equity in health care.
- This also shifts the focus of the care professional to promoting and maintaining health. The traditional 'cure & care' approach remains important and will, in practice, consume a large part of the professional's time and activities. However, it should be complemented by promoting healthy behaviour across the different stages of life and supporting a healthy environment for all, emphasizing the importance of primary prevention.

WHAT WILL HEALTH AND SOCIAL CARE LOOK LIKE IN 2040?

While it remains very difficult to predict the future, several trends in health and social care can be clearly identified.

- Both the technological evolution in health care itself and the socio-economic and environmental challenges of the present era threaten to increase already existing inequalities in access to education and care, social network connectivity and wealth. These inequalities limit the capability of individuals to actively participate in decision-making about their own health and well-being, which is a crucial component of future self-learning health systems with more emphasis on prevention.
- These future self-learning health systems will be characterised by hyper-connectivity with multiple, diverse data being collected on an individual and societal level, optimizing diagnosis, prognosis and treatment choices. However, it will also form a challenge to privacy and the balance between individual rights and societal benefit.

Having to make the proper choices at the individual level and support policy decisions at the political level, taking financial limitations into account, will leave the health care professionals of the future with a daunting task.

- They will need to conquer the ever-increasing information flow and translate it into individual and generalisable decision choices, making proper use of the capabilities of AI while keeping the human factor as the core value in their relationship with citizens, patients and their family.
- Teamwork will be the only valid solution to the need to approach the individual as a whole, while also keeping pace with the need for expanding knowledge and specialisation.

COMPETENCES OF THE FUTURE CARE WORKFORCE

Health care and welfare are provided by professionals from numerous disciplines, often working in isolation from each other, which results in disconnected disciplinary silos. Inherently, overlaps between disciplines or gaps of care provision cannot be avoided. Such suboptimal care delivery becomes an even bigger problem when there are shortages in the workforce. Hence, it is imperative to break down the silos and assign health care professionals to patients in a more flexible way. To achieve this, all health care professionals will need a common, generic set of basic competences; and a system of credentialing needs to be in place. This means that the collaborative teams of the future should be more fluid, and members of different settings should be working together on the specific needs of the patients, i.e. form co-acting groups.

Starting from an emphasis on competences instead of professions, all care professionals ought to have the following critical competences:

- Person-centred care entails an integrated perspective on the patient as a person, with strengths, capacities and resources.
- The person-centred approach should be supported and facilitated by new technologies. Therefore, care professionals need an understanding of how technologies are developed, to be willing to participate in the co-design of innovations, embrace technologies and integrate them in their workplace, and support patients when they are using or being confronted with advanced technologies.

- New technologies will result in a huge amount of data. Therefore, health care professionals will need a basic understanding of data-analysis and statistics, as well as the competence to explain statistical findings to patients.
- Given the increasing importance of prevention, competences in health promotion, in behavioural change, and in early detection and intervention, both in clinical settings and in society, will be required.
- Society is characterised by a high degree of diversity. Care professionals will need to master a sensitivity for and competence in dealing with diversity. A culturally diverse workforce will facilitate the adoption of culturally sensitive care.
- Self-care: given the high rates of burn-out and addiction among health care professionals, they need to learn how to take care of themselves. To achieve a change in attitude among the future care workforce, the ‘glorification of busy’, and by extension the cultivation of sleep deprivation, should be stopped.
- Communicating with patients/families: communicating about uncertainties is critical. When patients understand that uncertainty is inherent to health care, it is less likely that they will see uncertainty as an indicator of incompetence. This is important for trust in individual providers and in the health care system at large. Further, care professionals ought to master communication skills that enhance empowerment and health literacy.
- Communication technologies can facilitate communication with patients and their families, and within the teams. Telehealth competences will be needed to achieve technology-supported shared decision-making and adequate coordination of care.
- Communicating to society: all care professionals will be involved (at least to some extent) in ‘science communication’ and hence will need the competences to explain health issues in a way that is understandable to the lay public. To tackle the ‘fake news’ epidemic, care professionals will need to be able to serve as ‘fact checkers’, to refute fake news, to listen to the underlying questions and uncertainties of the public, and to answer adequately.
- Although the majority of care professionals will not work as researchers, all providers need to have adequate insights into the scientific process, so that they understand how and why research is critical to inform clinical practice. In this way, they will also better understand why there are uncertainties in clinical decision-making and public health.
- To be able to use and apply scientific evidence in clinical practice, care professionals ought to have the competence to search for, appraise and understand the reporting of empirical research, and to translate this information for patients. This forms the basis for evidence-based practice.
- Health care professionals will need the competence to participate in the co-creation/co-design of new health care interventions. Co-creation and co-design are methodologies to develop new interventions together with patients, which enhances the adoption of the interventions because the newly developed interventions meet the true needs of the end-users.
- While multidisciplinary collaboration in health care has been advocated for a long time, a transdisciplinary approach is more effective. In transdisciplinary collaboration, team members collaborate across the boundaries of their own discipline.
- It remains important in collaborative efforts that overviews and coordination are safeguarded. One of the team members needs to serve as a ‘case manager’ who ensures that the shared goals for each patient are kept at the centre of attention.

- Health advocacy: care professionals must work with patients/families and with communities or populations to increase their opportunities to adopt healthy behaviours and to have access to needed health services. They also need to participate in the public debate, in order to contribute to the improvement of health.
- Economic status, neighbourhood and physical environment, education, food, community and social context are all acknowledged as social determinants of health. Since several of these social determinants are actionable, a system approach is required. Care professionals, and by extension all disciplines that have a potential impact on policymaking, need to know how to develop 'health in all policies'.
- Patients and populations rely in part on the demonstrated health behaviours of care professionals. Therefore, the impact of care professionals as role models for good health cannot be underestimated. They need to embody practices of health promotion and protection.
- Clinical and professional leadership: while not every care professional will end up in a management role, each of them will be involved in discussions and decisions about the organisation of care, quality improvement, priority setting and financing/remuneration. Therefore, they need to have competences to participate in such discussions at the system level.
- Managerial skills: at a micro-level, all care professionals will need competences to manage their own practice, i.e. to carry out professional duties in the face of multiple, competing demands, to set priorities and to establish plans for ongoing care.
- Being a care expert: the development and use of the above-mentioned competences, and the integration of all the CanMEDS roles. In line with the need to assign tasks to care professionals in a more flexible way, taking up a role as expert entails that care professionals only perform tasks for which they are credentialed, and do so in a skilful and safe manner.

TOWARDS THE FUTURE OF HEALTH CARE CURRICULA

What should health care curricula look like in the long term, e.g. 2040 and beyond? This time frame has the advantage of not being constrained by the current legal or regulatory frameworks regarding educational programmes or health care professions.

We start with some general guiding principles for all future curricula that form professionals to be active in the health and care sector. The ultimate goal of these curricula is to help realise the overall ambition of maximizing the health potential of every person, both at the individual level and at the population level. To do so, health curricula should meet several criteria:

- Curricula, or at least some of their components, should be designed in a sufficiently generic way so that health care workers across different degree qualifications share basic competences, facilitating collaboration between health care workers with different qualifications.
- Health care training should be conceived as a continuum starting with an initial training that traditionally leads to a specific discipline-based degree and professional qualification. Once health care workers are professionally active, a broad spectrum of continuous professional education and lifelong learning follows.
- Health and technology should be interwoven in the curriculum so that students become familiar with the different aspects of health care technology. This will prepare students to adopt new technology as their practice evolves and to collaborate with engineers and scientists.

- We should beware of overloading health care curricula and of asking the impossible from (future) health care workers. On the one hand, we should be ambitious in designing optimal health care curricula that fulfil the needs of patients and the population. On the other hand, we should temper unrealistic expectations towards individual health care professionals and their training.

Next, some guiding principles for the design of health care curricula are defined with respect to learning outcomes, curriculum design, proficiency attainment and entrusting. As such, they provide a frame of reference that programme committees at all levels of training can use to implement their specific curriculum.

First of all, a set of overarching learning outcomes is proposed that apply to every health curriculum.

- Expertness, reflecting the discipline-specific expertise and competences to deliver health care in an evidence-based way.
- Artfulness, reflecting the professional competences to collaborate with other health care workers, to act according to legal, deontological, and ethical standards, to take responsibility for continuous professional development and to adopt a person/patient-centred approach.
- Roles adoption, reflecting the growth process towards being an effective member of a collectively smart care team with shared expertise and alignment of vision, purpose, and values.

Second, curricula can be anchored to the different contexts in which health care is delivered, since these contexts reflect the patient's experience and perspective in different health care situations. Such a demand-based organisation of the curriculum allows for a patient-centred and patient-oriented learning experience across different health curricula. To go beyond the classical 'cure & care' context, the following contexts are envisaged, based on Lillrank's classification:

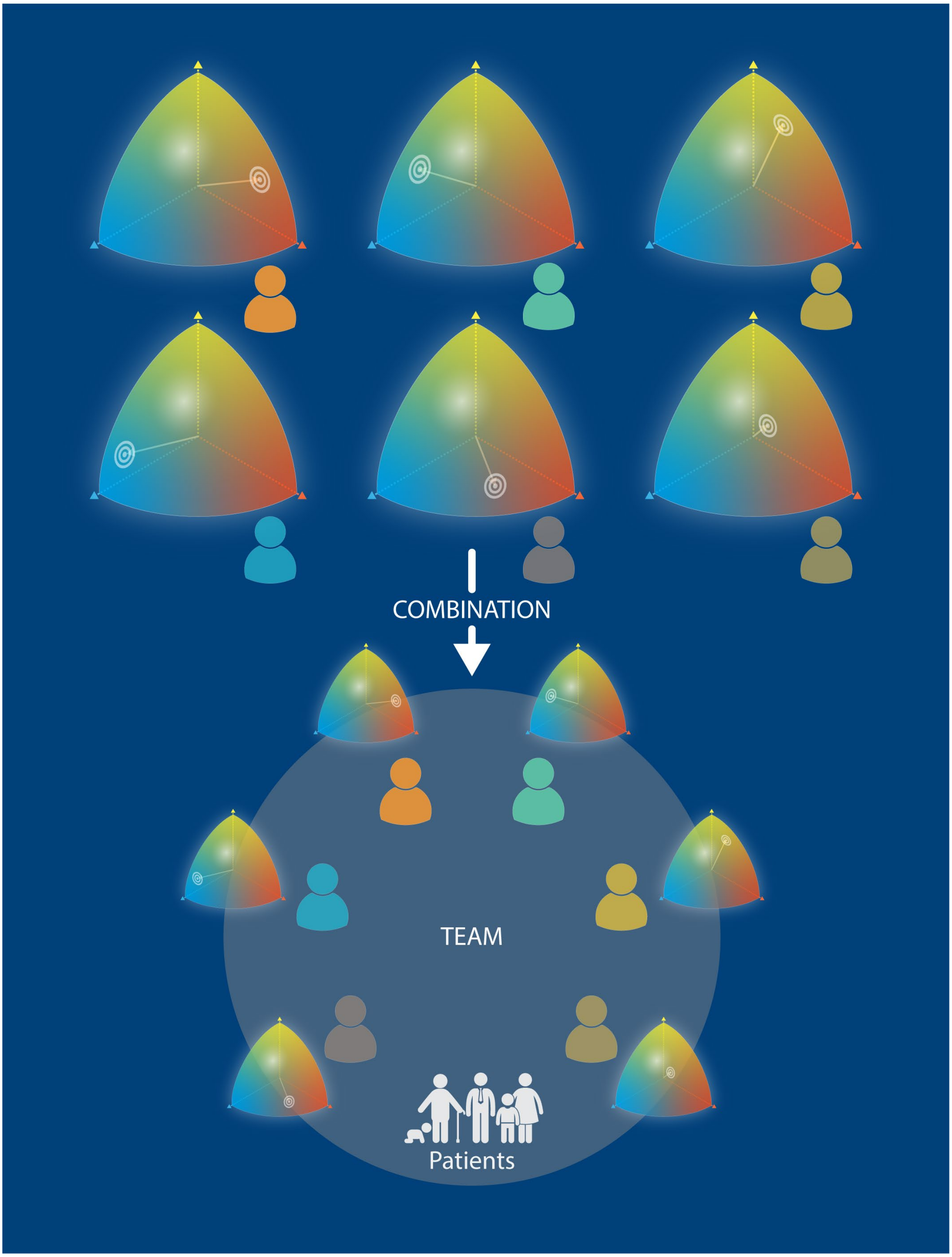
- Prevention or long-term health promotion in the absence of an acute health problem.
- Emergency care that requires immediate action.
- 'One visit', i.e. non-urgent, non-severe cases that are concluded in a single session.
- Elective procedures for conditions that can be precisely defined and scheduled.
- Emergent cure processes in which the full diagnosis requires a structured and progressive process with interim assessment of the diagnostic results.
- Care processes that last until the end of life, e.g. chronic or terminal conditions.
- Projects, i.e. complex, rare and poorly understood, which require an individual *ad ho*c approach.

Third, curricula should specify and differentiate the level of competence that is expected upon graduation. A useful guide to define the proficiency level of expertness is provided by Bloom's revised taxonomy (Anderson et al., 2001) with six levels of complexity: remembering, understanding, applying, analysing, evaluating, and creating.

Fourth, roles adoption should be progressively emphasised during the curriculum. The initial phase of the training mainly focuses on expertness and artfulness. At a later stage, and especially at the level of continuous professional education, roles adoption will become more and more prominent. This will require interprofessional and interdisciplinary course modules with (in)direct input of patients to ensure relevance to the professional situation, in particular the functioning of a multidisciplinary care team.

We conclude by proposing a basecamp module at the start of every health care curriculum. The underlying idea is to immerse starting students – whatever their specific curriculum – in a common way of thinking and acting along shared principles of health care in different patient settings. A basecamp module also allows for interdisciplinary or interprofessional course activities with students from other programmes, thereby instilling the concept and value of teamwork in health care from the very beginning. Such a basecamp should not deal with in-depth analysis or detailed elaboration of the subject. Rather it is an initiation course that provides an overview of health care and sets out the milestones for their learning path. Ideally, patients and their families should be closely involved in the basecamp training. A very ambitious implementation of an interdisciplinary and interprofessional basecamp would be to group starting students from different health care curricula in a common module during one semester, after which they split up and continue in their discipline of choice. A return to the basecamp could also be incorporated in modules of lifelong learning. Mixing starting students and active professionals in a basecamp would also promote the transfer of competences between ‘generations’, thereby instilling a sense of responsibility toward the next generation of colleagues and promoting a sense of meaningfulness.

Figure A. Health care professionals with different disciplinary and curricular backgrounds join to form a multi-disciplinary care team which also comprises the patient as a member.



INTRODUCTION

In all Western countries, the health care and health insurance system has come under pressure. In an ageing society, the needs of the population are changing and the prevalence of chronic diseases and multimorbidity is increasing. This raises the need for prevention and for social care on top of traditional curative health care. Society is becoming more and more diverse, and the average educational level of the population is increasing, changing the relationship between the persons in need and the carers. There is a general feeling that there should be less focus on hospital care and more on the organisation of ambulatory care. More and better collaboration between different care professions is needed. At the same time, technical developments are moving at speed, in many cases contributing to an increase in government expenditure devoted to (health) care. All these issues were already familiar before the outbreak of the pandemic, but the pandemic has brought them even more clearly to fore: the need for prevention, the importance of informing the population, the need for a flexible organisation of care, …

This position paper offers a reflection on these broad challenges. If the observed trends can be projected into the future, what does this mean for future care professionals? How should they be prepared for these new challenges? What competences are needed in this new environment?

Chapter 1 offers a summary of the most important societal changes: demographic developments (section A), changes in the informational environment and the trend towards patient empowerment (section B), changes on the labour market and in the organisation of labour (section C), the legal and environmental context, including the challenge of global warming (sections D and E), and finally some of the current developments in the health care system itself (section F). Chapter 2 describes the main technical scientific evolutions in the domains of genomics and personalised medicine (section A), robotics (section B), medical imaging and artificial intelligence (section C) and telemedicine (section D). In Chapter 3 we present the ethical framework that we use to evaluate these developments. Technical and societal evolutions and the conclusions drawn for the care professions are influenced by the decisions we make as a society, and these decisions should be guided by an ethical perspective on what we consider to be good care in a good society. We see health as a multidimensional and dynamic concept and defend an integral approach towards persons in health and illness with a preferential option for people with fewer opportunities for a healthy life. Chapter 4 combines some of the ideas from the preceding chapters in a speculative sketch of what the health care system might look like in 2040. We then turn to more practical issues. Chapter 5 describes the necessary competences of future care workers: their roles as professional, communicator, scholar, collaborator in a joint team effort, health advocate, leader and health expert. The resulting challenges are taken up in the final Chapter 6 in which we present some pathways to integrate our vision into future educational curricula. Of course, we only sketch broad tendencies and do not propose a specific curriculum reform.

Throughout the text we interpret ‘health’, ‘health care’ and ‘care’ in a broad sense. In fact, one of our starting points is that the distinction between health care and social care is becoming more blurred due to the developments described in the first chapter. In the same vein, the term ‘health care professionals’ should be interpreted broadly. It does not refer only to the traditional health care professions (such as medical doctors, nurses, physiotherapists, ...), but also to care professions (such as family workers) and engineers who are active in the health care sector.

It is obvious that the societal and technological challenges that we describe will also require changes in the way we organise and finance our health care system in general, and care providers in particular. At some points we will take position on these issues, but this is not the focus of the paper.

We only discuss these more general structural issues when and in so far as they relate directly to the future role of care professionals.

We also leave aside the debate about the desirability of devolution in the Belgian health care system. A more important limitation is our restriction to the organisation of health care in Belgium. For reasons of space and time, the perspective on global health has not been developed, although we are aware that it is essential from an equity point of view and that the pandemic has shown that a broad world perspective is needed.

Given that we have reflected on the future, some of our positions and insights are necessarily speculative. This position paper does not attempt to predict what will happen in the next decades. It offers a framework that can stimulate a structured and coherent reflection on the future role of care professionals and on the specific steps that can be taken to help them fulfil that future role.

1. SOCIETAL DEVELOPMENTS

Future developments in society will have a crucial impact on the future of the care professions. Thinking about the health and care sectors in 2040, therefore, also means thinking about society in 2040. It is of course impossible to predict the future, but we can cautiously extrapolate current trends to get a rough idea of the challenges we will have to face. Such an extrapolation of trends does not yield a prediction. Certainly, with a time span of a couple of decades, structural breaks in some of the trends are possible and these could lead to a completely different society. Five years ago, only a few observers had predicted the outbreak of a pandemic or of a war in Europe. Yet, even the simple prolongation of trends is already somewhat speculative (as will become clear) and it is surely the most cautious approach.

The future is not fixed, but is partly determined by what people make of it, by the values and goals that are now being realised through social processes. In this first chapter, we discuss what seem to us the most relevant social developments, and in the following chapter we focus on scientific evolutions. The third chapter presents the ethical framework based on which we want to evaluate, and if possible, influence, these changes.

In the first section of this first chapter, we briefly describe demographic evolutions: the ageing of the population, increasing levels of education, less stable family relationships, large health inequalities, increasing diversity, and the increase in the number of chronically ill people. These demographic evolutions are closely linked and partly overlap with the developments that we describe in the second section: the trend towards increasing patient participation in the decision-making process with the associated challenge of health literacy, the growing influence of social media and the spread of quality indicators. Next, we look more closely at the labour market situation and the challenge of reorganising care in the light of social developments. Possibilities for change are partly conditioned by the legal context. In the fourth section, we pay particular attention to developments in the field of privacy and to the limitations that result from an inappropriately strict regulation. In the fifth section, we look at changes in the natural environment, including climate change. Finally, we discuss some likely evolutions in the care sector itself. Of course, much more about the developments and challenges in the care sector will be said in the following Chapters 2-6. In this first chapter, we limit ourselves to a description of some issues in the care sector that follow more or less directly from the societal developments we describe: the challenge of keeping care affordable, the blurring of the boundary between health care and social care, rethinking of the role of hospitals in the global organisation of care, and the expected changes in the way providers are remunerated.

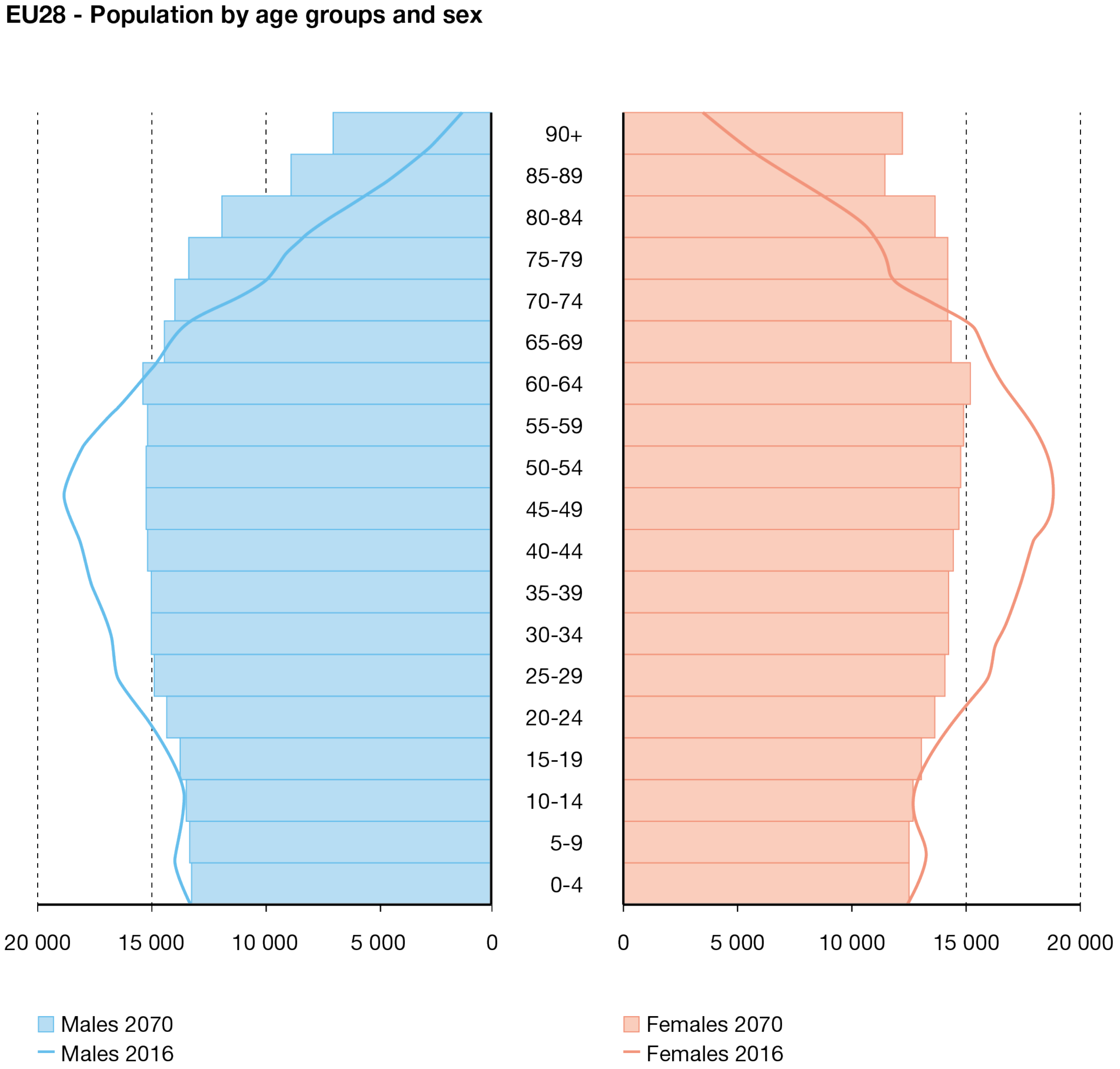
A. DEMOGRAPHIC DEVELOPMENTS

I. AN AGEING POPULATION...

The population is ageing, and we can assume that this evolution will continue in the future. A possible simulation of this future is shown in Figure 1. While ageing is by now a well-known fact, to properly analyse the consequences of this process requires some important nuances.

In the first place, a distinction must be made between the structural demographic transition caused by the long-term decline in birth and death rates, and the baby boom caused by a temporary wave of births in the middle of the 20th century. The first phase of the structural demographic transition is a rejuvenation of the population, resulting from a fall in infant mortality and an improved life expectancy for children. The second step, and the first towards population ageing, is the decline in fertility, which leads to de-juvenation and a narrowing of the base of the population pyramid. This step was taken in the West in the period 1870-1970. It is only after this fertility decline that mortality decline becomes the main driver of further ageing, with an increase in life expectancy in the older population. We are now in this phase. In itself, this ageing is a positive evolution: more children survive, and most people live long enough to see their grandchildren grow up.

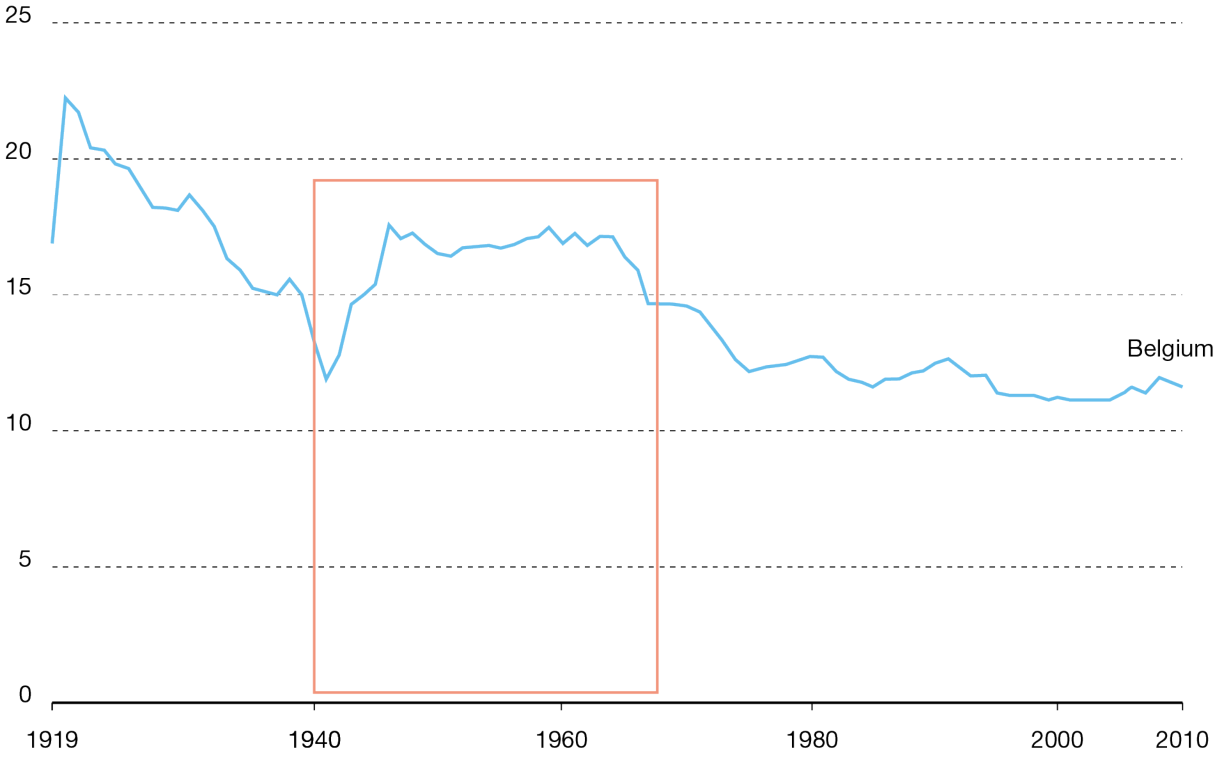
Figure 1. Ageing of the population (source: Commission services, Eurostat)



On top of this structural transition, we have witnessed a temporary acceleration of the ageing process as a result of the baby boom. During WW2, women postponed having children, but the number of births caught up after the war (see Figure 2). There was thus a sharp increase in the number of births and this post-war 'generation' then gradually moved up the population pyramid. This is a temporary phenomenon: by 2040, the baby-boom generation will have died out.

In the current welfare state, this baby boom in particular has important economic implications because of the rising costs of care and pensions. These consequences cannot really be absorbed by a demographic policy: we cannot stop the ageing of the population, but we must adapt the social institutions to the reality of the ageing population. We will return to this point later.

Figure 2. Number of births per 1,000 people in the population, Belgium (source: Mitchell, 2013, downloaded from https://ourworldindata.org/fertility-rate)

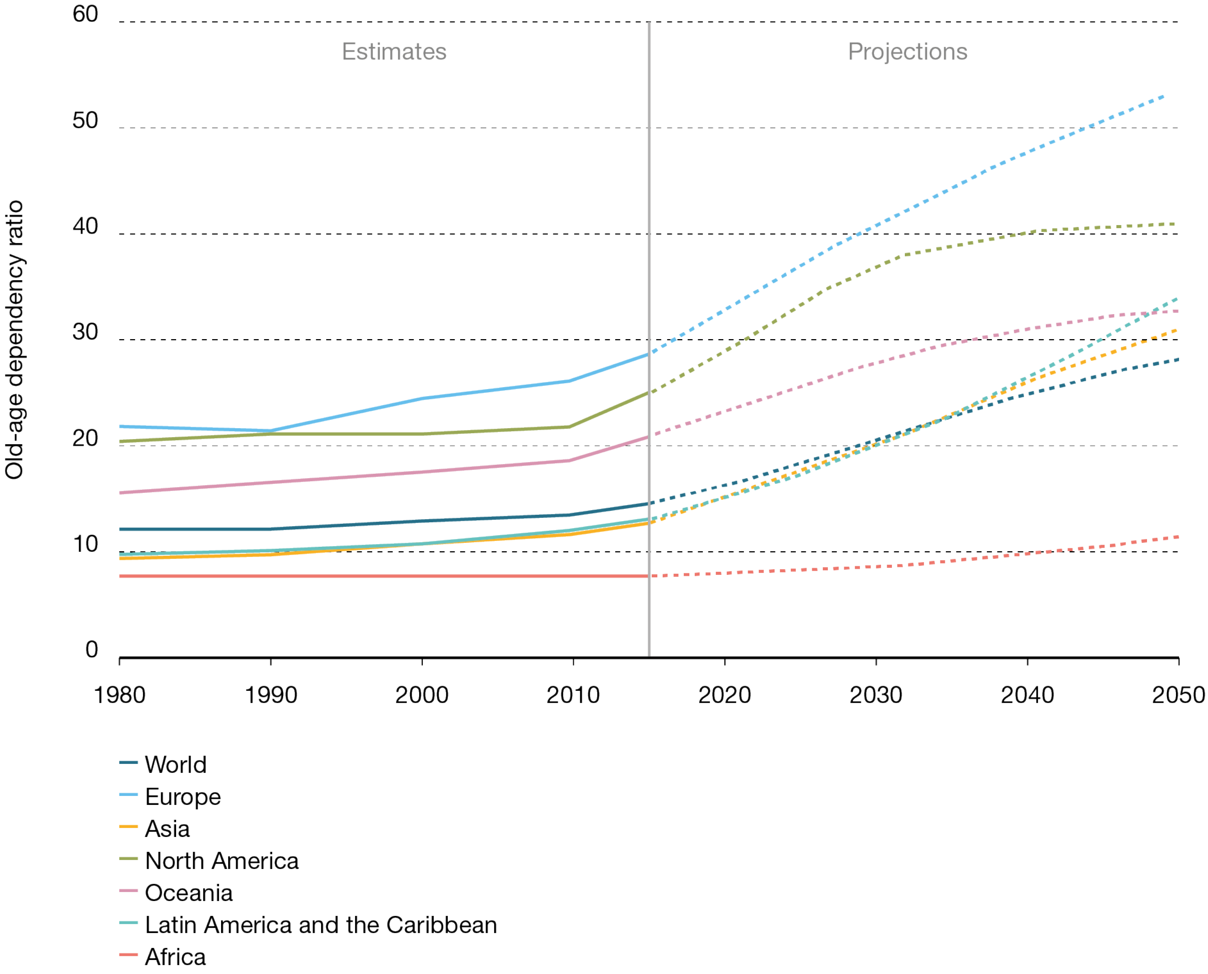


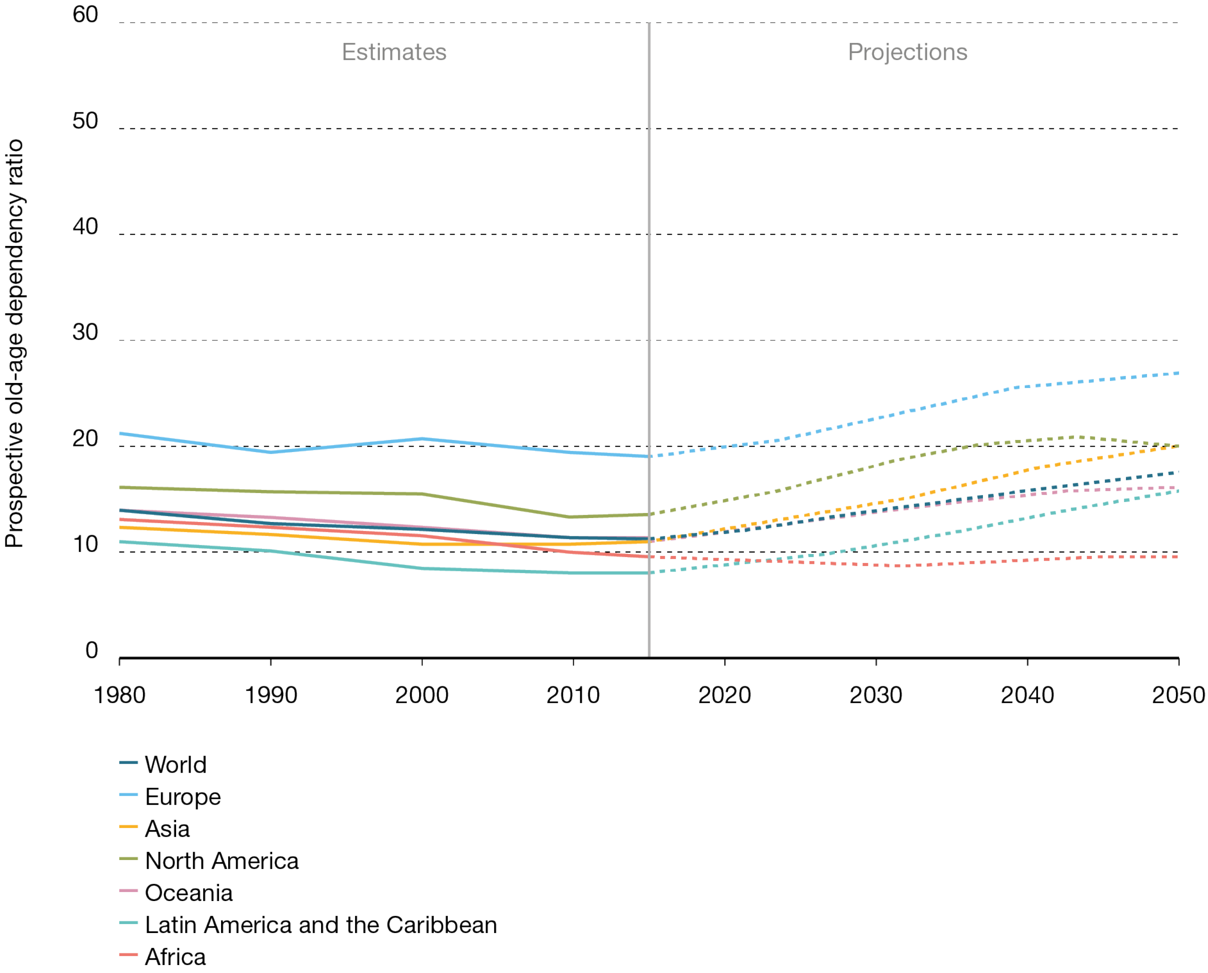
II. … THAT IS HEALTHIER AND BETTER EDUCATED…

A classic way of summarising the impact of ageing is the so-called *old age dependency ratio*, which divides the number of people aged over 65 by the number of people aged between 20 and 65. However, this is a very limited measure that does not consider remaining life expectancy and state of health and disability (Sanderson & Scherbov, 2015). To get a better picture of the future, use should be made of the *prospective old age dependency ratio,* which divides the number of people with a life expectancy of 15 years or less by the number of people at least 20 years old with a life expectancy of more than 15 years. This measure gives a less negative picture and also changes the ranking of several countries and continents (see Figure 3). A second alternative measure is the *adult disability dependency ratio*, in which the number of people at least 20 years old with disabilities is divided by the number of people at least 20 years old without disabilities. When comparing this with the conventional ratio, the increase is even less dramatic than with the *prospective old age dependency ratio*, because the health status of populations has improved.

More importantly, the increase in the level of education of the population must also be taken into account. This has significant implications for the demography of the labour market. In a recent demographic analysis of the EU labour market (Marois, Sabourin and Bélanger, 2019), four virtual scenarios for the period 2015-2060 were calculated for the labour force dependency ratio, defined here as the ratio of the number of inactive persons to the total active population: an education equality scenario, where children of low-educated mothers are assumed to achieve the same level of education and labour market participation as the rest of the population; immigrant equality, where labour market participation among migrants evolves towards that of natives; gender equality, where labour market participation among women becomes the same as among men; and finally super equality, where the three aforementioned previous trends occur simultaneously (Figure 4). The results clearly show that the composition of the population according to educational levels is a more important factor for the labour market than the demographic evolution per se. In section C of this chapter, we will take a closer look at the evolution of the labour market for the care professions.

Figure 3. Prospective old-age dependency ratio (source: United Nations, 2017)

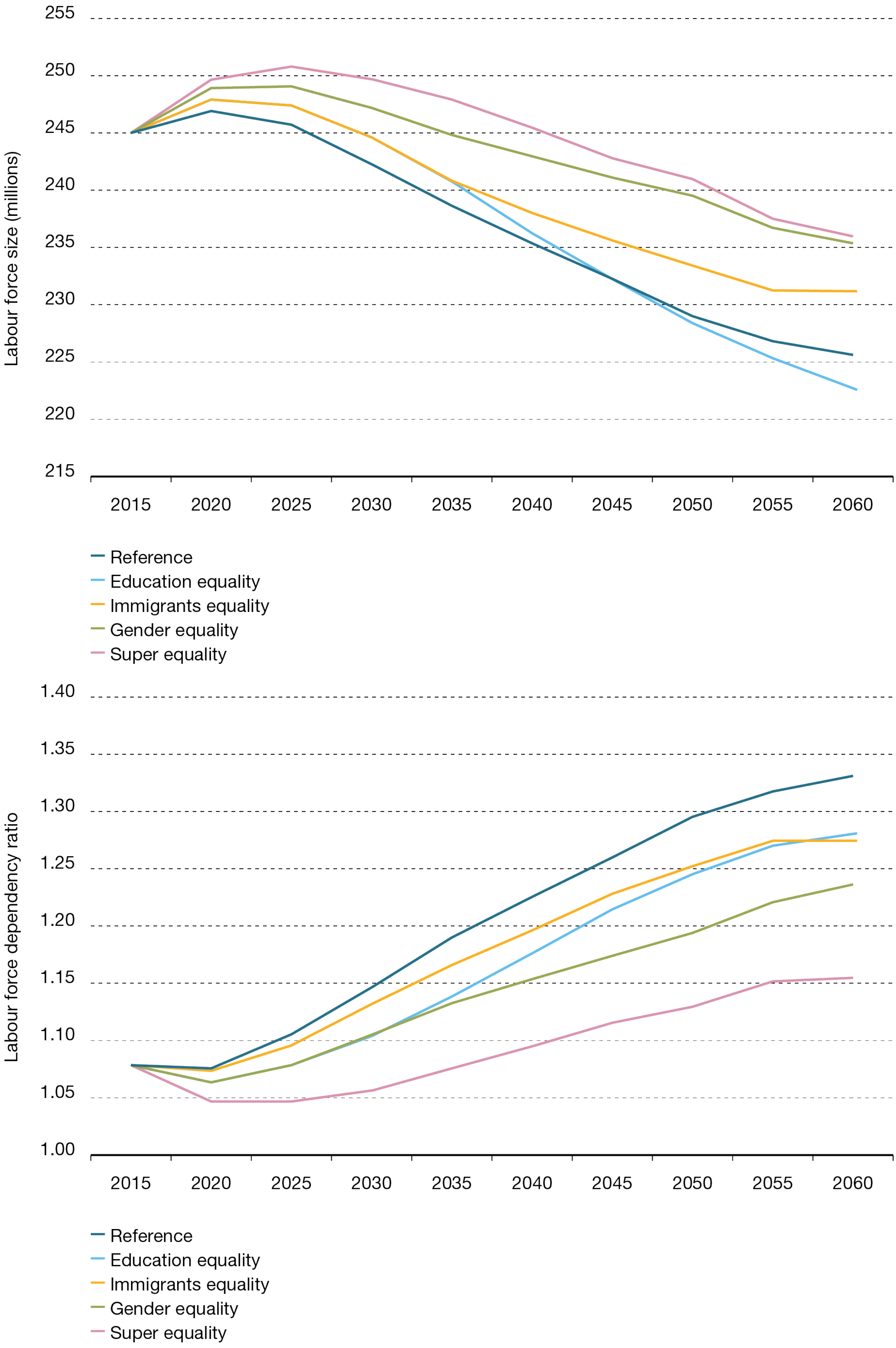




Data sources: OADR are from United Nations (2017). World Population Prospects: the 2017 Revision. POADR are special tabulations provided to the United Nations by Warren Sanderson and Sergei Scherbov based on the methods outlined in Sanderson and Scherbov (2005, 2010, 2015) and consistent with the population estimates and projections published in the 2017 *Revision of World Population Prospects*.

Figure 4 also shows the importance of increasing the participation of women in the labour market (the ‘gender equality’ scenario). There is still some way to go, but the evolution is certainly moving in the direction of an increase in women’s participation in the labour market. Moreover, it is becoming increasingly common for women to have a higher average level of education than men and to be the main breadwinner within the family. The fact that more women are active in the labour market is positive. But the unpaid work that women have always done, for example in the form of informal care, will now have to be paid for. This work will not simply shift to men, but will require further professionalisation of the sectors concerned.

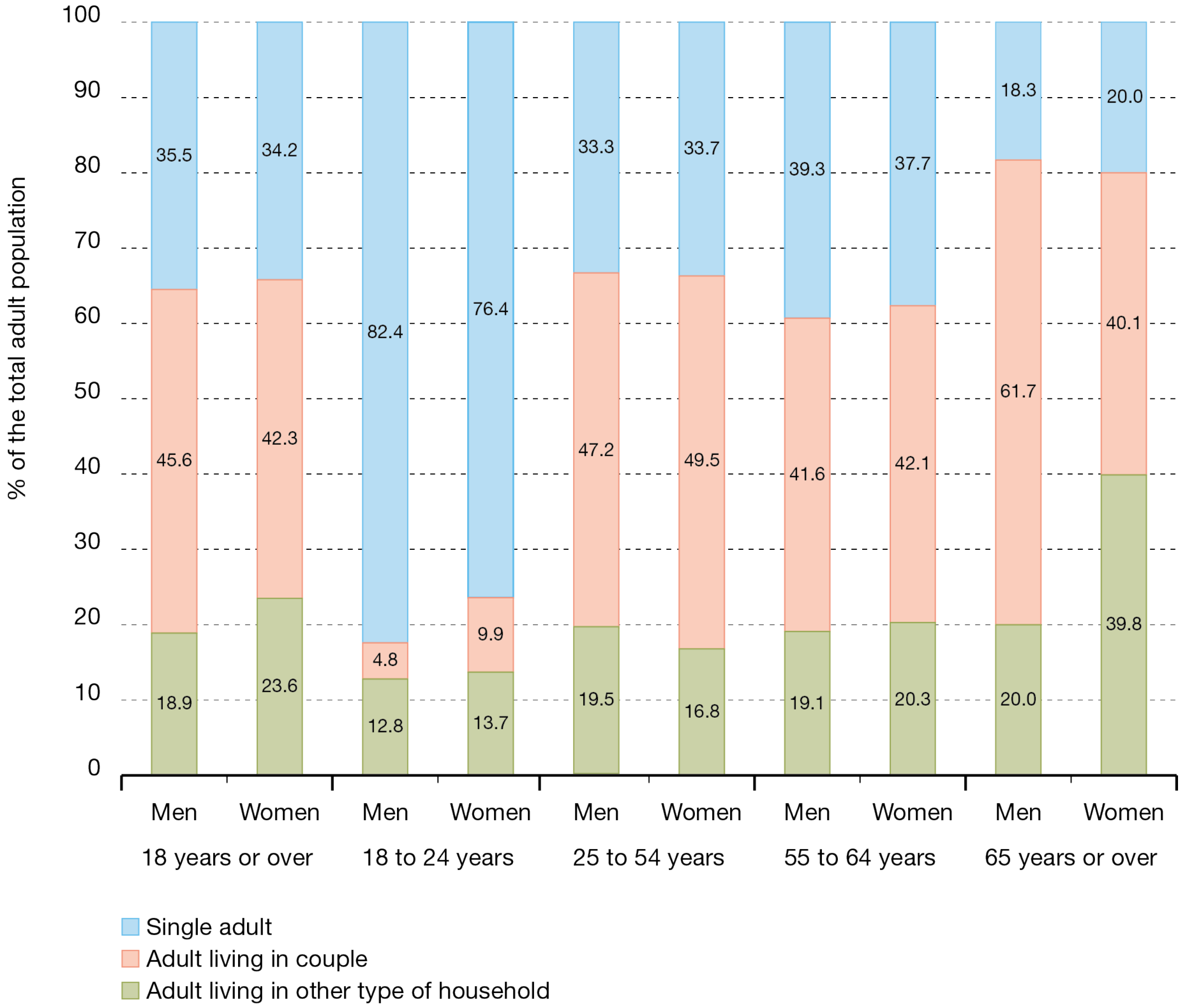
Figure 4. Projected labour force size and labour force dependency ratio of the European Union under five scenarios, 2015-2060 (source: Marois, Sabourin & Bélanger, 2019)



III. … AND LIVES IN MORE UNSTABLE FAMILY STRUCTURES

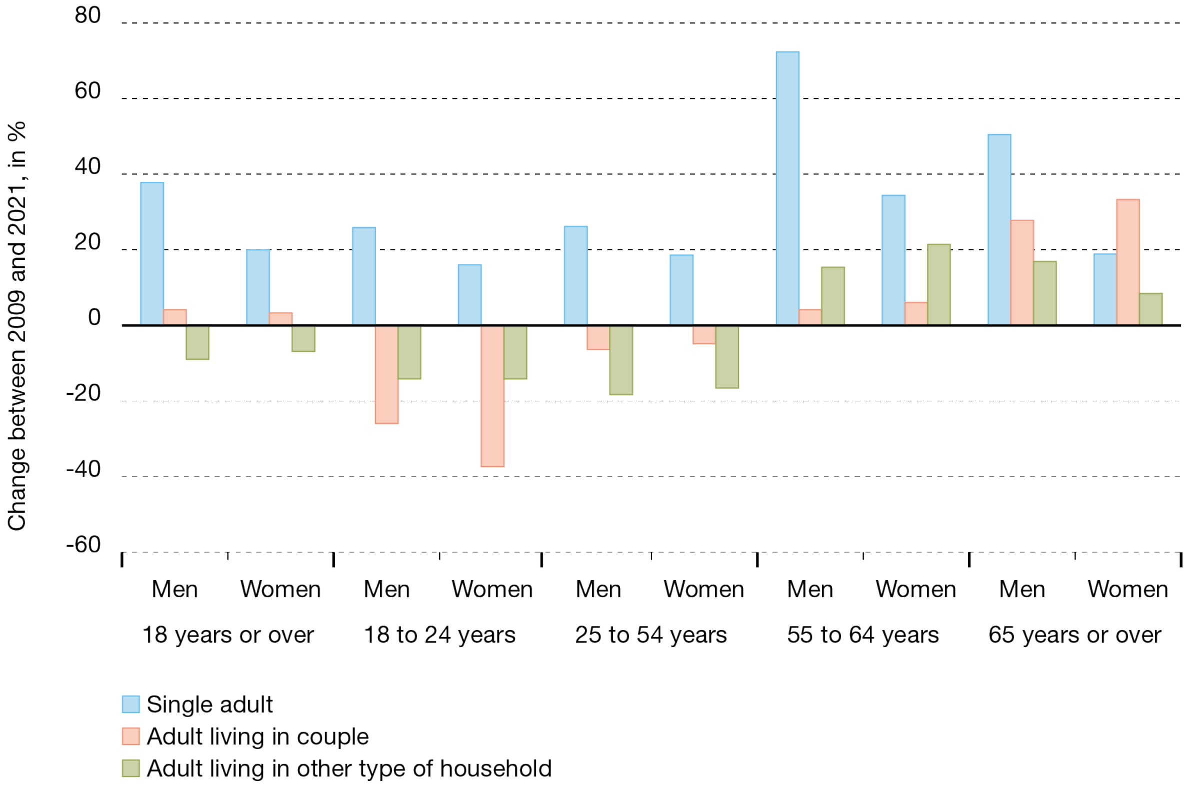
Ageing also has consequences for the social fabric. The social network of older people tends to shrink as contacts at work, children's schools, etc., disappear and friends of their own age group die. Older people thus become more dependent for assistance on their children and their extended family. In addition, we observe increasing instability in the structure of families. In 2021, less than half of European adults were living as a couple (Figure 5a) while the number of singles had increased significantly (Figure 5b shows the growth rates for different types of European households between 2009 and 2021). The number of divorces is increasing, especially among those with limited education. Family instability is strongly associated with an increase in poverty risk, and having experienced a divorce is an important predictor for the demand for care (including psychological and social care).

Figure 5a. Share of the adult population in the EU by type of household, sex and age, 2021 (source: Eurostat)



Source: Eurostat (online data code: lfst_hhindws)

Figure 5b. Growth rate of the adult population in the EU by type of household, sex and age (source: Eurostat)



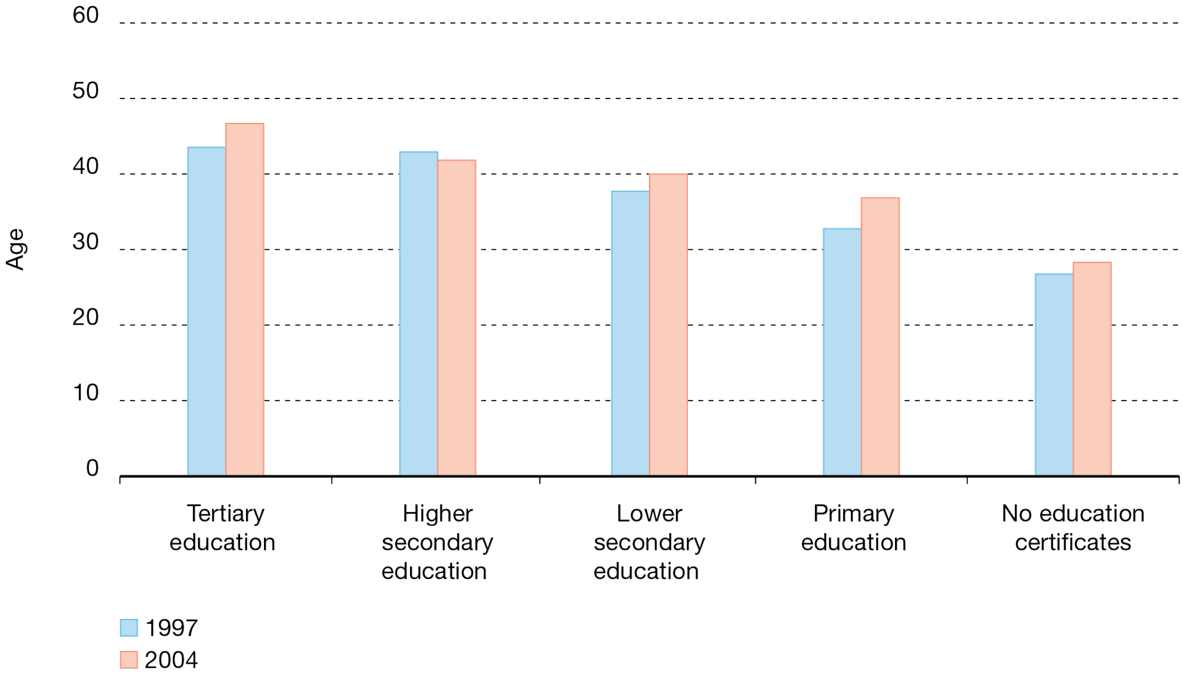
Break in the data series in 2021 due to the implementation of Regulation (EU) 2019/1700.
Source: Eurostat (online data code: lfst_hhindws)

In general, new forms of relationship formation and dissolution over the last 30 years have totally changed the make-up of families and households. Families and households are becoming more complex, heterogeneous, and flexible. It is highly likely that this trend will continue during the next decades and will have an impact on the labour market and on the demand for care. In fact, significant effects can also be expected from the concomitant changes in housing patterns, e.g. the potential increase in cohousing.

IV. HEALTH INEQUALITIES

All these demographic developments should not only be analysed at an aggregate level. Within society as a whole, there are vast interpersonal differences in health that are strongly correlated with socio-economic status. In all affluent countries, for example, there is a strong statistical link between social position and life expectancy. Figure 6 illustrates this phenomenon for Flanders: men who hold a higher education diploma tend to live 18 years longer in good health than men who hold no primary school certificate.

Figure 6. Life expectancy and level of education – life expectancy in good health for males (25 years old) in 1997 and 2004 (source: Van Oyen et al., 2011)



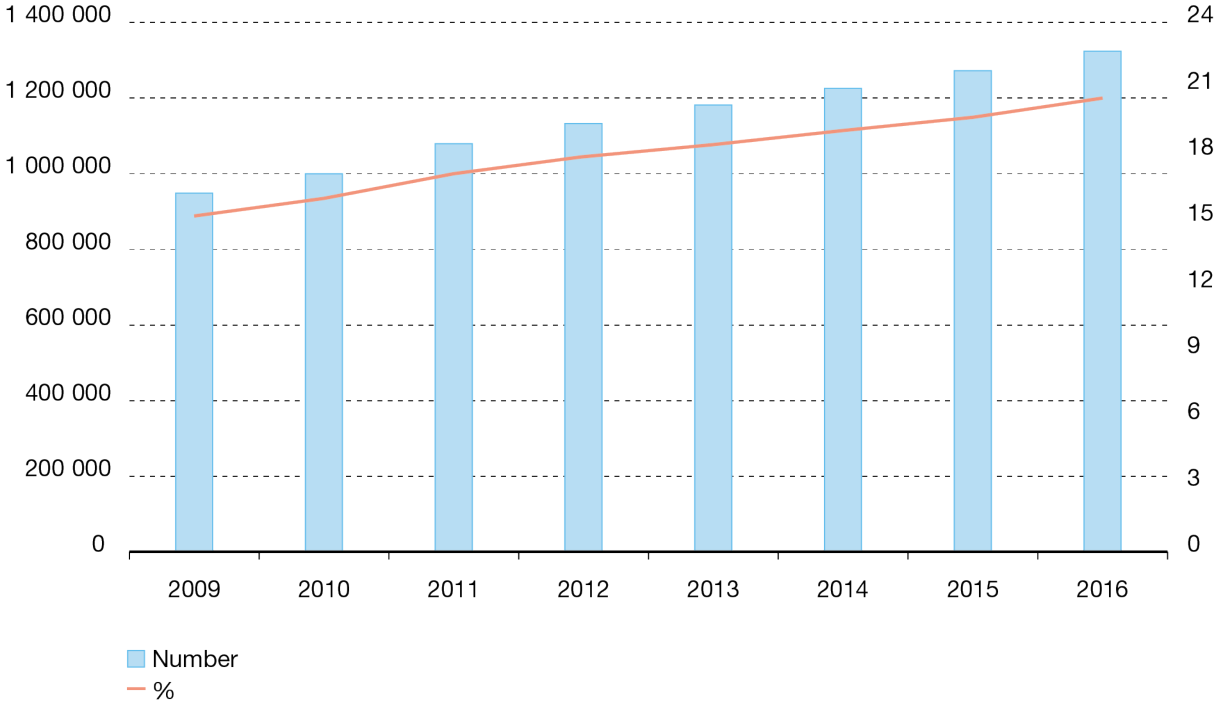
The issue of social inequality will serve as something of a leitmotif throughout our text and will emerge in several sections of the present chapter. Health inequalities are linked to some extent to disparity in access to the health care sector, but their underlying causes go much deeper. In fact, the social gradient in health is structural and relates to differences in lifestyle, health literacy, educational level, working conditions, etc. As a result, when tackling social inequality – also in the area of health –, other sectors such as education, housing, labour market policy, etc. are of the utmost importance. In this text we shall place the primary focus on the role of the health sector, but we will regularly point to the importance of the broader social context.

V. GROWING CULTURAL DIVERSITY

A final important evolution is the growing diversity in society. Figure 7 illustrates the continuous increase in the number of people of foreign origin in Flanders. Figure 4 already observed that the labour market participation of people of foreign origin is lower. Figures 8-10 demonstrate that their need for care is greater, that they provide less informal care outside the household and that they have to postpone health care for financial reasons more than the average person. Patients from these groups thus have more difficult access to regular health care services. Cultural differences resulting from this increasing social diversity, moreover, make communication between patients and care providers more challenging: more difficult, perhaps, but also more enriching.

A particular point of attention here is the limited influx of people of different cultural origins into the care professions. This does not only have consequences for the already substantial scarcity on the labour market (see section C). An increase in the number of people of foreign origin in the care professions would also bring in a source of new knowledge and contribute to promoting the relationship of trust between patients of foreign origin and care providers. The importance of this relationship of trust will be discussed at greater length later in this text.

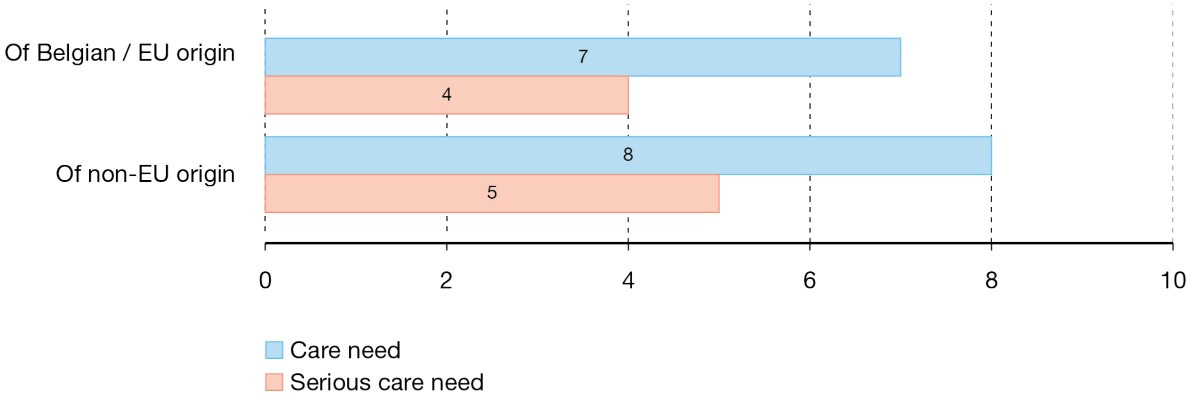
Figure 7. Number and share (in %) of persons of foreign origin in the Flemish Region, 2009-2016 (beginning of the year)



Source: DWH AM&SB KSZ, processed by Flanders Statistics.

Figure 8. Need for care (Source: Noppe et al., Vlaamse Migratie- en Integratiemonitor 2018)

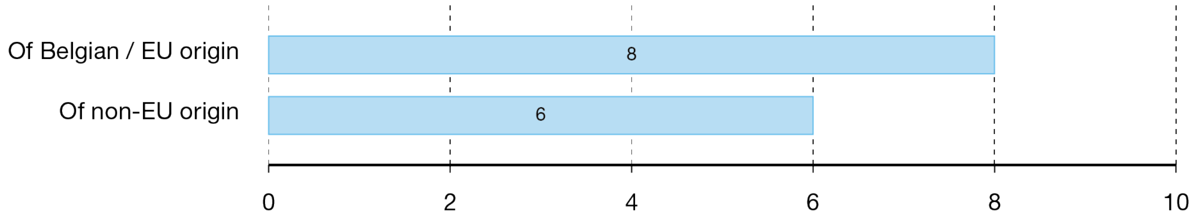
Percentage of respondents in Flanders living in a family with children <25 years old, in which at least one family member has a (serious) care need due to a handicap, illness or old age, in 2016



Source: Household Survey, calculation ABB

Figure 9. Reliance on informal care (Source: Noppe et al., Vlaamse Migratie- en Integratiemonitor 2018)

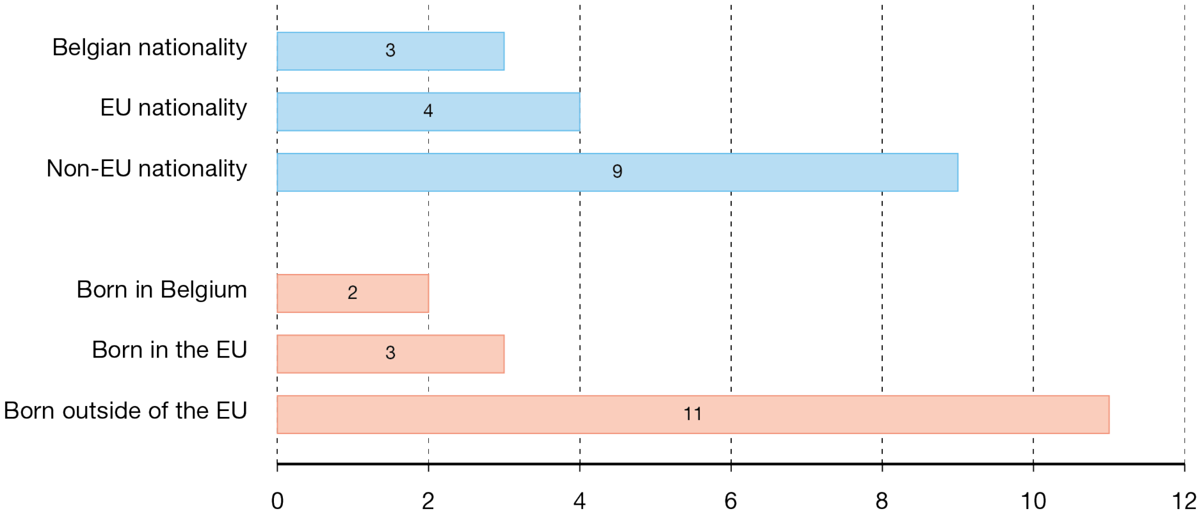
Percentage of respondents in Flanders living in a family with children <25 years old, in which at least one family member takes care of someone outside of the family, in 2016.



Source: Household Survey, calculation ABB

Figure 10. Postponement of medical care for financial reasons (Source: Noppe et al., Vlaamse Migratie- en Integratiemonitor 2018)

Percentage of respondents in the Flemish Region of 18 and older, living in a household that had to postpone medical care (doctor or dentist) for financial reasons in the previous year, in 2016.



Source: Statbel, EU-SILC-survey, calculation Statistiek Vlaanderen

VI. CHRONIC DISEASES, MENTAL HEALTH, MULTIMORBIDITY AND LIFESTYLE

While life expectancy continues to rise, the pattern of morbidity in society is also changing. Chronic non-communicable diseases, also known as ‘diseases of affluence’, now predominate in high-income countries. These include cancer, cardiovascular disease, lung disease, diabetes, and mental disorders, with depression an important subcategory of the latter. Welfare diseases are also the main cause of premature death and chronic illness. In addition, we also see a growth in (or a stronger awareness of) mental health problems, also and perhaps even mainly within the young and active population (Butterworth et al., 2020). Third, more and more individuals are suffering from different health problems at the same time. Think, for example, of an older person with a heart problem, who suffers simultaneously from sciatica and, partly as a consequence, is seriously depressed. Or a person with dementia who also has a cardiological problem. The growing phenomenon of multimorbidity and our increased awareness of the importance of mental health raise specific challenges for the care sector as they obviously increase the need for an integrated treatment plan. We will discuss this in greater detail below.

A characteristic of the 'diseases of affluence' is that they are largely co-determined by behavioural patterns. Figures 11 and 12 provide an overview of the risk factors for Belgian men and women respectively. Different forms of behaviour are associated with the number of years lost in good health, the so-called DALYs, as a result of various diseases. Smoking, alcohol consumption, high blood pressure and obesity emerge as important risk factors. Here too there is a clear social gradient: among the lower educated there are proportionally more smokers, more obese people, and more physically inactive people. Only alcohol consumption is higher among the higher educated.

In practice, it turns out to be very difficult to change people's behaviour. Behavioural change is not just a matter of knowledge. In recent years it has become increasingly accepted that human behaviour is controlled by two fairly independent systems: the *reflective self*, which requires cognitive capacity and is related to self-definition, and the automatic *experiencing self*, which requires no mental effort and is controlled by instantaneous emotions or triggers from the environment (see, e.g. Kahneman, 2011). In the past, it used to be assumed that health behaviour could be 'steered' from the cognitive system by changing attitudes towards this behaviour. This approach envisages that people would be inclined to adapt their behaviour when they have a better understanding of the advantages of a healthy lifestyle. In the meantime, however, research has shown that there is a substantial gap between what people intend to do or think they will do and what they actually do. After all, at the very moment when they are about to exhibit undesirable behaviour, people have to find the motivation not to do it and to override their associated yearnings. This is far from evident. In the following section we will elaborate further on the fact that 'health literacy' can be very important here, but that it should of course be interpreted broadly enough to also include skills and attitudes and not only knowledge.

Although the pandemic has revealed that infectious diseases will remain important, we can likewise safely assume that lifestyle diseases will continue to gain in importance in the coming decades. Prevention and behavioural change will thus become even more important. Wearables and health apps may play a bigger role in this regard because they monitor users closely in their daily lives and can provide continuous and immediate feedback. We will discuss these wearables further in the second chapter of this position paper.

Figure 11. Risk factors for health in Belgium – men, 2016 (source: Maertens de Noordhout et al., 2018)

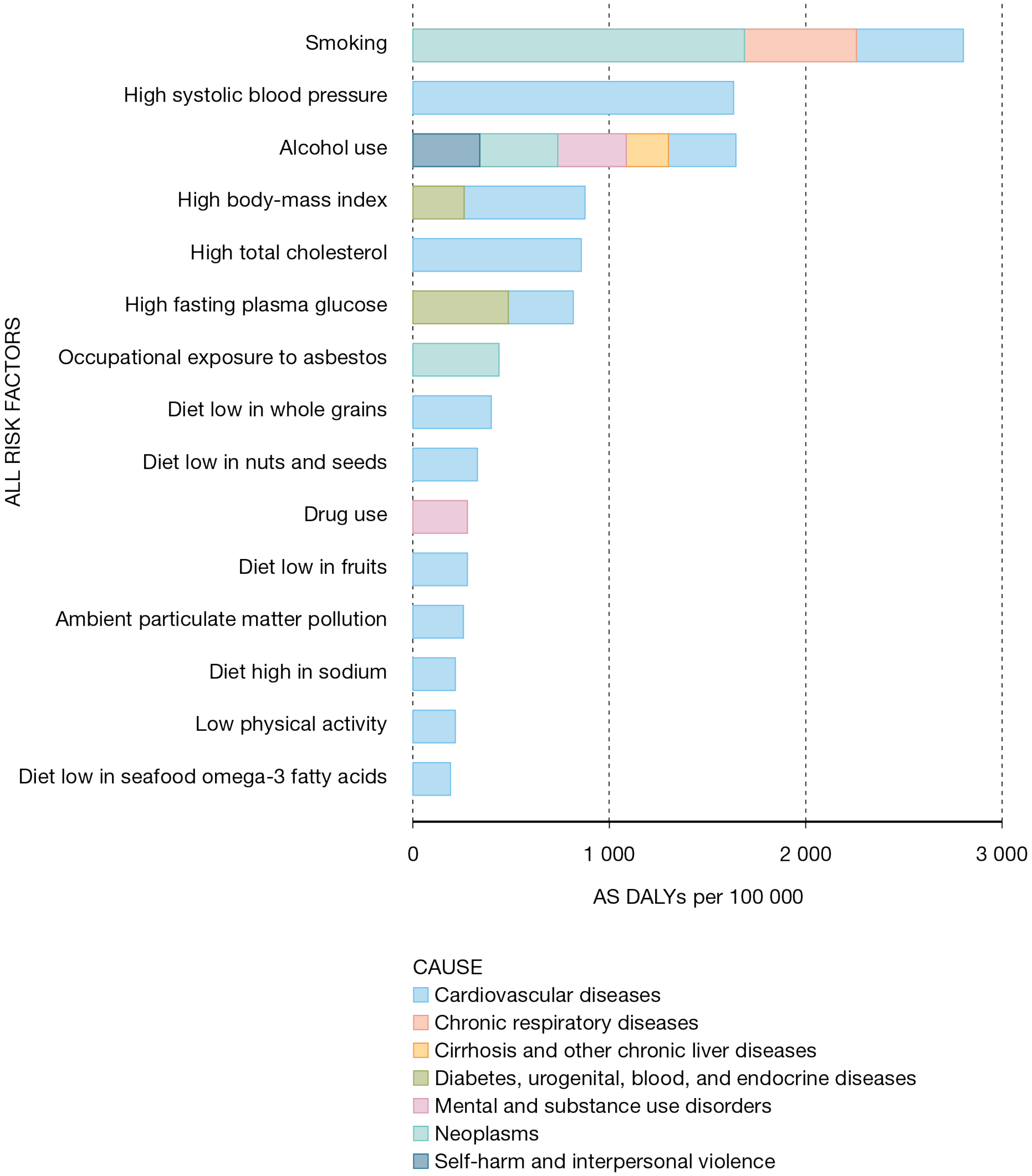
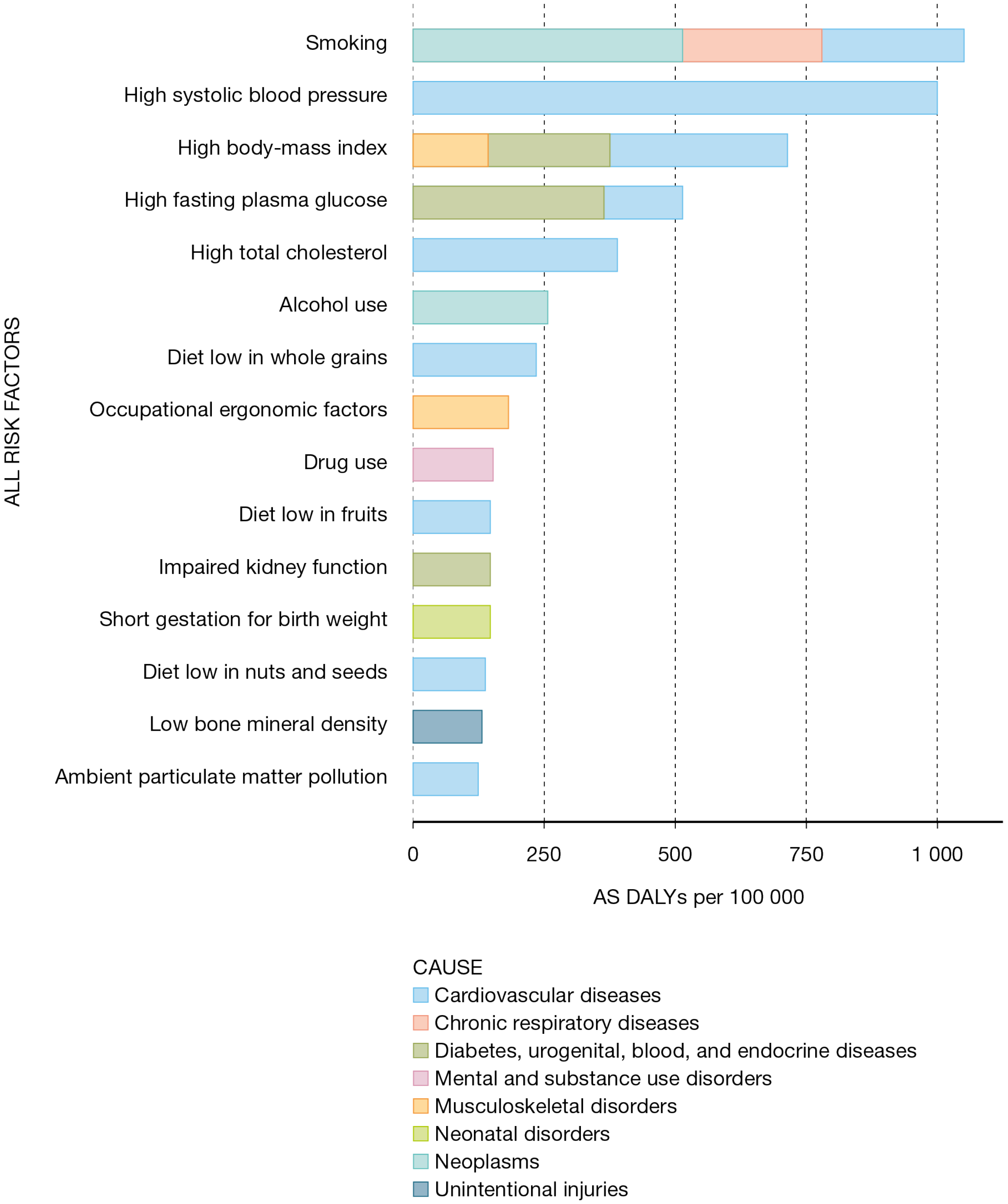


Figure 12. Risk factors for health in Belgium – women, 2016 (source: Maertens de Noordhout et al., 2018)



B. PATIENT EMPOWERMENT, HEALTH LITERACY AND INFORMATION

An increase in the level of education of the population has also led to an increasing demand by patients to participate in the decision-making process about their own care and about the organisation of health care in general. This demand is reflected in the growth of patient organisations. However, participation in the decision-making process requires citizens to have the necessary health literacy and to be able to use the information they receive, for example via the social media, in a sensible way. A special role is reserved for the collection and dissemination of information about the quality of health care providers and hospitals.

I. SOPHISTICATED PATIENTS: THE MOVE TOWARDS PATIENT EMPOWERMENT

Highly educated, emancipated, and mature citizens now form an ever-increasing part of the population. Citizens themselves are taking initiatives to tackle problems and develop the necessary consultation and decision-making structures to do so. The health variant of this movement towards citizen power is that of the empowered patient, who wants to be more involved in the decision-making process (see, for example, Cleemput et al., 2019, and LIGB & Vlerick, Green Paper on the future of the hospital, 2019). Patient organisations play an essential role in this development.

Key concepts in this evolution are 'shared decision-making' and 'patient empowerment'. Patient empowerment is the broadest concept, because it includes the context in which specific care decisions are made. It can be defined as "an enabling process or outcome arising from communication with the care professional and a mutual sharing of resources over information relating to illness, which enhances the patient's feelings of control, self-efficacy, coping abilities and ability to achieve change over their condition" (Small et al., 2013). Empowerment is the capacity of patients to develop and use specific coping strategies and to participate in decision-making. It creates the opportunity to establish a balance of power in the relationship between care professionals and patients.

Both empowerment and shared decision-making require health literacy. If people do not understand the decision being made, it makes little sense for them to get involved in it. Health literacy is defined as "the motivation, knowledge and competences to access, understand, appraise and apply health information in order to make judgements and take decisions in everyday life concerning health care, disease prevention and health promotion to maintain or improve quality of life throughout the course of life" (Sorensen et al., 2012). Recently digital health literacy has become an important point of attention.

All this goes beyond the traditional notion of 'informed consent'. If interpreted narrowly, 'informed consent' can be reduced to legal safeguards for ethical committees. Giving *real* consent requires health literacy. Art. 4, 2, b of European Directive 2011/24 establishes the obligation for a Member State to ensure that health care providers provide relevant information "to help individual patients to make an informed choice, including on treatment options, on the availability, quality and safety of the health care they provide in the Member State of treatment". We will discuss the need for and pursuit of health literacy in more detail in the next subsection, and the legal aspects of informed consent in section D.

Here too, social inequality must be taken into account. Some, mainly lower-educated, groups tend not to organise themselves with ease in relation to health problems. Furthermore, the organisation of 'citizen power' partly runs via social media, while care information via such media tends to be fragmented. There are some 1500 self-help groups in Flanders, by far the largest portion of which is health-related,[1] but there is no patient organisation for every disorder. As an example, the large (and growing) group of people with polypathology is not well represented. Moreover, existing patient organisations are often underfinanced and do not receive sufficient independent financial support.

The 'empowered patient' also faces the technologisation of care and the digitisation of information. We will discuss the most important technical developments in more detail in the next chapter, but we can already raise a question here that is crucial for each of them: how will they affect the degree of empowerment of patients in the future? We seem to be evolving towards a situation in which people no longer have control of their own situation and are outsourcing part of their/our health to devices. Even if that danger, in reality, should not be exaggerated, at least some patients may have that feeling. When patients lose a sense of ownership, they also risk being alienated – and that danger is greatest for the most vulnerable. The challenge of maintaining the precarious balance between technology and human contact, as an essential part of the prevention/cure/care process, will be addressed regularly in the following chapters.

II. THE CHALLENGE: HEALTH LITERACY

As already mentioned, the movement towards patient empowerment and shared decision-making also creates a greater need for health literacy, without which the former would actually remain without content. In recent years, attention to health literacy has increased considerably, both in the academic world and in policy circles.

The concept of health literacy has broadened over the years. Originally it was just about knowledge and being able to understand medical terms. Recently, other skills have been added, more specifically the capacity to enter into a dialogue and to critically evaluate the information provided. In a very broad sense, health literacy does not even have to be exclusively focused on the reflective system; it can also be about strengthening the experiencing self. Moreover, people must also have health skills outside the doctor's surgery: they must be able to process information on prevention and lifestyle. To function adequately as a patient or citizen, they also need to be able to find their way around patients' rights and reimbursement rights for care or prevention, and understand the usefulness of vaccination, for example. Of course, one should remain realistic about the limitations of health literacy: situations of polypathology are difficult to understand and evaluate, even for specialised care professionals, and one should not expect citizens and patients to have sufficient technical background to understand all the medical details. Nevertheless, such technical knowledge is not always necessary to participate in decision-making.

Figure 13 provides an overview of the quality of health literacy in Belgium. On the whole, it appears that approximately 60% of the population achieves a 'satisfactory' score, but with clear differences between the regions. This puts Belgium fairly near the front of the European pack. Still, recent experience with the COVID-19 vaccination campaign, e.g. in Brussels, has shown that there is still a long way to go.

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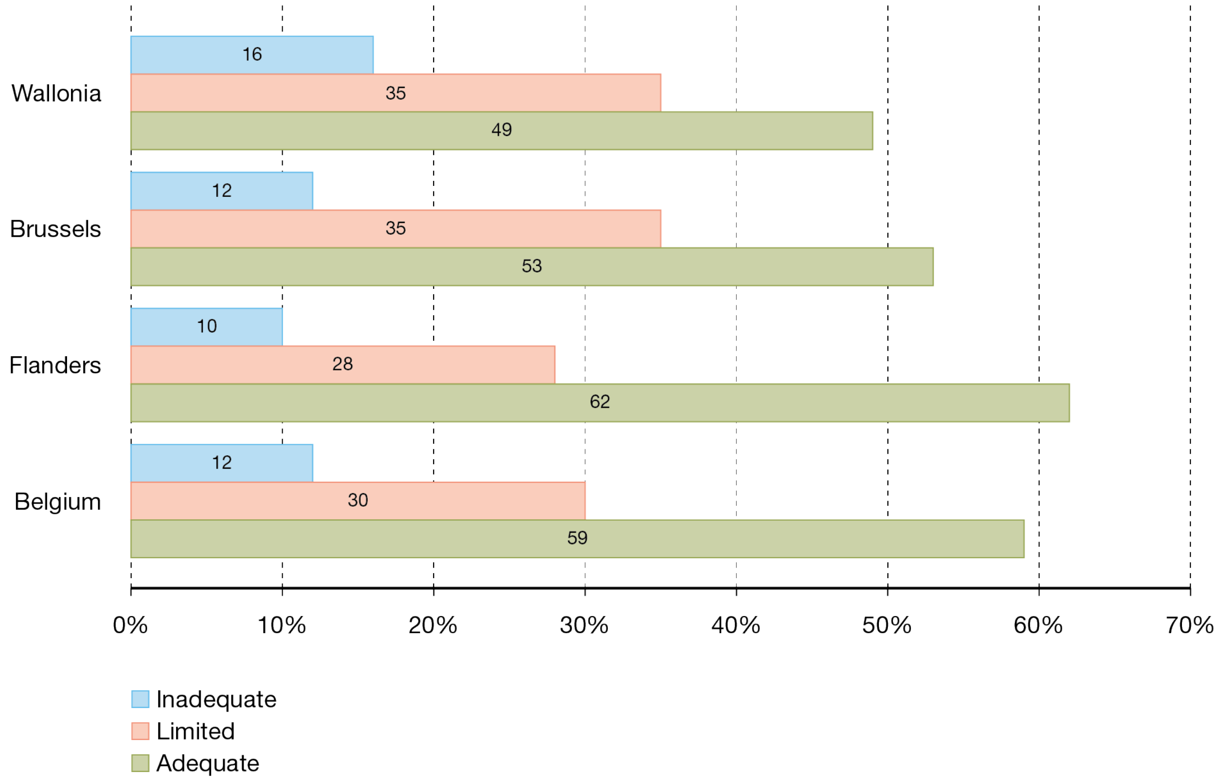
[1] see Trefpunt Zelfhulp, Activity Report 2020: https://www.zelfhulp.be/over-ons/activiteitenverslag

Figure 13. Health literacy in Belgium (source: Vancorenland et al., 2014)

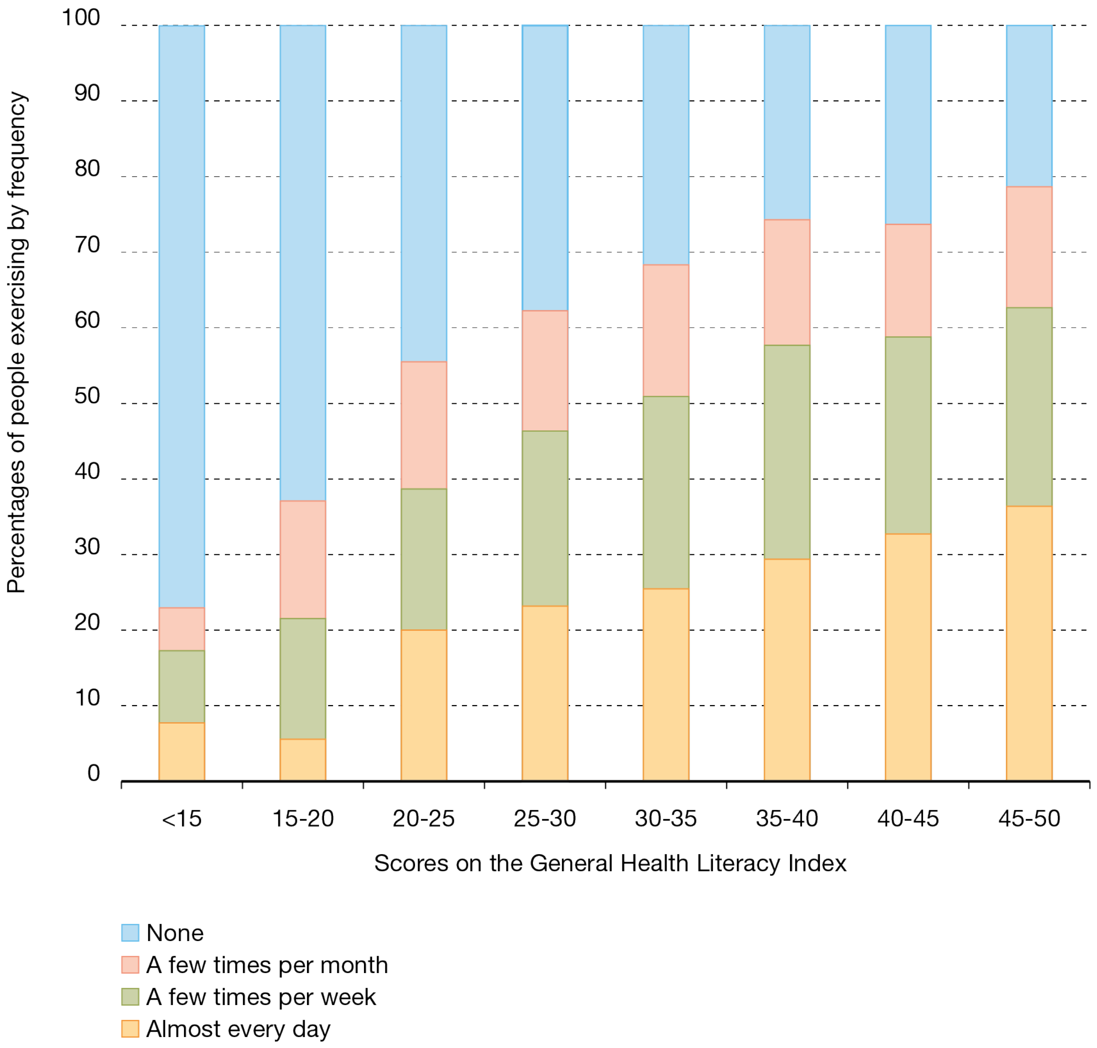


Source: Vancorenland et al., 2015

Health literacy is linked to behaviour and thus has consequences in terms of health and life expectancy. Almost all lifestyle factors and aspects of health care consumption are linked to health literacy. Figure 14 illustrates this for the specific example of physical activity. People with lower health literacy live, on average, less healthy lives and have a lower life expectancy. Because health literacy, unsurprisingly, exhibits a strong social gradient, its distribution also provides a partial explanation for health inequalities. Low health literacy is often a structural problem that occurs across generations, and it would therefore be dangerous to bypass these deep social differences and place the responsibility entirely on individuals.

Improving the health literacy of the population will undoubtedly be a major challenge in the future. In this respect, improving individual health skills is necessary but not sufficient. The need for skills can also be reduced by making the environment more ‘readable’. Care organisations must adapt their policies so that people can find their way around the information more easily. Even more is needed for behavioural change. Features of the physical environment must be changed to make it easier for people to live healthily, and one should try to strengthen social norms in this regard. Health literacy is important, but efforts to influence people’s behaviour should not be narrowed down to health literacy and should always be integrated into the broader social context. This should also account for the fact that people receive information from different sources. A recent development in this respect is the growing influence of social media.

Figure 14. Health literacy and physical activity (WHO, 2013)



III. INFORMATION AND THE MEDIA

We have already pointed out that our behaviour is controlled by two relatively independent systems: a reflective and cognitive system on the one hand, and a more automatic and trigger-driven system on the other. This distinction is relevant to the analysis of communication. If one wants to make people think consciously (the first system), one has to increase the relevance of the message. Good arguments increase the chance that people will change their attitude and behaviour, and messages are best linked to concrete situations or other relevant characteristics of the recipient. But one can also try to convince people via the second experiencing system: by giving the right peripheral cues, and by communicating more often and responding more to emotions than to cognitions. The use of these techniques has already changed a great deal in the last 20 years and will change even more in the coming years. Not only commercial organisations, but also political and ideological groups have started to use a high volume of short messages (with fewer arguments) to gradually influence opinions.

This distinction helps to interpret the historical evolution of health communication and to better understand the challenges for the future. In a first period, from WW2 until the 2000s, public health communication was aimed at the reflective system. Attempts were made to convince people first cognitively, then attitudinally, and finally behaviourally. Examples of communication forms were health communication by the government on general media, e.g. messages of general interest via public broadcasting, health campaigns in the media, direct communication by care providers such as doctors and pharmacists, health education in schools. These forms of communication are expensive and an individual with a dissenting opinion had almost no tools to communicate. The opponents to this 'positive' health communication were mainly commercial companies, e.g. the sugar and tobacco lobbies, and they worked with the same tools.

From the 2000s onwards, the social media emerged, creating more personalised communication channels that were also very cheap. The mass media no longer have full reach and filter bubbles have emerged; people make their own selection from the available information, which means they see their own 'truth' repeated over and over again. Recently, the mobile aspect has been added, leading to a constant availability of media but also to more filters. The screen of the device is getting smaller, which means that people see even fewer search results and alternatives. With mobile devices there is more information available about a person's preferences, making it easier to target even more specifically online. Reach is becoming an important parameter for attracting advertising money, and social media is adapting its content to that dynamic.

It is not clear in the current situation whether policy makers have a relatively larger budget for objective health communication than in the past. Meanwhile ideological groups make use of volunteers or even largely automated fake profiles on social media with which messages are further disseminated and endorsed. Besides the internet, social media also play a role, e.g. in the anti-vaccination movement, and they cannot be restricted. 'Objective' health messages are thus faced with a broad array of potential enemies. Given enough time, an anti-campaign can be launched for every truth. Moreover, there is often a problem of form: many well-meaning communicators have remained stuck in traditional and paternalistic forms of communication. This approach is increasingly ineffective; the message must appeal to the receiver and account for his or her motivation and capacity.

It is important to create an environment that encourages healthy and wise decisions, but this is not easy in practice. Social media tend to be polarizing and threaten to become increasingly so in the future. To maintain their relevance, organisations like Meta create sub-platforms and push *communities.* Because people mainly communicate in groups with the same vision, the existence of other visions becomes less and less visible and the filter bubble is strengthened. The dissemination of so-called 'fake news', also about health, has become much easier than in the past and it has become more difficult to reach and change the mind of citizens who are susceptible to this misinformation.

IV. QUALITY INDICATORS

A specific form of information relates to the quality of health care providers and hospitals. In the Belgian system, for example, in which there is considerable freedom of choice for both providers and patients, this flow of information is crucial to enable good choices. Indeed, as in many other countries, there is growing interest in the collection and publication of quality indicators, but insufficient interest in making them easily available for patients and citizens.

There is evidence that the dissemination of quality indicators does in fact influence behaviour, but much depends on how this information is presented. Information can only influence the behaviour of (care) seekers if it is relevant, new, and understandable (see, e.g. Varkevisser et al., 2012). Information that confirms what people already know will obviously not change their behaviour. Moreover, here also we come up against limitations in the (health) literacy of the population (see Figure 13). The problem actually goes deeper than health literacy: according to the OECD (2019), 15% of Flemish citizens have limited literacy. An increase in the amount of information that is not accessible to such people can thus increase social inequality.

Who is to ensure that the information becomes ‘readable’ for as many people as possible? The limitations of social media have already been discussed in detail. It seems natural to see general practitioners as the appropriate persons to pass on tailored health information, but in practice this does not appear to happen very often. In the Netherlands, GPs make little use of the available statistical information and rely rather on their own experiences (Doering and Maarse, 2014). Trust in intermediary organisations varies greatly between countries. In the UK it is mainly the government that tends to be mistrusted, on the European continent it is mainly private *for-profit* organisations. As a result, non-profit organisations, including the government, patient organisations and health funds, and providers themselves are probably best placed to provide information to patients.

How do health care providers respond to the dissemination of quality indicators? There are three possible mechanisms for behavioural change: pressure from the market, *naming and shaming*, and intrinsic motivation (Kolstad, 2013). The empirical evidence on these effects is mixed, but the dissemination of quality indicators seems to have a positive overall effect on quality. Hospitals at the very bottom of the quality ranking, for example, are particularly inclined to adjust their behaviour. The positive effects are stronger in the US than in Europe, however, and several negative effects are also observed. A first is ‘framing’, whereby hospitals start to focus on the measured results and neglect other important dimensions. In the UK, for example, emergency admission standards led to patients sometimes having to wait outside in the ambulance to avoid counting this as waiting time in the emergency department (Bevan and Hood, 2006). A second possible negative effect is ‘risk selection’: improving outcomes by selecting better patients and making oneself less attractive for the more difficult patients, often from lower socioeconomic backgrounds.

Against the general background of more empowered citizens who want to be able to choose for themselves, we can assume that the use of quality indicators is likely to increase in the future. The challenge then for the government, providers, health insurance funds and patient associations is to provide the best possible information as quickly as possible, to avoid the emergence of websites that collect subjective experiences without quality control. It is important that high quality information is there first and ‘occupies’ the market. Incidentally, within the current legislation, providers may face a difficult trade-off. They can build a website with ‘objective’ information, but it is forbidden to recruit patients. The line between these two objectives can become blurred.

C. THE ECONOMIC ENVIRONMENT: LABOUR MARKET AND LABOUR ORGANISATION

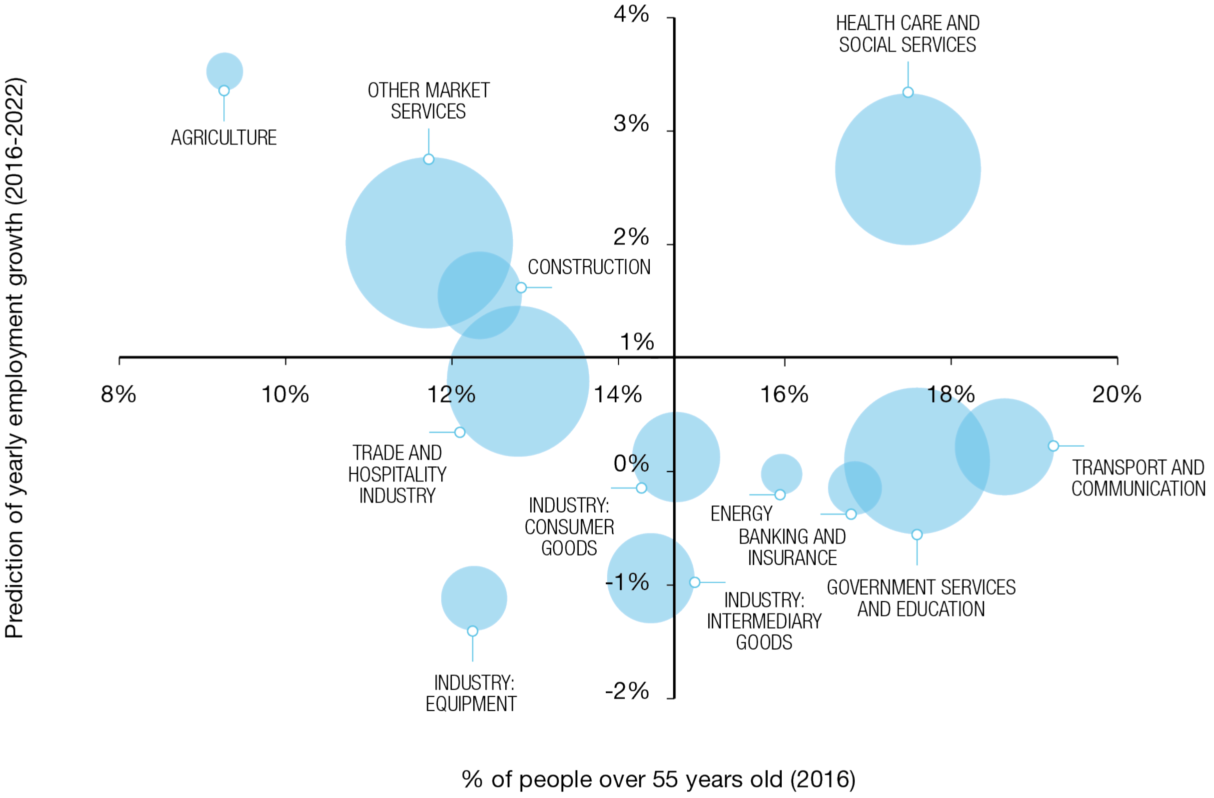
The demographic developments we outlined in the first section also have consequences for the labour market for care professions. However, the way in which the care and labour process is organised is equally important.

I. DEVELOPMENTS ON THE LABOUR MARKET

Figure 15 offers a synthetic comparative view of the labour market for care professionals. On the one hand, health care and social services are among the sectors in which employment growth is expected in the future (the vertical axis in the graph). On the other hand, the proportion of currently employed people over 55 is substantial (the horizontal axis), so there will also be a large replacement demand.

In the light of demographic trends suggesting a decline in the working age population, the combination of these two factors naturally presents a major challenge, especially in a sector in which labour accounts for 70-80% of turnover. A situation is looming in which fewer people will be available to meet an increasing need for care. According to a study by Agoria (2018), if the policy remains unchanged there will be more than 100,000 unfilled vacancies in the health care sector by 2030.

Figure 15. Future labour market for health professions (source: Neefs et al., 2017)



Recent work by the KCE (Lefèvre and Gerkens, 2021) has focused on the sustainability of the Belgian health care system in the longer term. One of the aspects considered is the workforce. The researchers concluded that it is very difficult to predict the future demand for different types of care workers and decided to focus their analysis only on the evolution for physicians. More work is certainly needed to obtain a better picture of the long-term demand for different health care professions. Of course, this long-term demand will crucially depend on how we organise our future health care system and how we educate our future care professionals. The latter point is the primary focus of the present position paper.

In the short term, however, a tension on the labour market for care professions is already evident. The COVID-19 experience has amply demonstrated the enormous challenge raised by scarcity on the labour market for care professions. An increasing number of vacancies in care and health care remain open, especially in residential care centres and home care. According to the tension indicators of the VDAB, which show how many people are still eligible for each vacancy, nurses and physiotherapists are the main bottleneck professions.

It may be possible to tinker with inflow into the profession, but opportunities for doing so in a tight labour market are very limited. There may still be potential among people of immigrant origin, who are severely underrepresented in the sector. As mentioned earlier, their inclusion would not only be important in quantitative terms, but could also help to narrow the cultural gap between the care sector and a growing part of the population in a super-diverse society. Active labour migration, i.e. looking for care professionals in other countries, can make a marginal contribution, but it is certainly not the definitive solution to the problem in Flanders, and may have detrimental consequences in the countries of origin.

The quality of the jobs is also important. Figure 16 shows that the 'degree of workability' of the jobs in health and welfare services is above the Flemish average. There are learning opportunities, reasonable career prospects and high staff motivation. During the last few years, however, the pressure on personnel has increased. Again, the COVID-19 crisis has had a strong negative effect. Moreover, the population's perception is on the negative side. Jobs in the sector are often associated with hard work, bad hours, and low pay.

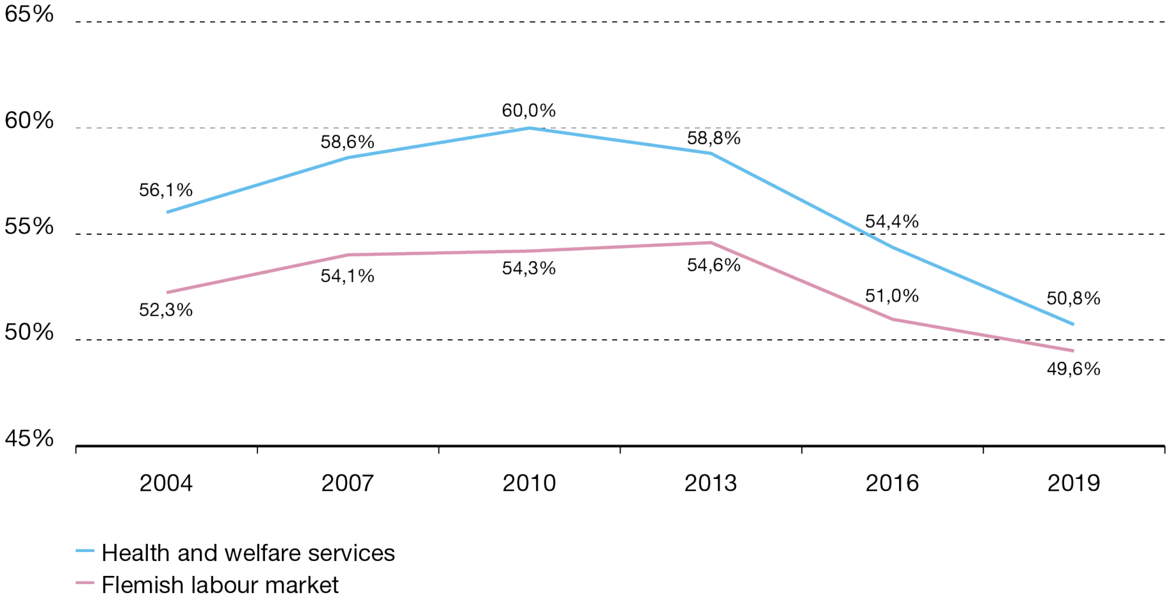
It is important to realise that the increasing pressure on care personnel does not only lead to scarcity, it is also explained by scarcity. If care needs continue to grow, and human resources are declining, the only 'solution' is to increase the productivity of these resources. As we will document below, technical progress may have positive effects on productivity, but it is unlikely that this will be sufficient. It will also be necessary to reorganise the care sector, so that it can deliver the necessary care without increasing the pressure on care workers too much. It is clear, therefore, that not only inflow into the care professions is important, but also the organisation of labour. This is all the more so since the ultimate objective is obviously not only to attract sufficient personnel, but to organise care in such a way that patients receive the best possible care.

II. LABOUR ORGANISATION

There are several facets to the improvement of work organisation in the care sector. First, internal flow must be organised in the best possible way. In the current situation, many people are drawn away from the primary pool, which has direct contact with the patient, to overhead and staff positions. There are not enough interesting career paths in which, for example, good nurses can be rewarded without diverting them to more management-oriented positions. This is detrimental because the best 'professionals' disappear, while the same best professionals are not automatically the best leaders.

In addition, different patient groups might be best helped by different forms of care organisation, which is difficult to fit into a homogeneous organisation model that is tailored to the needs of the specialists. The resulting tension is resolved by centralisation, but this in turn leads to a fragmentation of functions. At the moment, we have a system with hundreds of different care functions, which leads to lack of transparency and significant system losses and eats away at people's motivation. The productivity of individual disciplinary interventions (as hoped for by the way they are organised) is lost due to the many coordination problems they cause, and the compensatory interventions needed to correct them. Specialisation simultaneously creates scarcity. Addressing care issues with a specialist care apparatus when the latter is unnecessary ultimately generates scarcity. Because of a surplus in the labour market in the past half century, the system never had to recognise this burden. However, when there is a shortage in the labour market, this mechanism can no longer be ignored.

Figure 16. Job availability rate in Flanders: Degree of Workability (Flanders, 2004-2010) (source: SERV, Vlaamse Werkbaarheidsmonitor, 2019)



In the near future, we will certainly have to think about reorganizing the care sectors. Let us repeat that the challenge goes far beyond simply dealing with the employment crisis. The organisation of work has a direct effect on the job satisfaction of care workers. With the current method of organisation, no customisation is possible between the collection of care requests and the competences and preferences of the care providers. Everyone must function at the same tempo. No diversity is possible between the individual capacities and preferences of the various employees, or between the evolutions in capacities and preferences within an individual career. In the present situation, the number of workers with burn-out is increasing (see, e.g. Van den Heede et al., 2022). Moreover, values in society, including preferences concerning the optimal work-life balance, are also changing, and the organisation of care has to respond to these changing preferences.

More generally, the organisation of care must be adapted in light of the societal developments described in the previous sections. Reorganizing the care sector to create more flexibility and a dynamic interpretation of competences can only work if robust portfolio management is put in place. Ideally, this system should work across organisational boundaries. This assumes the construction and maintenance of a dynamic database with an inventory of the competency needs (as a function of the care demands) and the available competencies and preferences. A possible gap between competence mix needs and available competences must allow for the fast detection of labour market dysfunctions and their elimination via targeted educational investments. A gap between the competence and preference matrices forms the basis for the development of personal development plans. Collective management of these plans makes it possible to detect competency gaps quickly and specifically and to plan a response in return. We will come back to these issues in later chapters, in which we focus on the specific competences expected from future care workers.

D. LEGAL CONTEXT

Changes in the care system require changes in regulation. On the other hand, changes in the legal environment also have a major impact on the care sectors. The most obvious example here is the changing climate surrounding privacy and the treatment of personal data.

I. REGULATION OF THE MEDICAL PROFESSIONS IN BELGIUM

The previous sections have highlighted the need for flexibility with some insistence. The health care sector will have to adapt flexibly to changes in the social environment. The problem here, however, is that the present regulatory framework in Belgium is very rigid. It is based on the Health Professions Practice Act of 2015, which replaces but also builds on Royal Decree No. 78. In addition to medicine and dentistry, the Act also regulates the other health professions, including physiotherapists, clinical psychologists and clinical orthopaedists, midwives, ambulance operators and paramedical professions. The principles of the law are simple: one may use a professional title if one has the corresponding diploma (endorsed by the FPS Public Health) and is recognised by the Flemish Community. The recognition procedure falls under the Communities, but the recognition requirements are still set at the federal level. For some health care providers, such as physicians, pharmacists and (clinical) psychologists, there is an obligation to be included on the list held by a deontological supervisory authority.

The disciplinary bodies for physicians and for pharmacists can issue opinions and can also sanction health care providers. They oversee adherence to the deontology rules as well as the maintenance of the honour, discretion, integrity, and dignity of the health care provider. The sanctions that the disciplinary bodies can pronounce include warnings, censures, reprimands, suspensions, and even removal from the list of the respective Order. A patient, as a complainant, can submit a complaint to the disciplinary body, but he or she will not be informed of the action taken as a result. When issuing a sanction, the Order of Physicians and the Order of Pharmacists can be guided by the Deontology Code. However, this Code is not binding. Therefore, a health care provider cannot be sanctioned merely because the said provider violated an article of the Code, but rather because the health care provider violated e.g. an essential deontological rule. It is not always clear to health care providers and the disciplinary bodies themselves what exactly falls under this essential deontological rule. Moreover, the Order, as an undertaking, must take competition law into account when making decisions.

The disciplinary bodies for (clinical) psychologists can impose the sanction of warning, suspension, or removal. Unlike the Deontology Code for physicians and pharmacists, the Deontology Code for (clinical) psychologists has been declared binding by the King. Furthermore, unless the psychologist concerned requests a hearing behind closed doors, a complainant may attend a hearing of the disciplinary board. The complainant may also take note of the decision of the disciplinary board since the decision is pronounced in open court.

The legislation contains a detailed description of what different professions can do, and people are punishable if they regularly perform actions for which they are not qualified. Thus, non-medical practitioners may not as a rule offer diagnoses, and medical specialists may only perform actions for which they have been trained. Moreover, each health care professional has the responsibility to refer the patient to another competent health professional when the health problem exceeds the boundaries of his or her own field of competence. Specific legislation, such as the law of 2013 on regulating aesthetic medicine and aesthetic surgery qualifications, states that a dermatologist may only perform the following aesthetic surgical interventions: hair transplants, dermabrasion, liposuction and lipofilling of all body parts except the breast area. For nurses, there is a long list of possible acts, some of which are prescribed by a doctor, some need the presence of a doctor, and some can be performed independently – the rules are made explicit in a complex Royal Decree of 18 June 1990.

A new Quality of Practice Act which applies to every health care practitioner was scheduled to take effect in July 2021. Due to delays with the implementing decrees, the entry into force was postponed, but the law is now almost entirely in action. The basic philosophy of this new law is to provide quality criteria for each type of care, whether it takes place in a hospital or in a private practice. The health care professional must keep records in a portfolio, demonstrating his/her necessary competence and experience. The portfolio can be seen as a kind of continuous learning obligation. The replacement of a one-off visa by a portfolio is actually an intensification of the job requirements. This new law will do little to improve flexibility, which is desperately needed. For example, the introduction of a new health profession will require a new royal decree each time.

This strict regulation makes it very difficult to respond dynamically to new challenges. In principle, we should first define the needs and then use these as a basis for defining the health care requirements for which we need specialist skills guaranteed by diplomas. Below this, however, there could be a whole layer of care professions which would not need to be strictly regulated. A team could then determine what specific competences were needed and recruit staff accordingly. To move in the direction of this 'ideal' model requires a major shift in thinking about the regulation of the health professions. Moreover, one has to consider the possible shift of legal responsibility from the individual care professional to the team.

II. PRIVACY AND LIABILITY

The classic view of privacy focused on three aspects: professional secrecy, the classic right to privacy and *informed consent*. Partly due to the rise of the computer and the Internet, however, the law has evolved from the right to privacy to the regulation of data protection.

Various social phenomena have accelerated this trend. One of these is the increasing pressure to valorise data in a data-driven economy. This raises the question whether medical databases, which are still relatively closed, will be opened up. If such databases remain closed, the data-driven economy will look for other ways to find answers to its questions. For example, one can make use of real-life data and publicly available databases to draw conclusions about the likelihood of a person having or contracting a condition (cancer, diabetes, etc.). A wealth of health data is collected outside the context of the health care provider or hospital, and the patient comes to the health care provider with this multitude of data.

Here we come up against a second phenomenon, which was discussed earlier in this chapter. The importance of patient-centred care is growing with the increasing empowerment of patients. The patient of the future, or perhaps better some patients of the future, will have more direct access to their data and will demand more of a say in their health record. This may contribute to their empowerment, reduce medical shopping and improve compliance. Yet a difficult challenge arises here: much of the information is sensitive and confidential and yet it must be possible to communicate between different care providers. However, once the patient realises that this confidential information is being passed on, trust in health care providers may disappear. In the long run, this can be detrimental to treatment. Despite this problem, it does not look like the evolution towards patient-centred care will stop in the near future. Patients increasingly want to be the 'owners' of the data concerning their own health situation.

The new regulations around data protection are elaborated in the European General Data Protection Regulation (GDPR) of 2016, which wanted to harmonise the rules in different countries while accommodating changes in technology. The GDPR is sector and technology neutral and aims to make commercial misuse of data by big players impossible.

The GDPR legislation is built on five basic principles that must be applied in each context and then concretely translated to that context: purpose limitation, necessity, transparency, storage limitation and security. For the health care sector, the challenge lies mainly in storage limitation, purpose limitation and security and in creating more transparency towards the subject and user about the origin, analysis, and interpretation of the data. Storage limitation means that in principle there is a maximum period for which data can be retained, after which they must be destroyed. This goes against the way data are handled in the medical sector today. The introduction of a maximum storage period, e.g. of 50 years, could have consequences for the treatment of children and for research focusing on longer term effects and genetics. The period for which it is useful to store data becomes even longer if we take into account that genetic information is also relevant for descendants.

Processing of personal data must always be lawful. However, the classic mechanism of informed consent is not the only – and not necessarily the best – option. 'Public interest' may be a better way to address the context of open, scientific research; legitimate interest is used more in the context of for-profit organisations. In terms of data processing, the GDPR legislation and the Quality of Practice Act have brought the discussion around freedom of consent back to the surface. The question is whether the unequal position between patient and health care provider does not automatically mean that free consent is not possible. A second problem is that the patient must, in principle, be able to withdraw his or her consent. In the case of data processing, the data must then in principle be removed or destroyed. If informed consent is withdrawn, this cannot be remedied by invoking a new legal ground; one remains stuck with the original informed consent. Moreover, reuse of data requires re-consent: with informed consent, clear expectations are created; anything outside these expectations requires re-consent.

The new regulations around data security place a heavy additional burden on care providers. The measures that are expected to keep the data safe are not always easy to implement in practice. For example, if a provider wants to scan a letter, it must be protected on the server, and there are also restrictive rules for passing on information via email. These regulations may also act as an obstacle for the collection of the personalised data that are necessary for supporting progress in health care research.

We are facing here a trade-off between the protection of personal data on the one hand, and the quality of care on the other, both for the treatment of an individual and for the acquisition of new knowledge through research. It is not clear how the legal framework will evolve in the near future. The basic concepts of GDPR will probably not be fundamentally modified in the short term, but it may be necessary to work on their interpretation for the health care sector. Individual rights are never absolute as they will often, if not always, infringe on other individuals' rights so that a societal appreciation of the privacy cost/benefit ratio could be more appropriate. This requires an open debate culture at the political and societal level to come to a balanced approach which needs revision as views, treats and opportunities will develop over time.

E. ENVIRONMENTAL CHANGES AND GLOBAL WARMING

So far we have focused on societal challenges with a strong impact on the future organisation of health care. We may also expect changes in the natural environment, however, and we now understand much better than before how important these can be.

In 2018, *The Lancet* published a review paper on the influence on health of exposure to pollutants (Landrigan et al., 2018). Data for 2015 showed that at that time 9 million people worldwide had died from chemical exposure. This represented 16% of all deaths and three times the number of deaths from AIDS, malaria and TB combined. The effect of this is particularly noticeable in babies and children in their first years of life – here the main cause is water pollution. In the young, healthy population there are few effects, but at an older age environmental factors again become important. This is related to the increase in diseases of affluence. In section A.VI, we related these primarily to behaviour, but they are also partly caused by environmental factors such as exposure to pollution, particularly air pollution.

During the development in the 1990s of the human genome project, in which the entire genome was mapped out, it was established that knowledge of the genes is far from sufficient to predict disease. There was a growing understanding that environmental factors, in addition to genetic ones, also influenced our biological response and thus diseases. The term ‘exposome’ was introduced for this purpose. In this approach, disease is caused by the genome and the exposome, i.e., the sum of all exposures taken together. Exposures are viewed very broadly here, and include not only pollution, but also general external factors such as social capital and education, specific external factors such as radiation, and internal factors such as metabolism.

The current medical paradigm is based on epidemiological research to identify the causes of exposure and to work on prevention on the basis of risk factors. This is always done at the population level. At the same time, as we shall see in the next chapter, there is a shift towards *personalised medicine*, based among other things on genetic information, to characterise what went wrong in a particular patient. Based on new insights into the exposome, prevention in terms of environmental factors could also be made more personalised. If we map exposures and environmental risks for a patient and store them intelligently together with the medical data, sophisticated data processing techniques could be used to work out a personal prevention plan, including personalised advice on the prevention of exposure to pollutants. Moreover, this approach could also provide information for a proactive environmental policy.

Within this context, climate change represents a specific and important challenge. There is a broad scientific consensus that global warming will continue over the next decades and that this will also have an impact on health and health care. In addition to the direct effects of climate change, there may be secondary effects, which are difficult to predict, but very likely: the tiger mosquito will increase in Europe and become endemic in certain cities, malaria mosquitoes will move further north, pollen seasons will lengthen, allergies will become more severe, and new allergies will develop due to the introduction of new plants, e.g. ambrosia. It is also likely that migration flows will continue to grow. The environment in which care workers must operate will therefore change significantly over the next few decades.

The recent pandemic has also reminded the world once again of the close interrelationship of the health of humans and the health of other animals. Some viruses can be transmitted from one species to another. It is likely that the idea of ‘one health’ for all species will become more essential in the near future.

F. DEVELOPMENTS IN HEALTH CARE

Although in this position paper we do not want to focus on the future organisation of the health care system, some challenges cannot be neglected because they have immediate implications for health care professionals. We first discuss the issue of the economic affordability of care expenditures, then go into the relationship between health care and social care, the changes in the position of the hospital and the choice of financing system for the providers.

I. ECONOMIC AFFORDABILITY OF CARE EXPENDITURES

For many years now, there has been growing concern about the increase in health care expenditures. While the said increase is often associated with an ageing population, this is not the main explanation. A more significant contribution comes from technical-scientific progress, which is leading to increasingly expensive interventions and medicines. It is to be expected that this evolution will continue in the coming decades. The growth of personalised medicine, to which we will return in the second chapter, will accelerate rather than slow this trend. It is an open question whether the benefits of the new techniques and medicines will outweigh the costs, but in any case, these cost-benefit considerations will gain in importance in the coming decades. After all, the share of our GNP that we devote to health care is an important social choice.

The social debate that needs to be conducted on this issue revolves fundamentally around determining a good price-quality ratio for health care. At present, estimates of how much one year of life in good health should cost society are often used for this purpose. Sometimes explicit limits are set by a government, or the implicit limits that were used in past decisions are derived retrospectively. For example, in the United Kingdom in the 1990s an explicit value of one year in good health was set at £20,000-30,000 per QALY, in the Netherlands €80,000 is a common threshold for more burdensome illnesses, and the WHO proposes three times the national annual GDP per capita (Cleemput et al., 2008; Raad Volksgezondheid & Samenleving, 2006). In the meantime, more and more countries have a *Health Technology Assessment* Institute that tries to map out these choices and helps with cost-effectiveness studies.

It is highly likely that three fundamental issues will dominate the debate in the coming decades. Firstly, it is not easy to reconcile rising health care expenditure with the increased pressure on public budgets caused by other items of expenditure such as pensions, military spending and spending on climate policy. In this situation, it is not appropriate to work with a fixed value for a year in good health, determined independently of other social needs.

Secondly, the price setting process of pharmaceuticals and medical devices is not always transparent. The demand for a fair price for medicines will become increasingly important within the emerging personalised health care system. Changes in the negotiating structure between the government and insurers on the one hand, and the pharmaceutical sector on the other, are imperative. More international collaboration between the payers in different countries (e.g. at the European level) is badly needed.

Thirdly, while the main emphasis in the affordability debate is on health care expenditures and on evaluating new medical treatments, medicines and devices, an equally important challenge in our ageing societies with a declining potential for informal care, is the financing of social care. Moreover, the increasing need for social care also raises deep organisational concerns.

II. HEALTH CARE AND SOCIAL CARE

With an ageing population, increasing multimorbidity and people with disabilities or chronic problems also living longer, it is considered more and more important that people receive care at home and can live as normal a life as possible. This is not just about organising care ‘efficiently’: in fact, in many cases collective care can be cheaper than home care. It is also about ensuring that the care recipient can remain a full member of society who is able to pursue his/her own life goals for as long as possible.

The provision of good basic care will be one of the greatest social challenges of the future. This concerns assistance with eating, drinking, washing, dressing, social contact, etc. All this is very basic but little attention is paid to it and in practice the organisation of care tends not to be adapted to it. Informal caregivers and volunteers cannot provide all the basic care, especially as the availability of informal caregivers decreases. Technology can help to provide an answer, but a human component will always be needed; care professionals cannot be (completely) replaced by robots. And relatives and friends cannot easily be replaced by professional carers for the provision of social support.

Against this backdrop, the relationship between health care and social care is changing. Bridges must be built and the two sectors must work together more intensively. Home care in the broad sense will receive more attention in the future and will also focus on other target groups. Until ten years ago, 80% to 90% of family care was provided for the elderly, but that share has now dropped to 70%, and more care is being provided for chronically ill people under the age of 65, people with mental health problems and people with disabilities (data Zorggezind and Familiehulp). Health and welfare are a system of interconnected vessels, because savings in one sector often induce more expenditure in the other. If mothers spend less time in hospital after giving birth, they will need more maternity care at home. If rehabilitation can take place in the hospital for a shorter period, more occupational and physical therapy is needed at home. This also changes the requirements placed on staff.

In line with what was discussed earlier in this chapter, this evolution is often accompanied by a shift of power from the professional to the client. In the persons with disabilities sector where individuals have a personal assistance budget at their disposal, the caregiver actually becomes a ‘staff member’ of the care recipient. The match between the professional and the patient then becomes important, making a more flexible deployment of personnel necessary.

These evolutions also change the situation of residential care centres. Their name has evolved, from ‘rest home’ via ‘rest and care home’ to ‘residential care centre’: living is now given priority, whereas residential care centres originally started from the medical model. It is now often assumed that everyone would prefer to be cared for at home. While this is correct, broadly speaking, residential care centres also receive requests from people with few health problems who are mainly lonely. There are no intermediate institutions for such people. Others often end up in a residential care centre in a crisis, because the informal carer is suddenly no longer available, for example, or because the person in question cannot return home after a period of hospital treatment. They are then ill-prepared and have often not given sufficient thought to the type of residential care centre they wish to be admitted to. Better proactive care planning is needed.

As regards the organisation of the residential care centres themselves, it is important that this involves a mix of wellbeing and health, which requires a diversity of staff. It is widely accepted that the number of staff and the skills mix should be adapted to the case mix of the needs and requirements of the residents, and these need not be the same for each residential care home. Each residential care home should be given the freedom to demonstrate that it is able to provide the right care and has the right staff to do so. From the pure ‘health’ perspective, good cooperation with hospitals and general practitioners is an absolute requirement.

III. DEVELOPMENTS IN HEALTH CARE: CHANGES IN THE POSITION OF THE HOSPITAL

Social evolutions also have consequences for hospitals, where a paradigm shift is taking place from volume-driven to value-driven care. Doctors and hospital boards need to reorient themselves to this more value-driven model. Outcomes are becoming more important and measured, costs cannot be neglected, and the importance of the patient perspective and patient representation is increasing. The awareness is growing that architectural and environmental features of hospitals and other institutions can contribute to a ‘healing environment’ and thus improve the comfort and health of patients and persons living in these facilities.

The societal aim is now more than ever to provide needs-based care. Hospitals must present a strategic care plan. Such a plan first describes the needs of the population to be served, followed by an analysis of the resources needed to meet this need. In the next step, together with the hospitals, an assessment is made of what is already present in the care portfolio, what must be added and what must be reduced. More than in the past, there will be a structured division of tasks between different (types of) hospitals. Collaborations and agreements between hospitals then become essential. In addition to collaboration between hospitals, work is also being done on the expansion of transmural care. Primary care is being reorganised and consultation structures are gradually emerging that should facilitate this process. Other institutions, such as the residential care centres or the centres for ambulatory care, will then have to find their proper place in a broader institutional setup.

Thorough research does not support the idea that collaboration between hospitals always leads to better quality: outcomes depend on the actual services involved. According to a review article (D’Alleva et al., 2019) that explored the extent to which networks contribute to better health in the population, lower costs, the wellbeing of the health care team and a better experience by patients, there was some evidence that for a number of specific pathologies there was improvement with respect to some of these aims. Per capita costs decreased slightly, but there was no evidence that collaboration and networking lead to overall better health in the population or to greater wellbeing among staff in general.

In the formation of networks, there is always an interaction between cooperation and competition. During a period of friendly cooperation, hospitals try to learn from each other through dialogue. However, as soon as competition is introduced into the relationship, a form of rivalry develops and hospitals may start to use their partners’ knowledge to gain a competitive advantage. Moreover, it is not always easy to realise cost advantages, because sometimes none of the hospitals in a network is willing to close down its own services.

Sharing information is important for a well-functioning network. For example, inter-hospital variability in care patterns and outcomes should be discussed. And significant differences exist between hospitals in terms of in-hospital mortality. Benchmarking in a trusted and confidential environment can lead to behavioural change and to an improvement in the indicators without the need for major external interventions. In the field of IT and digitisation, for example, multiple developments are taking place simultaneously. To close the loop between the patient, the hospital, the doctor, and home care, and to include clinical and decision support, this aspect must be built into the network thinking.

Patients can also play an important role in this process. They already choose between different hospitals based on their reputation for a particular intervention. As we observed earlier, this reputation is not always based on hard objective information. The collection and dissemination of quality indicators could help to speed up the necessary reforms in the hospital sector and can, in that sense, be complementary to 'inside' benchmarking.

IV. FINANCING THE PROVIDERS

The (health) care system thus faces a whole series of difficult challenges: the need for more integrated care, more coordination between the care lines and a stronger focus on prevention. Because the behaviour of providers is partly determined by the way they are remunerated, methods of remuneration will have to be adapted. This evolution has already started in many countries, with traditional financing methods such as fee-for-service increasingly being supplanted by other methods. In the early 2000s, DRG funding (per diagnosis group) or a mix of systems (fee for service and capitation, i. e. a payment per patient) was introduced for hospitals. The current trend is towards pay for performance or bundled payments in most countries. In terms of new methods, the addition of add-ons to core funding, i.e. additional payments for specific interventions, is a simple adjustment. More fundamental are flat-rate payments for care bundles or for the care of a population.

Within pay for performance, add-ons for coordination seem to work, but in practice they remain marginal. In many countries, an additional payment is introduced when specific quality indicators are met. This seems logical from an intuitive point of view, but empirical research on this subject is inconclusive (e.g. Zaresani and Scott, 2021). It looks as if additional treatments or diagnostic investigations are carried out if payment is made for them, but there is a risk that these interventions will be given preference over others of equal importance. In the case of pay for performance, voluntary participation by doctors is essential. A selection problem arises if mainly the best doctors take part in the process and this selection may largely explain some of the positive evaluation results. The case for payment by performance is therefore not very strong, even though this is a popular method.

An alternative is bundled payment, but this involves a more fundamental change and is more difficult to implement. There are two types of bundled payments. The first is episode-based financing for acute care, e.g. by expanding diagnosis-related groups to include the preliminary and follow-up phases. A second type is specific financing for the treatment of chronic illness with a single fixed amount, e.g. for all diabetes patients. This approach contributes greatly to standardisation of care and adherence to the guidelines, but it also means more administration and does not always lead to a reduction in costs. In addition, it is not always easy to get all the participants to agree on the same approach, e.g. negotiations have to take place about who gets what, and it is difficult to determine the optimal tariff. All things considered, however, there are more positive results here than with a simple pay for performance, at least when the bundled payments are integrated in a broader reform effort (Steenhuis et al., 2020).

Population-based payments are another alternative approach, with current examples mainly in the US. In Belgium, this is also the philosophy underlying the so-called 'Projects Integrated Care'.[2] Within this approach, an accountable care organisation receives a budget that is determined on the basis of the characteristics of the patients. If the costs are lower than the budget, the accountable care

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[2] Plan Geïntegreerde Zorg, https://www.riziv.fgov.be/nl/professionals/informatie-algemeen/interfederaal-plan-geintegreerde-zorg

organisation can keep (part of) the difference. Sometimes the organisation is also asked to cover any shortfalls itself. Research shows positive effects on quality, and the freedom to develop one's own strategy is much appreciated. The effect on costs is less clear: the good accountable care organisations often see their expenses increase, especially in the short term. For example, to reduce the length of hospital stays by providing more home care, home care must first be expanded, while at the same time hospital costs have not yet decreased. The reduction in costs therefore only follows later.

It is very likely that the evolution towards bundled and population payments will continue in the coming years. Even if the concrete results are unclear, there are usually positive effects on the organisation and quality of data collection. In any case, this evolution seems necessary to make care models with more and better coordination possible. We will argue in later chapters that the future organisation of health care will be in teams, and this is only possible if remuneration of acts by individual providers is gradually replaced by a financing schema that rewards the team. However, the voluntary cooperation of providers is a necessary condition for success. This means that they should be aware of the advantages and disadvantages of different remuneration systems and be willing to subscribe to a needs-driven organisation of care.

G. A PROVISIONAL ROUND-UP: CHALLENGES FOR HEALTH CARE

This first chapter has provided an overview of societal developments that are of great importance for our health care system and, hence, for the future of the care professions. It would be a mistake to simply extrapolate these trends and interpret this extrapolation as an image of the 'most likely' future. There can be no doubt that unexpected events will occur between now and 2040. Only a minority of observers had predicted that 2020 would see the beginning of a worldwide pandemic – or that there would be a war between Russia and Ukraine in 2022. Even a scenario analysis would be very tentative and uncertain – we sketch one scenario in Chapter 4, but this is only meant to stimulate critical thinking.

Nevertheless, although predicting the future is impossible, a description of current trends is already sufficient to sketch some of the broad challenges that the health care system is facing in the medium term. They all return in the following chapters and will feed into our view on the necessary competences of future care professionals (Chapter 5) and on the crucial features of new curricula (Chapter 6):

- The changing composition of the population and the increasing prevalence of chronic diseases and of multimorbidity requires a better integrated health care and a better integration between health and social care. This can only be realised on the basis of an integral view on human wellbeing, taking into account the life goals of persons with care needs in the care planning. Prevention and mental health will become more important.
- Prevention is not only about behaviour, it is also about the natural environment as a disease factor. Global warming will raise new challenges for the health care system which are difficult to predict.
- The trend towards patient empowerment is strong and leads to a change in the interpersonal relations between care professionals and persons in need of care. Improving the health literacy of the population is crucial. This is even more important in a setting where different sources of information are competing and there is an increasing share of fake news.

- Different segments of the population are hit differently by these developments and react differently to them. Respect for persons implies respect for the growing cultural diversity. Moreover, socioeconomic inequalities and the resulting health disparities remain large.
- Without changes in the organisation of labour, the present scarcity on the labour market for the care professions will persist in the future.
- The legal context, including the rigid regulation of the medical professions and the privacy and liability regulation, makes it difficult to introduce structural changes in the health care system.
- The organisation of health care is (slowly) moving in the direction imposed by these societal developments: better integration between health and social care, changes in the position of the hospital and the gradual introduction of new remuneration schemes for the providers.

Societal changes are one main component needed to build a coherent view of the future of the care professions. Related to these societal changes, but at the same time independent of them, are the technical and scientific evolutions in health care. These are described in the next chapter.

2. TECHNICAL SCIENTIFIC EVOLUTIONS IN HEALTH AND SOCIAL CARE

In this section, we discuss four key technical evolutions that will impact health and social care in the future: A) evolution in genomics and personalised medicine, B) robotics, C) medical imaging and artificial intelligence (AI) and D) health monitoring and telemedicine.

A. EVOLUTION IN GENOMICS AND PERSONALISED MEDICINE

I. FROM GENETICS TO GENOME TECHNOLOGY

Genetics is key in medicine and one of the major reasons why all humans are different, physically as well as psychologically. Humans have about 20,000 genes, but each of us lacks about 20 of them, and each of us is also a carrier of about 100 inherited mutations and of an average of 1-2 *de novo* mutations. As a result, we are all mutants. This is important to realise, because we all want healthy children, but at the same time mutations are inherent in the biological system. Mutation frequencies have only been known in recent years through the advent of genome analysis. Our understanding of chromosomes has grown since the 1950s and genome technology has revolutionised our insights in genetic disorders. It was long thought that the number of genetic disorders was limited (less than 100 disorders were known), but since the 1990s the number of genetic tests has increased considerably, following an almost exponential curve. Currently, about 8000 genes are associated with health conditions.

In addition to physical illnesses, genetics and genomics also play an important role in mental health. In many psychiatric problems, for example, there is a strong genetic association. As we observed in the previous chapter, however, this does not mean that we are fully determined by our genes. We are the result of the interaction between our genes and the environment (in the broad sense) and the connection between both is studied *inter alia* in epigenetics. Although the term ‘epigenetics’ was coined already more than half a century ago, it has only been during the last two decades that we have witnessed a robust increase in epigenetics research. Epigenetics was originally defined as the interaction of genes with the environment in order to produce individual phenotypes (Waddington, 1942). In a more recent definition, epigenetics is described as “the study of molecules and mechanisms that can perpetuate alternative gene activity states in the context of the same DNA sequence” (Cavalli & Heard, 2019). In this view, phenotype is the result of a combination of different factors: genomic composition, epigenetic components and environmental effects. Advances in research fields such as genomics, genetics and biochemistry will allow us to continuously improve our understanding of the role that epigenetics plays in our lives, inheritance and evolution, and it is expected that this has the potential to further contribute to the development of personalised precision medicine and prevention.

Another challenge resulting from the ever-evolving potential of genomics is the (philosophical) question: to what extent should we allow variation? This is linked in its turn to a further difficult question: when should something be considered (ab)normal?

This implies that the revolution in genomics is forcing the various stakeholders to make difficult decisions. In that respect, it needs to be stressed that in most cases there are no clear-cut, black and white answers, and care givers need to interpret the genetic information in a nuanced way. Finally, as interpretation of genetic variants requires very large datasets, we also need to think about data management and international data sharing. The legal challenges within the GDPR legislation have already been described in the previous chapter.

II. PREDICTIVE GENOME TECHNOLOGY

We have recently been witnessing a shift from genomic medicine to genomic health care. In the past, medicine was normally about treating sick people, but, as already observed in the first chapter and to be elaborated further in later chapters of this position paper, prevention and screening are now seen as equally essential. Genetics may be important here, in that it allows prediction, e.g. being able to predict the risk of cancer among (still) healthy people. Based on their genetic profile, patients can potentially be treated in a personalised way. This personalised approach also has consequences for the treatment. More specifically, we are evolving towards health care that is more predictive, preventive, personalised and participatory. Personalised medicine is about taking a patient's preferences and needs into consideration and following the existing (personalised) guidelines, i.e. using a personalised risk profile based on existing risks. While these risks are not exclusively genetic, nevertheless a significant share of personalised medicine is currently genomic medicine. As we observed in the previous chapter, information about the exposome can be integrated into this approach.

Sequencing capacity has increased dramatically and there has been an equally dramatic decrease in the cost thereof. A complete genome can presently be mapped for about €1500. The challenge is thus not the cost of sequencing, but rather the interpretation of the genetic information. This information is rarely clear cut. Often, for example, there are milder forms within a series of mutations and the proper interpretation thereof within the patient context can currently only be done together with trained geneticists. Close collaboration between the 'organ' specialist, the primary physician and the geneticist has the best potential for making the correct diagnosis and determining the optimal treatment in the context of a specific patient's situation, needs and expectations. As genetic information and its interpretation become more widely available and understood, part of this expertise will shift to the generalist (primary prevention) and specialist (secondary/tertiary prevention and cure/care), as well as laboratory medicine and imaging. The geneticists within a team will then be consulted for new and challenging cases where their knowledge and expertise can be best deployed. Increased understanding of the genetic background of many cancer pathologies also underlines the need for organ-overreaching approaches for which the input of the geneticist is crucial. A team approach again holds the best guarantees for a successful outcome for the concerned patients. Whole genome sequencing is sometimes performed in the context of cancer research, as cancer often results from genetic defects. In the future, genome information may play a role in stratifying cancer risk: often there are many small risk factors combined, multiple variants that each contribute a small additive risk, but adding the small risks together can result in a high risk of cancer. To determine this, an entire genome analysis should be performed.

Another context in which genetic testing plays an important role is in prenatal screening for developmental disorders during pregnancy. Genetic tests used to be uncommon, but now the majority of pregnant women take a non-invasive prenatal test (NIPT). In contrast to ultrasound, as typically used in the past, much more information is generated by a NIPT, resulting in the further challenge of more complex decisions. In addition, the NIPT also reveals data about the mother (incidental findings, such as cancer), which also needs to be reported.

For recessive disorders, it is possible to test in advance whether the prospective parents are carriers of the relevant gene. Today, it is possible to test for 1600 genes and such pre-conception heredity testing is often recommended. People with a recessive disorder can choose, for example, to have embryos screened at a fertility centre. Embryo selection can then be performed based on a preimplantation genetic diagnosis. In principle, it is possible to do a complete genome analysis and arrange the embryos according to risk. As such, we might be heading towards genome-wide classification or even transhumanism (cf. first gene-edited babies in China). It is self-evident that this raises difficult ethical questions.

B. ROBOTICS

I. BACKGROUND: TRIANGLE OF HEALTH PRACTITIONER, PERSON IN NEED OF CARE AND TECHNOLOGY/DEVICES

The application of technology in the context of care typically locates this technology in a triangle, with an interplay between three actors: (i) the health practitioner, who can be a medical doctor, but also, for example, a physiotherapist, a nurse, or a home care giver; (ii) the person in need of care (or prevention), who can be a patient in a hospital, but also an elderly person living at home and in need of care on a more or less continuous basis; (iii) the technology, either in the form of hardware or in the form of software, e.g. on mobile devices.

Within this interplay, it is important to define who will be the intended user of the technology: is it the skilled medical doctor or nurse, or will it be a patient who will use the technology on a stand-alone basis in his or her home environment? The concepts of 'intended use' or 'intended user' are also essential in the certification process of medical devices, where applicable. Article 2 (12) of EU regulation 2017/745 (also known as the EU MDR) defines the concept of 'intended purpose' as "the use for which a device is intended according to the data supplied by the manufacturer on the label, in the instructions for use or in promotional or sales materials or statements and as specified by the manufacturer in the clinical evaluation".

In the context of robotic devices in home care and retirement homes we refer to assistive devices that complement the care delivered by nurses or home care givers (either professional staff or family and/or friends). Companion robots can support elderly or handicapped people by providing simple service tasks such as bringing food or drink, reminding the client to take medication, or by monitoring the environment and giving warning signals to care givers when a fall is detected, for example, by smart camera systems (see Figure 17).

Although these devices can play an interesting role within the continuum of home care, it is by no means desirable that these devices take over the role of human care givers, whether it be professional staff or family or friends. Their application should be seen as complementary to care delivered by humans, with the potential advantage that technology can be present 24 hours a day and 7 days a week. This complementarity is a key concept in the application of medical technologies, and it will represent an ongoing leitmotif throughout this text.

Robotic devices can also play a supporting role in patient care and logistics. Handling patients in hospitals and in health care facilities in general can be physically demanding for the caregivers. Exoskeletons have been developed to provide a functional support structure parallel to the human body (Turja et al., 2020). In hospital logistics, autonomous robotic vehicles can transport medication from a central pharmacy to the patient's wards, or they can transport hospital equipment such as beds or medical devices. They are less suited for the transportation of patients.

Figure 17. Care-o-Bot (Fraunhofer IPA)

Robotic devices in surgery (which will be the focus of the remainder of this section) support surgeons who are confronted with difficult tasks. The procedure that needs to be completed with several sub-steps is often complex and it remains a challenge to design and implement procedures during surgery that are optimal for each patient. In addition, multi-player interaction involving several human actors and several pieces of technology in the context of an operating theatre further complicates the surgical context. It goes without saying that the application of complex technology such as surgical robots should aim at increasing the quality of surgery, while at the same time endeavouring at least not to increase its complexity. In this context, we will argue strongly in favour of the development of so-called 'intuitive technology', which builds upon a clever integration of health insights and engineering developments.

II. HISTORY: CATEGORIES OF SURGICAL ROBOTIC SOLUTIONS

Since the 1990s, research in the US, UK and Japan has exhibited a variety of approaches to surgical robotic concepts with very varying levels of success. Rather than providing a historical overview of these developments, we will present some of the key technologies using three categories: automation, supervisory control, and tele-operation.

Some of the earliest developments in surgical robotics belong to the category of automation. Robotic devices were programmed to assist in orthopaedic surgery and in prostate surgery. They were designed to perform major parts of the surgery in an autonomous way, based upon previous programming in a computer supported pre-surgical planning system. During these parts of the surgical procedure, the main role of the surgeon is passive supervision. (Siebert et al., 2002; Bargar, 2007) The role of the surgeon is mainly limited to providing input into the surgical plan, and in accurate positioning of the robotic device with respect to the anatomy of the patient. Although some studies revealed that these approaches provided highly precise interventions into the patient's organs, the lack of online intervention by the surgeon was perceived as a major drawback.

The category of supervisory control covers robotics that are programmed in a way that allows both the human operator (the surgeon) and the robotic device to perform subtasks in a parallel way, which offers more potential for successful application in surgery. During eye surgery, for example, the tool holder can be held by a robotic arm which is controlled both by the surgeon and by the robot controller. The surgeon drives the instrument to the desired location, while the robotic arm stabilizes the surgeon's input. In orthopaedic surgery, furthermore, a bone milling tool can be held by the robot in one predefined plane, while the surgeon can move the tool within this plane to prepare the bone surface and avoid critical areas such as veins or nerves.

When the surgeon is in a remote location with respect to the surgical robot next to the operating table, the concept of tele-operation can be applied. In terms of robotics, the surgeon is then operating a so-called 'master device' where he/she is giving input to a robot positioned at the operating table, which is then called a 'slave robot'.[3] Some of the most successful recent developments in robot assisted surgery are based upon this concept of tele-operation. Learning curves have been steep (Grivas et al., 2021). It should be emphasised that – for the time being – the information flow is mainly from the surgeon to the surgical robot, with little feedback coming from the robot to the human operator. Haptic and tactile feedback (meaning feeding contact force and pressure sensation between the instrument and the tissue back to the surgeon) are major issues of research worldwide. However, experienced surgeons claim that the visual perception of tissue deformation can give an indication of stresses acting on the tissues which – to some extent – is a qualitative measure for tissue loading.

III. CHALLENGES FOR THE FUTURE

We observed above that surgery is a complex procedure. The introduction of advanced medical technologies may make these procedures even more complex. Nevertheless, it is not because the technologies themselves are more complex that the operation of these devices during surgery also need to be complex. User-friendly interfaces are a primary challenge, allowing the human operator to interact with the device in an intuitive way, requiring little additional intellectual effort. The control of the instrument wrist in the Da Vinci robot is a good example of an intuitive approach to surgical robot control. This concept can be generalised to intuitive technology or user-centred design as key concepts for medical technologies that need to be integrated into complex medical procedures, either performed by a medically skilled person or by the patient him/herself. In addition to tele-operation, co-manipulation of a surgical robotic device also offers potential for an intuitive approach to robot control. Here the surgical instrument is co-manipulated by both the surgeon's hand and a robotic arm ensuring, for example, a stable and precise tool trajectory (Gijbels et al., 2018).

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[3] Although 'master' and 'slave' are well known definitions in robotics, it is recognised that these words have some colonial connotations which may urge the search for other definitions, e.g. commanding device and executing device.

Another technological development with high potential is the introduction of more artificial intelligence into pre-operative planning systems and intra-operative feedback systems to the surgeon (Moglia et al., 2021). Indeed, multi-faceted patient-specific information is now becoming available from medical image modalities and from other biophysical patient measurement records. When pre-operative planning is complemented by multi-modal information about the patient's condition, and/or when the surgeon is provided intra-operatively with complementary patient data or with data coming from structured databases of similar patients and successful patient treatments, this is likely to increase the quality of the intervention. Again, on the condition that this information is offered to the surgeon in a user-friendly, even intuitive way. In the following section we will go deeper into various possible medical applications of AI.

Robotics are high-cost devices, and this applies likewise to the world of medicine. Assistive devices in home care and surgical robots come at a high price, explained by the cost of the R&D involved and the high-quality components that are needed in the context of patient care. Given the budgetary restrictions, not every innovation is likely to find its way into regular clinical practice or indeed to the stage of reimbursement. The early introduction of surgical robotics was often justified by hospitals wanting to use it into their PR strategy to position themselves as high-end, state of the art care centres. Nowadays, as discussed in the previous chapter, health technology assessment will be key in the quantitative exploration of the balance between costs associated with the introduction of a new medical technology and its benefits. It should be emphasised that both costs and benefits should be seen as comprehensive concepts, meaning that costs should also include costs of pre- and post-surgical treatment, and benefits should include elements of savings in care costs and earlier return to work.

As part of the health technology assessment, it was observed that patients tend to be released from hospital one day after robot assisted radical prostatectomy, whereas they formerly had to stay for several days.[4] An analysis of the hospital admission, surgery and post-surgery care revealed that this reduction was not only due to the application of surgical robotics for this type of surgery, but also to the integrated care path that had been developed and deployed. The organisation of health care does indeed make a significant difference.

C. MEDICAL IMAGING AND AI

Artificial intelligence (AI) plays a rapidly growing role in health care and this role will certainly become even more important in the future. In this section we focus on the importance of AI for medical imaging. Other applications will be discussed in section D.

I. EVOLUTION OF AI: FROM MACHINE LEARNING TO DEEP LEARNING

AI as used in computational image analysis is actually not new, but has been around for as long as there are computers (see Figure 18). In the 1950s, AI was about implementing knowledge as rule-based systems. Since the late 1970s, machine learning methodologies emerged to deduce AI using as input features or descriptors of an image defined by the expert, and in the last 10 years deep learning has been on the rise, where the computer can learn from the images themselves. Ideally, the features used should be distinctive and separable, so that the clusters are as compact and as far apart as possible. In

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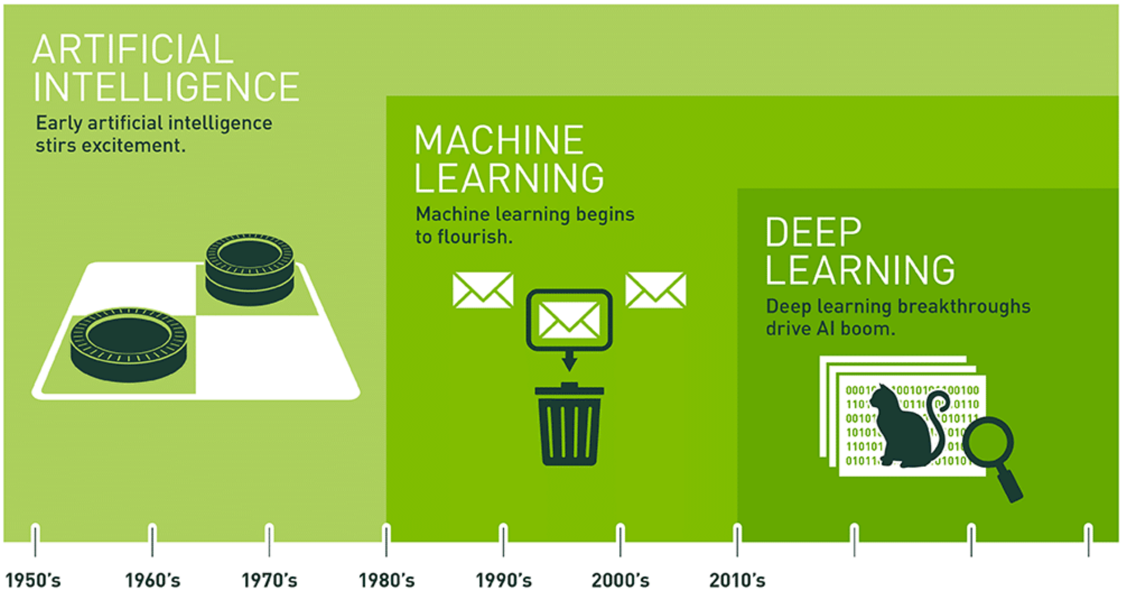
[4] Internal communication, Dr. W. Everaerts, UZ Leuven.

general, three types of features are used: photometric (colour, texture etc.), geometric (position, size etc.) and contextual (clinical and genetic data). In the last 10 years or so, computers have been able to learn features automatically with ‘convolutional neural networks’ (CNN), also called deep learning. Already in 1993, SB Lo et al. (Lo et al., 1995; Lo et al., 1993) demonstrated how to detect lung nodules with such a convolutional neural network. However, interest in CNNs and deep learning only really took off in 2012, when unexpectedly good results were shown at the annual ‘Olympic Games’ in computer vision. A CNN with 5 layers and 500,000 neurons implemented on the graphics processing unit (GPU) of a computer turned out to work much better than any other submission. With this method, only 15.3% of the cases were misclassified, compared to 26.2% with the second-best method. This revolutionised the world of computer vision, and from then on, a whole variety of deep learning network architectures using CNNs and more powerful conceptual tools with millions of parameters to be tuned in a training phase by matching the ground truth invaded the field of computer vision and imaging, quickly extending into medical applications.

Figure 18. The development of AI (source: Copeland, 2016)



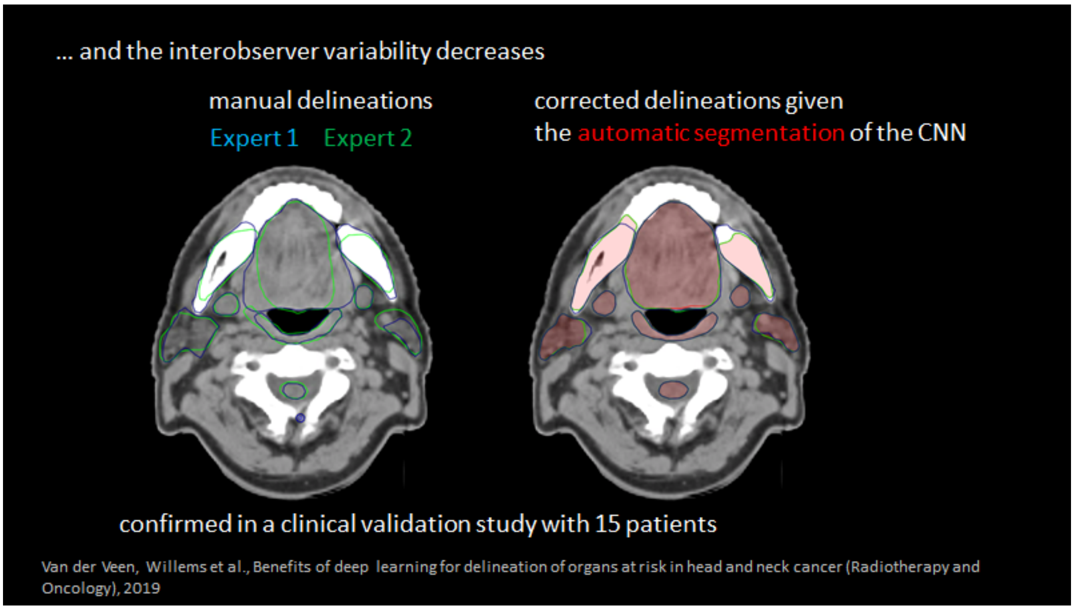
Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

II. POWERFUL AI APPLICATIONS IN MEDICAL IMAGING

Simultaneously, AI-based software tools also penetrated the market. For example, Icobrain (the cloud-based AI product of manufacturer Icometrix, with CE marking and FDA approval) can be used for image analysis in multiple sclerosis (MS), brain injuries and dementia. It calculates brain volumes (whole brain and grey matter) and lesions, as well as changes over time in these volumes, which is important in multiple sclerosis. New, larger, and stable lesions are all colour coded differently. In this way, patients can also be compared with the normal population. The images are sent from the hospital via internet to a secure cloud and return to the radiologist as a report a little later. In this way, a qualitative interpretation is possible, in addition to quantitative data about the brain volumes and lesions. Such an approach is also possible for neurodegenerative diseases. This system is observer-independent and always gives the same results. The productivity of people using such a system increases by 60%. Sensitivity (the ability of a test to correctly identify patients with a disease) increases significantly, while specificity (the ability of a test to correctly identify people without the disease) is not really affected.

Another application is radiotherapy in the head-neck area, where radiation to the tumour has to be aligned as accurately as possible (Van der Veen et al., 2019) (see Figure 19). The network is trained to align 16 organs at risk; the doctor receives these AI alignments and can still make corrections. However, the total alignment time is greatly reduced, as well as interobserver variability. It can take days to train neural networks, but once they are trained, they can work virtually in real time. An example is the detection of polyps during an endoscopy, where the size is also calculated, and the polyp is classified.

Figure 19. Example of deep learning in radiotherapy of head and neck to maximize the dose to the tumour while minimizing toxicity to healthy tissue (source: Van der Veen et al., 2019)



… and the interobserver variability decreases

manual delineations
Expert 1 Expert 2

corrected delineations given
the automatic segmentation of the CNN

confirmed in a clinical validation study with 15 patients

Van der Veen, Willems et al., Benefits of deep learning for delineation of organs at risk in head and neck cancer (Radiotherapy and Oncology), 2019

In addition to diagnostic use, CNN can also be used, for example, to predict which part of the brain tissue can still be kept viable during a thrombectomy (where a blood clot is removed in the blood vessel itself) (Robben et al., 2020). Where labelled data collections were available, the development time of a traditional classifier sometimes took several years, while a deep learning approach can be much faster, due to the availability of generic software tools.

The next step is now moving forward towards explainable AI, which can tell which pixels are responsible for the decision. Moreover, clinicians also want to know why the said pixels contributed to the conclusion. In this way, AI is indeed only explainable to a limited extent.

III. HURDLES OF AI SYSTEMS, TAKING COVID-19 AS REPRESENTATIVE EXAMPLE

The potential of AI is usefully illustrated by some recent experiences in the context of the COVID-19 pandemic. These experiences also illustrate the hurdles and risks of AI systems and thus the future challenges raised by it.

The first type of problems is related to privacy protection compliance and can be seen as a specific illustration of the general rules discussed in the previous chapter. The procedures for approval in this area (GDPR, data protection authority, ethical commission, etc.) are currently very time-consuming. If (too) strictly implemented, the current GDPR and ethical requirements in Belgium can seriously impede progress in medical research, which requires large international datasets. Moreover, the regulations differ throughout the world, thereby asking for extra resources to roll out a system widely. The associated high responsibility is also a deterrent.

A second type of problems relates to the data, which may be unreliable, inappropriate, incomplete, context-dependent or constantly changing. For example, a system to detect COVID-19 that is trained on CT images without contrast agent, needs to be retrained for images with contrast agent. Also, access to clinical expertise to supervise model building is limited due to work pressures on front-line clinicians. In addition, the data needs to be converted into the information the experts need: this usually takes months but now it has to be done very quickly, with the risk that the output is not always tailored to the needs. We also lack best practices for dealing with misinformation.

The third type of problems is related to the use and acceptance of the technology. This can be about low (public) acceptance, such as the use of a tracing app. It can also imply inappropriate use or unavailability of the technology for large parts of the population. These kinds of problems emerge in situations of urgency: they are also there in normal times but are then less visible. In any case they should be dealt with, requiring social debates on the balance between public interest and privacy.

IV. FUTURE CHALLENGES OF AI-EMPOWERED MEDICAL IMAGING

Medical imaging has always been one of the most advanced fields of AI applications, showing remarkable improvements in reliable identification of imaging abnormalities. This digital revolution is accelerating and cannot be stopped. AI-powered medical imaging is already used to detect critical diseases, and its significant role in the fight against COVID-19 has accelerated the widespread use of AI in health care, in particular towards telemedicine. More powerful AI solutions are invading every field in medicine. In particular, AI has changed the focus in radiology from a subjective perceptual skill to a more objective science. We already mentioned that it is also starting to play an important role in robotic surgery. AI-empowered image processing facilitates and accelerates searches through very large databases, thereby improving patient data analysis and accelerating diagnostic support. Moreover, AI facilitates the integration of heterogeneous sources of information, such as different images (CT, MR, …) with a patient’s clinical history, multi-omics, and sensor-based recordings, to better learn the context via these multiple views, thereby making these AI-solutions more intelligent. Additional challenges to be solved before implementing AI-empowered medical imaging on a large scale are how to pre-process and organise all the data and images generated by different centres, create platforms where new applications from different vendors are integrated into the hospital imaging systems, and how to provide the required infrastructure to satisfy inclusive privacy-preservation and security regulation in image sharing.

D. HEALTH MONITORING AND TELEMEDICINE

I. EVOLUTION OF HEALTH MONITORING AND TELEMEDICINE: MOTIVATION AND CONTEXT

The rapid evolution of information technology (IT) has raised people’s awareness about health and wellbeing (Van der Veen et al., 2019) and it has increased worldwide access to health care services (WHO, 2010). Telemedicine, which includes digitally enabled care and benefits from this IT evolution, is expected to go mainstream (Dorsey & Topol, 2020). Even better, telemedicine is expected to shift care from hospitals and clinics to homes and mobile devices, integrate with personalised care, and to become more popular in middle-income and low-income countries. Moving care outside hospitals might even be safer. Tied to this shift, virtual care and traditional clinical care are likely to integrate in the future.

Consequently, health care is evolving towards a more personalised system that will allow prevention of diseases, as well as prioritizing and tailoring both treatment and disease management. However, multiple challenges still need to be tackled in order to fulfil society’s many emerging expectations. For instance, as shown in Figure 20, the global market for wearable technology is projected to grow from USD 116.2 billion in 2021 to USD 265.4 billion by 2026 at an annual growth rate of 18.0% (MarketsandMarkets™, 2020), mainly driven by a growing demand for smart devices in the health care sector in this forecasting period.

Figure 20: Attractive opportunities in wearable technology market (source: MarketsandMarkets™, 2020)

The wearable technology market is projected to grow at a CAGR of18.0% from 2021 to 2026, to reach USD 265.4 billion by 2026.

APAC is expected to witness significant demand for wearable technology from 2021 to 2026.

Market growth could be attributed to the demanding lifestyle in developed and developing countries as well as increasing advancements in wearable products such as smart goggles, wristbands, and smart shoes.

In emerging markets such as India and China, wearable products are largely used for fitness and health monitoring which provides attractive growth opportunities for the wearable technology market.

In addition, the increasingly varied range of (non-)invasive sensing devices (see Figure 20), registering an increasing scale of signals with improving resolution and accuracy with decreasing size and power consumption, will eventually register a ‘tsunami’ of health data. This registration is often done in a long-term fashion, using multiple modalities with differing data quality that still demands 24/7 reliability. The widespread availability of these sensing devices and improvements in communication technologies are also driving the booming market of home monitoring. Furthermore, the computational performance still doubles every 18 months according to Moore’s law, which is reaching its limits. This increase in computer power has widespread implications for computational AI in health care (data mining, machine learning, imaging, signal processing, dynamic modelling). Similarly, broadband capacity enables technologies that today cannot be anticipated, such as cloud computing ten years ago, offering immense possibilities through sharing hardware, software, data and computing resources in the cloud (Claes et al., 2014).

II. CHALLENGES FOR DEVELOPING ENGINEERING TECHNOLOGY FOR HEALTH MONITORING

Wearable technology can be used to improve an individual's health, wellbeing, and performance by integrating measured/modelled biological responses into the monitoring and control of biological processes via an engineering control approach. A possible metaphor for this approach is that of driving a car: to drive a complex car, you don't need to be a specialist in car mechanics; you start from a desired direction of travel, you use your eyes as sensors and compare the data with the desired direction and combine this with knowledge of how the desired direction is influenced by steering actions. This knowledge is typically translated into a mathematical model describing the relationships between the key variables.

There are already many new (wearable) sensors on the market and trends in these sensors are characterised, among other things, by strong miniaturisation, wireless communication, and edge computing power. Although the possibilities in hardware are rapidly increasing, the main challenge for the future of human health engineering lies in analysing the data and transforming raw data into information and then into knowledge. A possible approach is to apply algorithms from real-time signal processing to extract online features that are linked to the physical or mental condition of the person in question. However, there are some challenges that are inherent to the characteristics of biological systems in general. First of all, biological systems are much more complex than a mechanical system such as a car. Think, for example, of all the biochemical reactions running in one cell, or all the neural activities in the human brain. Second, people are also individually different, due to both their genetic background and their environment (in a broad sense, such as the social conditions in which they grew up, thermal environment, air quality, etc.). Thirdly, there is the time-varying nature: the same individual does not always react the same way when subject to the same perturbation (e.g. heart rate response to a specific exercise changes as a function of physical condition, fatigue, infection status, etc.). Finally, there is also the dynamic nature of biological systems, because living systems are never in a complete steady state (e.g. heart rate at rest or biomarkers in the blood of coma patients are still varying).

These characteristics of biological systems also have an impact on the mathematical models used in the above-mentioned control engineering approach. The model types at both ends of the spectrum are mechanistic (or white box) models based on insight and knowledge, on the one hand, and data-based (or black box) models, estimating statistical relationships based on (lots of) empirical data on the other. In between are data-based mechanistic or grey box models that combine characteristics from both data-based and mechanistic approaches. More recently, very powerful methods from artificial intelligence (AI), such as big data approaches and deep learning methods, have revolutionised our capacity to model very complex (biological) systems. From a health monitoring point of view, a major challenge is that these models find connections between the key process variables without the researcher understanding how these relationships were determined, resulting in true black box models which cannot be interpreted in physical and/or physiological terms. Whether this is a problem depends on the goal of these models. For models that must serve to make long-term predictions, such as climate models, insight is very useful. Weather models are therefore very complex. However, for shorter-term predictions (e.g. predicting when a hurricane raging above the sea will reach the nearest city on land), less complex models, estimated from continuous measurements with limited historical information, may suffice. For medical purposes, data-based mechanistic models, which are compact and accurate (like the data-based models), but at the same time provide insight into the system (like the mechanistic models), might be good candidates for real-world applications, such as monitoring during general anaesthesia (Aerts et al., 2014). Engineers and technologists face additional specific modelling challenges, which may seem trivial, although not from a modelling perspective. For example, defining the relevant model inputs and outputs requires expertise about the considered (health) application and thus interaction with relevant experts. Ideally, models also take into account the properties of the biological system, and thus can be interpretable in biological terms. The latter means that model characteristics must be linkable to the existing knowledge of the expert using the model, so that it is not experienced as a black box.

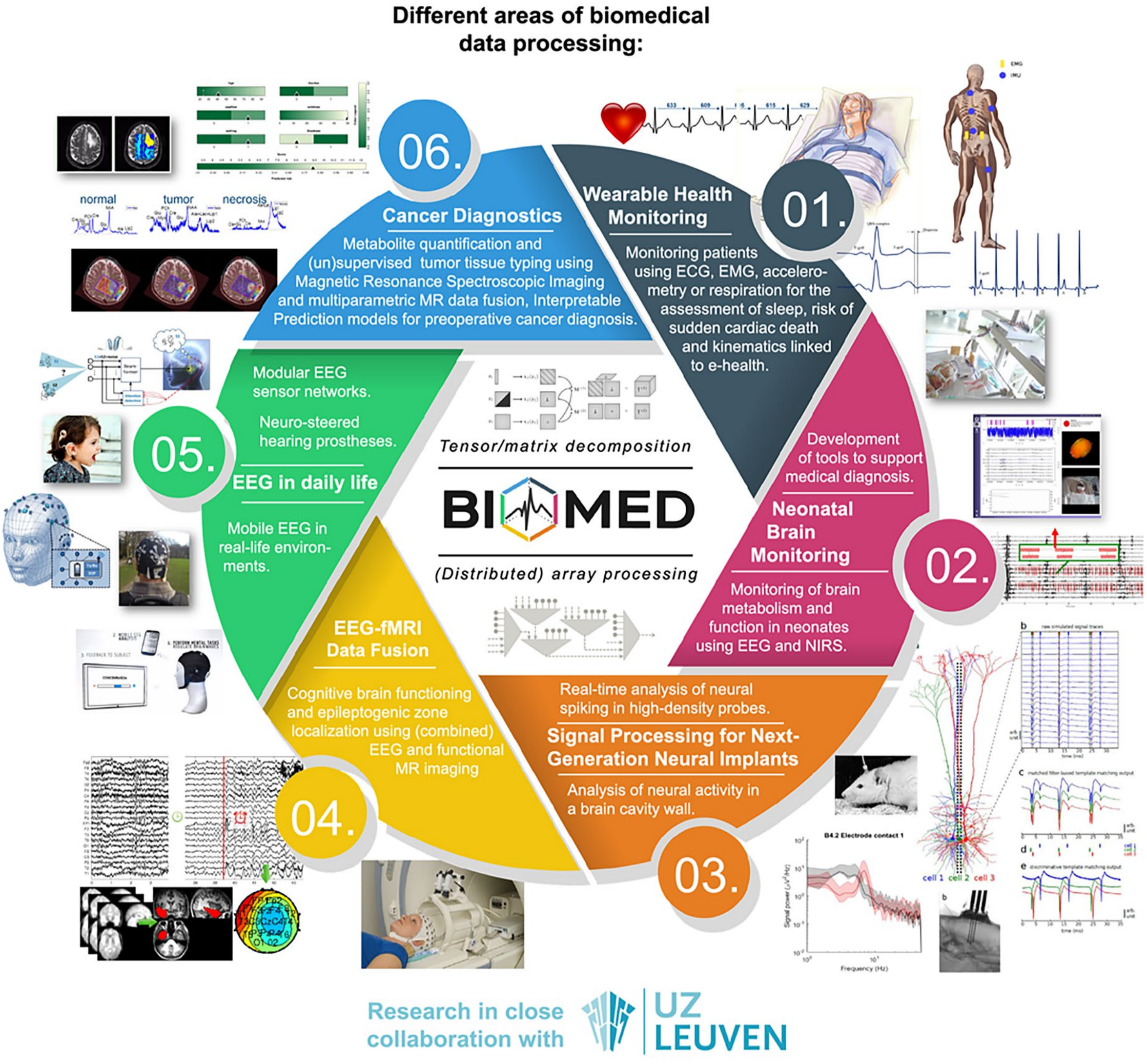
In a next step, these models can be used as a basis for monitoring and controlling/managing biological (health) processes. However, as humans are very highly regulated systems themselves, controlling such fairly optimally regulated systems is challenging as the human physiological control systems will react to external control actions and it is not always clear how and to what extent the human body will adjust. The heart rate of homeotherms, for example, is influenced by many variables, but it can be demonstrated that by applying basic approaches from model-predictive control theory, heart rate can be actively controlled, allowing one to follow predefined heart rate target trajectories by using control inputs such as by varying running speed or power in the case of horses or human athletes respectively (Aerts et al., 2008). In another example, it was demonstrated that the optimisation of deep brain stimulation made it possible to make animals ‘freeze’ for a moment in their movement (Wu et al., 2015). These examples show that technically a great deal is already possible, but the main question in this type of research is what the added value is. More specifically, the developed technology should solve relevant needs of the individual or society and should do so at acceptable costs.

III. APPLICATIONS IN SMART HEALTH MONITORING AND TELEMEDICINE: CASE STUDIES

Thanks to the ever-growing possibilities in mobile health (mHealth) technology, many applications in smart health monitoring and telemedicine are being developed today. In what follows, we describe examples of ongoing research in this field, visualised in Figure 21. It will be clear that many of these developments have immediate implications for our reflection on future care professions.

A first research field is that of wearable health monitoring or wearable sensors designed to monitor patients in their home environment, e.g. people with a risk of heart failure, sleep problems or in the context of rehabilitation for lower back pain. A second field of research is brain monitoring in Neonatal Intensive Care, to monitor brain recovery after injury, detect harmful events such as epileptic seizures, and detect any delays in the brain maturation of premature babies, for example due to stress exposure. Mathematical models making use of machine/deep learning extract the best features and learn how to link these delays to mental development and potential learning problems in later life. This involves close and long-term collaboration between engineers, psychologists, psychiatrists, endocrinologists, and neonatologists. A third field of research is that of implanted sensors designed to capture and interpret the signals of neurons, and to intervene with a closed loop system. The fourth involves multimodal data processing. Fusing two different modalities, such as EEG and functional magnetic resonance imaging in the scanner, facilitates a variety of ways to spatiotemporally map the brain regions active during a cognitive task. A fifth area involves mobile EEG, used for continuous brain measurements outdoors. This is used in neuro-controlled hearing prostheses, for example, hearing aids that are amplified with info from the brain, making it possible to focus on a specific speaker in a group and to filter out or amplify certain sound waves. A sixth field of research is that of cancer diagnostics. The information from spectra (metabolite concentrations) and demographics (age, etc.) is combined with images (tumour size, shadows, etc.) to determine the malignancy of tumours. This involves interpretable algorithms that provide insight into why a certain diagnosis is made. In particular, a scoring system for ovarian cancer prediction, visualizing the risk of each parameter (e.g. age, lesion diameter, number of papillations, etc.) with a colour code and implemented as an app on a smart phone, is widely used although not CE certified (Kaijser et al., 2013).

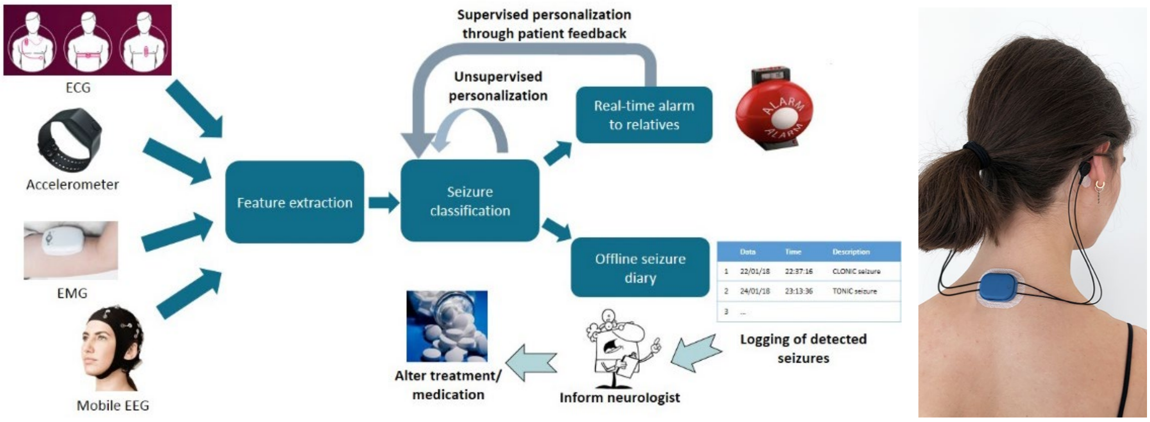
Figure 21: Examples of smart health monitoring in different research fields (source: https://www.esat.kuleuven.be/stadius/research.php?view=BioMed)



Thanks to wearables, taking various readings from patients in hospitals can be made more comfortable for the patients concerned and some patients can also be monitored at home. The best example closest to clinical practice is sleep monitoring. Nowadays, patients with a sleep disorder need to spend one night in hospital, which is expensive and uncomfortable. Instead, these patients can wear sensors (on the wrist or finger, or as patches), or even better, use contactless sensors built into their mattress, and be monitored for a month while sleeping in their own bed. Even if these sensors are not as accurate as those used in hospitals today and the recorded data is of inferior quality (e.g. because of ambient noise and patient movements), the algorithms can be made more reliable because the data are recorded in a realistic environment and continuously over a much longer period of time. Important here is to check the quality of the data and only use data segments of sufficient quality to improve diagnostic reliability. Again, AI is used to make these sensors smarter. Similar smart sensors in car seats can continuously check one's cardiorespiratory health and are thus very promising for the prevention of cardiorespiratory disorders.

To be able to monitor epileptic patients properly and determine whether certain types of medication are working, it is important to have objective and reliable information about the timing and number of seizures over longer periods of time (Figure 22). This is now possible with the certified wearable device EpiCare@Home from Byteflies, which has been validated as part of a major European project SeizeIT (supported by EIT Health) in 7 different clinical centres across Europe (Vandecasteele et al., 2020; Swinnen et al., 2021). Algorithms based on an extensive patient database (>500 patients) have been developed, which can be personalised by indicating false alarms. This retraining of the algorithm by personalised feedback can be done in a supervised or automated way. All this technology will soon be available, at least for the least complex epileptic types such as absences. However, CE or FDA approval for clinical decision-making, up to reimbursability, are still major inhibiting factors. For most other types (e.g. focal seizures) automation of epileptic seizure detection is still too complicated due to the diversity and complexity of the disease. However, measuring heart rhythm with the FibriCheck smartphone app to detect irregularities is already certified for clinical use and is now reimbursed.

Figure 22: Automated real-time seizure detection at home (left) + EpiCare@Home device (right)



	Data	Time	Description
1	22/01/18	22:37:16	CLONIC seizure
2	24/01/18	23:13:36	TONIC seizure
3	...		

IV. IMPLICATIONS FOR FUTURE HEALTH MONITORING

Health care is becoming increasingly technology-driven and gradually finding its way to the home environment. This field is currently a booming sector. Prevention is also becoming more important. For example, smartphones already make it possible to measure body temperature, blood pressure, breathing, alertness, etc., although not yet very reliably. Wireless implants such as pacemakers, insulin pumps, defibrillators, etc., are widely accepted. The expression 'Dr. Algorithm is coming' means that data science and software, driven by AI, are flooding medicine, and making health monitoring smarter. One of the main challenges of AI has already been discussed above: although it can replace routine tasks, thereby generating significant time savings, it often remains a black box for more complex tasks such as a medical diagnosis. Despite efforts to explain AI, a human expert (or possibly a team in the future) is required to interpret and communicate the final diagnosis to the patient. However, this situation is becoming less self-evident as the AI-solutions become smarter and start to outperform human skills in decision-making.

The integration of all this technology is also increasing in importance and being driven by AI: a multi-scale approach that combines images with multi-level data, from the cellular level to the macrostructures, is on its way. For example, face recognition through DNA (Claes et al., 2019) is being done in genetic imaging (combining bioinformatics and imaging) by analysing all the sequences of the genome and matching them with images and other data through AI. Additionally, sequential information can be integrated in different layers of a deep learning network to monitor disease/treatment evolution over time. These evolutions further increase the complexity of network architectures, with millions of parameters that need to be trained.

This digital revolution is accelerating due to COVID-19 and cannot be stopped. As already explained with regard to AI-empowered medical imaging, AI-empowered health monitoring is on the rise to detect and even prevent critical diseases – even before first symptoms occur – and its embedding in wearable devices is rapidly opening the way to home-based health care. This technology is becoming increasingly accessible to patients. Equipped with AI-solutions providing personalised diagnostic information, patients want to participate in diagnostic decisions and involve their smart devices in their treatment follow-up. There is a high probability that technological knowhow from personal devices will become smarter and patient learning will supersede that of their health provider. This will create a specific context for the move toward patient empowerment.

Finally, the transfer of smart health monitoring products to the technology market is a difficult issue. New business models are needed, integrating ethical aspects, reimbursement, and a plethora of regulatory issues. Moreover, the market for many patient groups might be too small and therefore not of interest to companies, although the societal value exceeds the economic value, as is the case for prematurely born babies. Ethicists, medical lawyers, and health economists will be expected to play an important role in this debate.

E. A SUMMARY OF THE CHALLENGES FOR FUTURE HEALTH AND CARE PROFESSIONS

In the present chapter we provided an overview of recent technical and scientific developments in the context of health care. Extrapolating from these technical developments into the future is even more speculative than extrapolating from the structural societal trends that were described in Chapter 1. Rather than venturing into such broad speculations, it is more useful to draw some general conclusions about the consequences of these developments for future care professionals. Indeed, even without being able to describe the future developments in a specific way, some general patterns can be described.

Interaction between engineering and medicine has changed profoundly over the past fifty years. Where engineering concepts were formerly trialled in the health context without directly involving engineering professionals in the organisation of care, a shift to mutual understanding has now become more prominent worldwide. Stimulating this mutual understanding is one of the main challenges for the future training of care professionals. More importantly, a shift towards a closer collaboration and even integration of medical and technical professions in health care seems to be an essential trajectory that must be implemented as quickly as possible into future health care curricula. Consider, for example, the control of complex biological health processes. It is key in the development of such technology that it is based as much as possible on expert knowledge and biological insights, going 'from biology to technology'. Therefore, in addition to contributing essential knowledge from both fields, medical technologists should be trained to integrate these different fields of knowledge early in the developmental process.

In this setting it is also important to point to the limitations of narrow engineering knowledge. Engineers can create the technology, but how the technology can contribute to optimizing human health is a question to be answered by the experts in the field. Another challenge is to define the relevant target trajectory for managing the patient/client processes to be considered. Often technology is developed and only then an application in clinical practice is explored and even pursued and promoted. While this can provide novel, unexpected applications, which can truly benefit individuals and patients, a needs-based approach carries more guarantees towards an application that is value-based and improves outcomes and experiences.

Crucial in this regard is that future (bio-)engineers adopt a more pronounced 'from biology to technology' attitude keeping all relevant stakeholders in the medical technology domain (patients, care givers, health insurance, etc.) in the loop from the concept generation phase to the implementation phase. This implies that technology developers are trained to collaborate and communicate with the different non-technical profiles involved in order to co-create the (complex) medical technology of the future. Finally, the technology developers themselves will likewise be confronted with an increasing need to form multidisciplinary teams; bringing together knowledge from different technological domains, such as engineering, bio-engineering, data analysis, computer science, AI, bioinformatics, etc.

In all this, the patient perspective should play an essential role. Patients are the ultimate users of health technologies and as such their assessment should be considered in the technology development and assessment process. They should not only contribute to assess technology from the clinical perspective, but also from the psychological and social point of view. As such, patients can significantly contribute to health technology assessment (HTA) (Facey et al., 2010). All this goes hand in hand with the trend towards patient empowerment – and reminds us of the danger that people may feel alienated when facing technological changes that are not under their control. To that effect, involving the end-users early in the process of studies and solution design is imperative. Such a human-centred approach is an essential ingredient to be included as early as possible as part of future educational programmes of any health care professional. Until now, however, its implementation in medical research and device/software development has been slow.

Genetics has become a core factor in clinical practice as it links with all professions and services, such as oncology, paediatrics, neonatology, metabolic diseases, pneumology, dental health, pathology, neurology, gynaecology, gastro-enterology, fertility, etc. This development and the evolution in genomics have created new challenges and opportunities for our care system. Preventive medicine suggests that a different organisation of health care might be needed. One may indeed argue that we need centres for healthy people, spaces for preventive health care where genetics and epigenetics come together to present the person with the best options to promote and consolidate a maximised healthy future. Geneticists and genetic counsellors will play a crucial role in the care teams of the future. Nevertheless, to interpret genetic information correctly, more statistical thinking is strongly recommended for all care professionals.

Of considerable importance is the processing of big data streams generated by genomics and by other medical devices (scanners, apps, robots, wearables, etc.), now a ‘big business’ driven by AI. AI has become a core factor in data science software and decision-making and is now infiltrating medicine and making health monitoring smarter. The challenges raised by AI in this setting are similar to those we described above:

a. The more commercial smart AI-empowered devices become user-friendly, the larger the risk that patient and clinicians will trust the solutions AI-empowered offer, in particular when the gap in technological literacy is growing.
b. There is a risk that health care centres in general, including GP practices, will fail to follow this digital evolution, thereby offering inferior quality in health care.
c. As enhanced personal health monitoring is able to make data available at greater speed, thereby offering the potential for better prevention, it clearly requires fundamental changes in health care management and shows the need for digital literacy and data analysis skills within the decision-making team.
d. The digital revolution has been accelerated by the COVID-19 pandemic and has facilitated home-based health care. At the same time, however, it has enlarged the digital gap. A large portion of the population (elderly, poor people, etc.) have no internet access, face difficulties in use of such technology or cannot afford it. To avoid social exclusion from future digital health care, these inhibiting factors must be removed as soon as possible. In particular, digital training should be part of any future health care curriculum.
e. Additional challenges to be solved before implementing AI on a large scale include the collection, organisation and pre-processing (including wrangling, segmentation, labelling, etc.) of all data, personalised or not, generated by different centres, and how to equip each health centre with the required infrastructure, solve interoperability issues and satisfy all GDPR regulations in data handling and sharing.

These challenges clearly show the growing need for medical technologists, ranging from biomedical and human health engineers (or any subareas such as bioelectronics, biomechanics, biorobotics and biomaterials) to data analysts, biostatisticians, and bioinformaticians. These technologically trained people should complement each decision-making team. Adequate answers to these challenges call for specific competences and roles for the professionals involved, which need to be provided through well-aligned educational programmes. These issues are discussed in more detail in Chapters 5 and 6.

3. MAXIMIZING THE HEALTH POTENTIAL OF EVERY PERSON

In the previous two chapters we described the main societal and technical developments that are currently taking place and tried to derive from them the most important challenges for the future. In this chapter we will introduce our own ethical framework, which we will use to evaluate these challenges. In Chapter 4 we will then combine the 'positive' and 'normative' insights in a synthetic (but speculative and certainly hypothetical) description of the world of care around the year 2040. Chapter 5 then draws some specific conclusions about the competences that are expected from care professionals to function in this changed world and Chapter 6 applies these general insights to sketch some key features of future educational curricula.

A. HEALTH AS A MULTIDIMENSIONAL AND DYNAMIC CONCEPT

Any perspective on the health care professions of the future will be closely related to what is meant by health. Depending on our definition of health, expectations towards health care providers will also differ. The relationship with wellbeing in particular needs to be clarified.

A classic definition of health is the WHO description dating from 1948: "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity". This definition is absolute and radical because it speaks of 'complete physical, mental and social well-being'. Even a slight disturbance on the physical, mental, or social level thus makes someone unhealthy. This immediately declares a large portion of the population unhealthy. In a cross-sectional study of the Scottish population, 42% were found to have at least one condition with a significant increase in (multi)morbidity as a function of age (Barnett et al., 2012). Furthermore, this definition also ignores the fact that people can have an illness, but nevertheless function normally and participate in private and social life thanks to treatment and adaptations. The question is then whether these people are also 'unhealthy'. A final point for consideration in relation to the WHO definition is the explicit link between health and wellbeing. Of course, good health contributes to wellbeing, but there are a host of additional factors that are also important for wellbeing, such as family situation, social contacts, working conditions, etc. Including all these elements stretches the concept of health enormously, making it potentially unworkable in practice. For example, should the system of financing health care then also support social activities or personal hobbies? And should care professionals have expertise in all these domains? Stretching the concept of health can thus lead to an undesirable medicalisation of various aspects of day-to-day life that are better taken care of by individuals or (in)formal social organisations.

An alternative definition of health comes from Huber et al. (2011) who launched the concept of positive health. According to these researchers, health corresponds to "the ability to adapt and to self-manage in the face of social, physical and emotional challenges". In this definition, health is not an absolute and categorical concept ('complete ... wellbeing'), but is given a gradual interpretation that can vary with the extent to which someone is still functioning well in daily life. It thus accounts for someone's resilience and adaptability. In this view, a 70-year-old person with high blood pressure is not necessarily unhealthy. If, thanks to medication, he or she is able to lead a 'normal' life that meets his or her expectations, then we can say that this person is leading a (relatively) healthy life. This, then, is the meaning of 'positive' in a definition of that emphasises what is still possible, rather than identifying deficits. More generally, this definition also offers a dynamic interpretation of the concept of health. After all, as a function of a person's life course – conception, prenatal development, birth, growth and development after birth, adulthood, and aging – 'the ability to adapt and to self-manage' varies. The concept of positive health is operationalised in six dimensions: bodily functions, mental well-being, meaningfulness, quality of life, social and societal participation, and daily functioning (Huber et al., 2016). A person's health is then estimated on the basis of scores in these six dimensions. An institute with an entire organisation has been built around the concept of positive health that strives for the implementation of positive health in the (Dutch) health care sector, both in terms of policy and in daily patient care.[5]

The concept of positive health has not been free from criticism (Schermer & Van der Horst, 2021). First, it places (too?) much responsibility on the individual. Positive health presupposes adaptability and resilience, but what if the individual is not capable of this for whatever reason? Is being unhealthy then his or her fault? In a sense, this clashes with the insights put forward in the first chapter, namely that there are health determinants that transcend individual ability (see also below) such as genetics, or because they take place at a higher social level (e.g. socio-economic conditions, climate, and environment). Second, by emphasizing adaptation, it can also divert attention from curative approaches that eliminate the underlying health problem. As a result, the concept of positive health may also generate some resistance, for example from physicians whose training and practice are more focused on curing and removing limitations. Third, it remains susceptible to the criticism of stretching the concept of health and the (over)medicalisation of life. Through the six dimensions that include meaningfulness and quality of life, health is given a very broad interpretation that can exceed the substantive, organisational and financial capacity of both the individual health care provider and the overarching health care policy. A final comment is that, in terms of content, it is a further elaboration of Engel's classic biopsychosocial medical model (Engel, 1977) rather than a fundamentally new definition of health. The addition of the dimension of meaningfulness is new, but the other five dimensions were already captured to a large extent by the biopsychosocial model.

These different definitions and models each have their strengths and shortcomings. Rather than making a specific choice for one model or another, we propose a number of characteristics of health with which we believe future care providers should be familiar. Ideally, these should be addressed in the training of the various care professions so that they later take up caring for people from a common frame of reference.

- Health is a complex multidimensional issue that cannot be captured on one axis. It certainly cannot be reduced to physical health only. Mental health is equally important. The addition of meaningfulness to the classical biopsychosocial model is welcome. For patients with chronic illnesses or permanent limitations, the question of meaning can be of particular importance in co-determining their experience of health. Good care accounts for the personal life goals of the patient.
- Health is a gradual entity rather than a binary state of being healthy or not. Depending on someone's position on the various health dimensions, that person has a higher or lower degree of health.
- Health is also a dynamic entity as a function of the course of a person's life. For children, further growth and development is part of the health experience, whereas for the very elderly the emphasis may lie on an adapted lifestyle, accounting for a number of limitations.

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[5] See https://www.iph.nl/

- Health includes a balance between healing and adapting. Both facets are not opposed to each other, but go hand in hand. Where the emphasis should be depends on the underlying pathology, available therapeutic arsenal, stage of life, personal expectations and wishes, etc.
- Health is a shared responsibility of individuals and society. On the one hand, it is important to sensitise people to a healthy lifestyle so that they take as much control as possible over their health. On the other hand, we must also avoid placing burdens on shoulders that cannot bear them. This raises the question of solidarity at different levels (family, neighbourhood, society) and of structural interventions by the government to promote health. This requires a coordinated preventive health policy on the part of the government that complements the curative component.
- From the point of view of public policy, health does not coincide with overall wellbeing. Of course, health is an essential component of wellbeing and individual feelings of overall wellbeing may have an influence on health, but at the policy level it is better to keep a distinction between the domains of health care and welfare. This avoids an excessive medicalisation of society and also helps to justify the solidarity-based financing of health care budgets. Of course, this approach does not run counter to the idea of 'health in all policies' – but it challenges the idea that all important dimensions of life should be fostered through the health care system.

B. DETERMINING FACTORS FOR HEALTH AND RESPONSIBILITY

Taking the above description as our pointed of departure, we now take the next step toward the so-called determinants of health. What factors determine that people do or do not have the ability to live independently and meaningfully for as long as possible? As discussed fully in Chapter 1, (access to) care is only one of the determinants, and according to some studies, not even the most important one (Schroeder, 2007). Other determinants include genetic and biological constitution, individual behaviour, socioeconomic status, social relations, and environment (pollution, climate, ...).

The fact that (access to) care is only one of the determinants of health does not mean that its impact is unimportant. Especially in acute or life-threatening situations, rapid and adequate intervention is of paramount importance. Biomedical and psychological research also provides insight into how certain determinants affect health and thus enable us to take targeted and critical action. The core business of care providers thus remains focused on preventive, diagnostic and therapeutic action. At the same time, they must be aware of the larger framework in which conditions for healthy living are created.

Chapter 1 also demonstrated that these determinants of health are unevenly distributed in the population and that adverse situations often cluster (Lim et al., 2012). This results socially in an unequal distribution of opportunity to enjoy a healthy life. The importance of lifestyle raises a difficult dilemma for policy. On the one hand, respecting the agency of individuals implies respecting that they themselves make the important decisions about their lifestyle. No one else can do this for them. On the other hand, without wanting to minimise individual responsibility, there are also sufficient arguments not to lapse into a 'blame' discourse with regard to (weaker or more vulnerable) individuals and not to place responsibility solely on the shoulders of the individual. After all, the circumstances in which an individual lives and works, often escape his or her capacity for action. Consider, for example, the impact of air pollution on health. In polluted areas, society must take collective responsibility for the health of its inhabitants. Or take the challenge to change one's lifestyle in a society in which healthy food is more expensive and in which alcohol consumption is an important feature of social life. Or consider the socioeconomic gradient in vaccine uptake during the COVID-19 crisis. Or look at the very uneven distribution of working conditions and their effects on health. The challenge is to create a social environment that stimulates individuals to make 'healthy' lifestyle decisions.

This implies that the health care of the future should not be restricted to the microrelation (one-to-one) between an individual patient and a (team of) provider(s). It will also involve the household, the family, the friends, the social neighbourhood, … Population management will be an essential component of the care system.

Furthermore, we must also account for the fact that health is a dynamic concept in which these determinants have a different weight according to age. It goes without saying that our genetic constitution at conception and prenatal growth is of crucial importance and that the effect of one's own individual behaviour manifests itself later in life.

C. A NORMATIVE FRAMEWORK WITH RESPECT TO HEALTH (CARE)

The above description of health and its determinants forms the theoretical groundwork within which care providers operate. Of course, they should work on an evidence-based basis, which means that their actions are based as much as possible on scientific insights, with an eye to individual variation or the position in which the person finds himself or herself and to his or her wishes and expectations. An overarching normative framework remains essential, however. Indeed, the provision of care is not independent of social and ethical choices and priorities. Below we first sketch the two basic principles underlying our normative framework: an integral view of the person, and respect for all persons with special attention for the most vulnerable. We then translate these basic principles into a number of specific normative choices that we believe are crucial to high-quality, accessible and affordable care, i.e. care that maximises the chances of a long and healthy life for everyone in society.

I. THE BACKBONE OF THE NORMATIVE FRAMEWORK

AN INTEGRAL APPROACH TOWARDS PERSONS IN HEALTH AND DISEASE

The human being is not a sum of subsystems but a dynamic whole of a number of dimensions: the physical, psychological, social and spiritual. These dimensions are fundamentally and dynamically interconnected and require an integral approach. Of all these dimensions, the spiritual is most often absent from interdisciplinary and integral approaches. The multitude of definitions of this dimension exhibit common elements: the search for meaning and purpose, the determining role of core values, the importance of meaningful relationships and life goals, the relationship to the transcendent or sacred, the identity and vision of life that one develops.

How can we keep the human being as a whole at the centre of care, despite enforced specialisation? (Super)specialisation in medicine has led to splitting and fractioning of policies and approaches. The person is no longer seen as a whole but as the sum of a number of organ or cellular systems. Similarly, in medicine and mental health care, the trend has been to look at the disease rather than how the disease affects the person. Furthermore, therapy compliance, healing and health are most efficiently achieved when people are diagnosed, treated, and supported as a whole.

This integral approach must also look at an individual throughout his or her life, from prenatal – with mainly genetic but also environmental influences –, through prevention as a young person, to early diagnosis, individualised treatment to care and an end-of-life approach. Another fundamental prerequisite for an integral approach to the human being is interdisciplinary cooperation between care professions based on the awareness that each care professional bears responsibility for the human being as a whole, in addition to taking responsibility rooted in his/her specialised expertise within or concerning one dimension of the human being.

PREFERENCE FOR PEOPLE WITH FEWER OPPORTUNITIES FOR HEALTHY LIVING

We start from the basic value that all people should have equal opportunities to realise what they consider to be important in life. This goes beyond health, but a good health condition is a necessary precondition for realizing one's full potential. Different individuals have different social backgrounds, which may make it more or less difficult for them to realise this ideal. In a world with limited resources, one must set priorities. In line with the mission statement of the KU Leuven, we believe that special attention should be given to the most vulnerable.

In addition to people with congenital defects or disorders, the most vulnerable include people from socially disadvantaged backgrounds. They tend, on average, to have poorer health and a lower life expectancy. Society bears responsibility for eliminating social deprivation as much as possible. Within the narrower framework of health, specific policies are needed.

Systems of health insurance make it possible to decouple the financing and the provision of care. All insurance systems, whether private or public, introduce (*risk*) solidarity within each risk group between the lucky (who do not get ill) and the unlucky (who do get ill). Yet public systems of health insurance, like the Belgian one, can and do go further. They also introduce (*subsidizing*) solidarity between risk groups: people who are more vulnerable because of their genetic endowment or because of their socio-economic background do not pay more for their insurance. Moreover, in principle they guarantee access to all the services covered to everyone who is insured. And they even go beyond subsidizing solidarity by introducing what can be called *income* solidarity: the rich pay larger contributions than the poor. Generous health insurance systems may create incentives for overconsumption. Care professionals may play an important role in trying to avoid such overconsumption.

In a system of insurance, insured patients pay only a limited fraction of the cost. For the weakest socioeconomic groups, however, even this limited fraction may still be a substantial burden. If we want to guarantee adequate access, we will have to introduce additional protection mechanisms, such as maximum billing, or generalised third-party payer arrangements. Again, these mechanisms require collaboration among the care providers.

Even if there were no financial barriers left (*quod non*), the most vulnerable groups in society would still face cultural and psychological barriers. In Chapter 1 we described problems arising from insufficient health literacy. Moreover, let us remember once again that health care is only one determinant of health. Care professionals have no direct influence on the mechanisms of social inequality, but understanding these major determinants of health remains essential. Care providers can contribute to the health of people with fewer opportunities by (i) providing accessible communication about health; (ii) encouraging and supporting healthy lifestyle habits; (iii) generating a context that increases therapy compliance; and (iv) accounting for the living conditions of the people concerned in the context of prevention, care and treatment.

Delivering health care essentially involves a fundamental choice for people affected by illness, disability, and adverse life experiences. Within this choice, we should be especially concerned about the group of people who have less access to a healthy life. This preference for people with fewer opportunities for healthy living translates into three levels of action: (i) (micro) accounting for the social gradient in communication and therapy choice; (ii) (meso) building accessible institutions that are open to diversity; (iii) (macro) being open to and supporting policies that counteract the social gradients that sustain health inequality.

II. PUTTING THE BACKBONE INTO PRACTICE

FOCUS ON PREVENTION, SCREENING AND EARLY DIAGNOSIS OR TREATMENT

We already observed in Chapter 1 that behavioural patterns (40%), in addition to genetic predisposition (30%), are a major contributor (Schroeder, 2007) when considering the underlying causes of premature death. It goes without saying, therefore, that the way people behave is of major importance for health and disease. It is quite often assumed that behaviour is an easily modifiable factor, and can be implemented simply by informing the patient. For a once in a lifetime behavioural change, we can perhaps be easily motivated externally. Unfortunately, changing one's behaviour in the long term requires many steps, positive habit formation and finally a non-stop supporting context. Indeed, as explained in Chapter 1, while health literacy may help, behavioural change is not just a matter of knowledge.

In Belgium, most care providers are active in secondary and especially in tertiary prevention.[6] However, in line with international recommendations, prevention needs to shift more towards the primary level to reduce or eliminate drivers of non-communicable diseases (NCDs) such as cardiovascular disease, diabetes, cancer and chronic respiratory disease. The international treatment guidelines of the top 4 non-communicable diseases recommend the following lifestyle elements: (i) manage stress and/or sleep well; (ii) be physically active; (iii) eat healthily and stop smoking; (iv) and, last but not least, be connected with others. Such a promotion of health supporting habits should focus both on the individual and on specific groups in society. The first and primary aim of these policies is of course to improve the health of the population. But mounting evidence also supports the fact that in the long run expenditure on preventing NCDs is lower than expenditure involved in curing or treating them (Bertram et al., 2018). Thus, from the point of view of both the individual and society, it seems logical to invest in healthy lifestyle commitments and habits, especially for individuals and groups at risk.

Such a preventive outlook challenges care professions on a daily basis. Gaps between knowledge, policy, and practice must be bridged to invest in effective prevention strategies. Training of care professionals should emphasise health promotion (primary), and improvement of early detection and interventions not exclusively in clinical settings (secondary), but also in society at large, such as schools, sport and recreative clubs. We will explore the implications of this perspective in Chapter 5.

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[6] Primary prevention = intervening before health effects occur, e.g. through vaccinations; secondary prevention = screening to identify diseases in the earliest stages, before the onset of signs and symptoms, e.g. through blood tests; tertiary prevention = managing disease post diagnosis to slow or stop disease progression;

SCIENCE AND TECHNOLOGY AT THE SERVICE OF THE HUMAN, OR 'THE HUMAN IN THE LOOP'

As described in Chapter 2, biomedical sciences are providing us with more and deeper insights into the functioning of the human mind and body. Various sorts of technologies are capitalising on these insights to design new diagnostic and therapeutic approaches and solutions for a broad array of health issues. Moreover, technology is also being promoted in the preventive context to change or influence human behaviour and to guide or nudge people towards a healthy lifestyle, e.g. smart watches that monitor physical activity. Technology optimists are looking forward to a fundamental transformation of health care by technology; others are more sceptical and warn against a plethora of side-effects such as dehumanizing care, selective access to technology for privileged persons, technology for the sake of technology, pressure on the affordability of health care due to the high cost of technology. Integration of ethics in health technology assessment thus seems imperative, but a recent systematic review concluded that "Compared with the scientific experimental paradigm, there are no settled proceedings for ethics in health technology assessment (HTA) nor consensus on the role of ethical theory and ethical expertise hindering its integration" (Bellemare et al., 2018).[7]

On a more practical note, it has been argued with respect to artificial intelligence – but this can be extrapolated to other care technologies – that the integration and implementation of technological solutions into care depend on fulfilling three conditions. (i) They serve human ends as opposed to technology for its own sake. Assessing the finality of a tool, the 'why', remains of the utmost importance, as any tool can have positive and negative effects. This also means that we must anticipate situations of failing technology and evaluate its pros and cons. (ii) They respect personal identity, meaning that technology can be used to prevent or reverse negative changes in individuals, but not to alter or augment their bodily or mental functions towards 'super beings'. (iii) They promote human interaction, i.e. they facilitate and augment contact between patient/client and care provider, e.g. by allowing more time for personal contact. As such, the introduction of health technology has the potential to contribute to patient-centred care, patient self-determination and the development of health care into a co-production of patients/clients and care providers. By focusing on these three principles, we can try to keep the human (patient, client, care provider) in the loop as much as possible, rather than having the human bypassed or surmounted by technology (Jotterand & Bosco, 2020).

An important corollary of keeping humans in the loop is that patients, citizens and care providers should stay on top of the development or introduction of new health technologies. However, even today not everyone in health care is able to grasp the technical details of his/her practice, let alone the underlying technological principles. It can be anticipated that this tension will only increase with future technology applications in health care. Ultimately, this raises the question whether doctors, nurses, pharmacists, psychologists and physiotherapists will still be able to understand the underlying principles of their professional practice. This creates a dependence or 'blind faith' in technology that must be weighed against the benefits or must be backed up by proof of efficacy and efficiency in clinical studies. For health care curricula and education, this raises the question of how to enrich programmes with novel developments without causing mental overload for the students.

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[7] At the EU-level, there is an ethical guide for AI: *European Commission, Directorate-General for Communications Networks, Content and Technology, Ethics guidelines for trustworthy AI, Publications Office, 2019,* https://data.europa.eu/doi/10.2759/177365

ORGANISE CARE IN AN INTEGRATED WAY

Chapter 1 has highlighted new developments in the economic, legal, and labour context of care. The current system is characterised by excessive specialisation between *care* and *cure*, between health, care and welfare, between somatic and mental health care, between professional pillars, lines and departments. Despite the best intentions of all the parties involved this has led to unwelcome effects such as suboptimal care delivery towards patients, a heavy burden on care professionals, a top-down bureaucratic approach to care, and an increase in management costs. More important, however, is the fact that this organisational structure is now confronted with a demand for care that is diametrically opposed to it. The various elements of this have already been discussed in the previous chapters. The world has become a *VUCA* world: volatile, uncertain, complex, and ambiguous. The context of care is becoming increasingly complex, with more elderly people and more intercultural relationships, with a large group of singles, with complex newly composed families and every potential form in between. In addition, due to the changing population, there is now a large demand for chronic care on top of the acute care demand. At present, acute and chronic care needs are served by the same system, but the two need to be distinguished in order to prevent acute needs from being over-served. At the same time, the two systems cannot be allowed to exist side by side without interaction, because one needs data from acute care when the demand changes to a chronic one.

The need for care should be redefined as a collaborative question, which differs according to the group of patients involved. The best strategy would be to try to map the needs of the population, see where the highest needs are, and on that basis make agreements to redesign the care process. The preparation, support and management of care should be organised *bottom-up.* From the patient perspective, his or her care should be planned with people who work together to understand the patient: care providers should give patients control, they should coordinate and deliver services to achieve best outcomes as a function of the life goals of the patient (Dawda, 2019). Among other things, integrated care implies:

- Determining the system level from which the care demand or need emanates. Of course, this can only be one person, the patient. In the case of complex care issues, there is a good chance that the care issue configuration transcends the individual and must be approached from a broader system (the patient and surrounding context). The need for system expansion is reinforced by the social gradient (cfr. 1.B.IV).
- Focusing on and maximising direct human contacts between patients/clients and care providers;
- Aiming for collaboration between care professionals in multifunctional and interdisciplinary (or even transdisciplinary) teams. Promoting diversity in the work force;
- Ensuring fluid transitions between zero, primary, secondary and tertiary levels in health care;
- Ensuring that patients have swift access to the care level that is best suited to their needs. Depending on the condition, this care level can be situated in the community or in the hospital.
- Differentiating care as a function of the context: acute versus chronic care; therapeutic versus preventive; curation versus adaptation.
- Designing workflows, buildings, organigrams based on the needs of patients (and context) or population: structure follows strategy.
- Organising care from the demand for care, really putting the patient first. Starting from the needs of a regionally defined population.

- (Re)designing more than one system (with one logic and one set of design criteria), recognizing that the total demand for care consists of different subsets that each need a separate design, based on a set of divergent design criteria. Thus, designing parallel patient or order flows based on demand/supply-based operating Logics (Van Hootegem, Dessers, 2017; Lillrank, 2018, 17-20, 213 - 252).
- Aligning the financing of care with the principles of integrated care.

The patient-centred approach not only allows for personalised care, but may also facilitate the autonomy and self-determination of patients (and context). Therefore, the integration of motivational guidance, behavioural change, and well-selected patient-centred evaluations is needed. To evaluate treatment effectiveness from the patients' perspective, PROMs (patient-reported outcome measures) and PREMs (patient-reported experience measures) are suggested. PROMs provide the missing link in defining a good outcome by capturing the quality-of-life issues that patients care about, and which often cause them to seek care in the first place. In addition, PREMs, for instance the Quality Index Scale, provide direct feedback about the care provided. A PREM can provide a warning that care quality improvement is necessary. At the same time, measures of quality about structure, process and health outcomes also remain important.

PROMOTING A HEALTHY LABOUR ENVIRONMENT FOR A SUSTAINABLE WORKFORCE

Providing good care can be very demanding, physically, psychologically as well as emotionally. Caregivers can also be burdened by (personal) mistakes and (system) dysfunctions. Not surprisingly, there is a rather high prevalence of burnout among care professionals. In a cross-sectional study of Belgian nurses and physicians, 19% of the respondents reported positively for at least two of the three defining features of burnout, i.e. emotional exhaustion, depersonalisation and reduced personal competence (Vandenbroeck et al., 2017). This has adverse consequences for care professionals, patients, and organisations. For example, burnout among nurses is inversely correlated with patient safety, quality of care, nurses' organisational commitment, nurse productivity, and patient satisfaction (Jun et al., 2021). Moreover, burnout drains the care workforce as emotionally exhausted care professionals reported higher rates of absenteeism, intention to quit and to work less (Vandenbroeck et al., 2017). From the perspective of both the quality of care and workability, it is important not to organise work on the basis of an exaggerated desire for uniformity.[8] In the composition of teams, maximum account should be taken of the competences and preferences (to be developed) of the professionals deployed. All strategies to combat burnout should focus on improving professional autonomy, informal social structures, qualitative leadership and learning opportunities. In positive terms: enthusiasm, development, job satisfaction, self-care and pride must flourish in the professional context of care.

D. IMPLICATIONS FOR FUTURE CARE PROFESSIONALS AND ORGANISATION OF CARE

This framework has important implications for care professionals. Their training and professional activity should be aimed at ensuring that the person/patient can live independently and meaningfully for as long as possible, free from preventable diseases, disabilities, and accidents. This requires an integral

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[8] The abandonment of uniformity has no impact on the possible pursuit of standardisation. In the application of lean management, uniformity and standardisation are sometimes misinterpreted as synonyms.

view of the person/patient and balancing of individual elements (genetics, behaviour) with social determinants. Care professionals should be aware of the socio-economic gradients and disparities that impact on health and disease and strive for equity in health care. Furthermore, this also shifts the focus of the care professional to promoting and maintaining health. The traditional cure & care approach remains important and will, in practice, consume a large part of the professional's time and activities. However, it should be complemented by promoting healthy behaviour across the different stages of life and supporting a healthy environment for all, emphasizing the importance of primary prevention. All these elements will be further developed in Chapter 5. Before turning to the competences of the care professionals, however, we first bring together the insights from the previous chapters in a synthetic, admittedly very hypothetical, speculative, and confrontational description of what the world of health and social care could look like in 2040.

4. WHAT WILL HEALTH AND SOCIAL CARE LOOK LIKE IN 2040?

Predicting the future is notoriously difficult, but some trends are clearly noticeable, and the COVID-19 pandemic has brought several deficiencies of the present situation into focus. The observed trend will be further influenced by changes in societal and political opinions, preferences and majorities, as new generations with a different view of our environment and the interaction between humans and the world surrounding them and with other political, societal, and financial balances, will come to power. Several implications of the evolutions described in Chapters 1 and 2 will, however, shape this future to a significant degree and define how citizens, patients, caregivers, and care providers will need to adapt, learn and collaborate to maximise the health potential of every person involved. We examine this future from the ethical point of view that was sketched in the previous chapter.

Of course, any sketch of a possible scenario will be necessarily speculative. Our scenario is only one of many different possible scenarios and should be seen neither as a prediction nor as an ideal situation. Some of the trends described raise deep normative challenges. The singular purpose of the present section is to assemble some of the ideas introduced in the previous chapter in a vivid picture.

A. OUTLOOK IN 20 YEARS

In 20 years, we will live longer, and we will remain healthier for a longer period of our lives. Nevertheless, chronic diseases, new infectious agents and the consequences of climate change are having a profound influence on our wellbeing and inequalities in many aspects of our lives have not been completely resolved, i.e. wealth, access to education and care, social network connectivity and many others. To a significant extent, these inequalities define our capability to make decisions that optimise our health expectations. On the other hand, society as a whole expects health care to improve not only our overall wellbeing but also our ‘well-feeling’ and to address individual needs and expectations by a personalised approach. How an individual feels is a stronger driver of her/his behaviour than most other aspects, such as education or objective information about the consequences of that behaviour. This expectation about the care system looking after the person as a whole, including her/his emotional, psychological and physical wellbeing and feelings, conflicts with expectations of efficiency and cost containment and with the present trend of ever-increasing sub-specialisation of the medical and other care professions. Similarly, the tension between individual rights and privacy versus the increased need for detailed individual personalised data to support health care systems creates a pendulum movement with restrictions and relaxations following one another depending on political and societal preferences.

Commercial third parties will play an increasingly important role as the tech big five (Google, Amazon, Meta, Apple, and Microsoft) are essentially data analysts which have tried to enter the health care ‘market’ in the past with variable degrees of success and will continue to do so now and in the future. Their impact will depend on how much trust individuals and society will have in their activities, but given their expertise, knowledge and financial strength, collaboration under well-defined conditions seems desirable. Other commercial entities will also offer medical services, ranging from preventive, diagnostic to simple therapeutic actions, either as a by-product of their main activity (i.e. large retail or wholesale trade companies) or as a niche application. Trust will be the essential determinant of their success, and setting the rules is an important task for the health care system and society to avoid building additional silos and impeding a coordinated, whole-person approach. Such commercial activities should undergo the same, rigorous evaluation of effectiveness as all other pharmaceutical and technical interventions as well as health technology assessment for their efficiency.

The care system needs to steer a middle path between an exceedingly individualistic, self-centred position and a detached, state-wide, organised approach in which individuals lose trust in the system as a whole and its providers. While the ultimate decision regarding this balance is a political one, the health care system can provide guidance and support for these decisions by exposing the benefits and weaknesses of specific approaches and documenting them from real-life experiences. This presupposes that every interaction, result, experience in health care becomes an input for a self-learning health system, which continuously gathers information, weighs the results against a pre-defined optimal outcome set (defined at both an individual and societal level) and provides guidance for improvement, learning and self-reflection.

I. HYPER-CONNECTIVITY

In 2040 we will be living in a hyper-connected world where everything conceivable is measured and processed, the extent of which might vary but will almost certainly surpass what we can imagine today. Starting from our genetic and epi-genetic characteristics, through our cellular and organ processes, to our behaviour and interactions with other individuals as well as the physical world in which we live and move, everything will be captured and interpreted by (semi-)autonomous hybrid physiology-AI systems that make predictions about our progress and evolution in interaction with this environment and provide suggestions for a better and healthier future. Abnormalities will be picked up early, even before they cause symptoms or complaints, so that preventive measures ranging from behavioural changes to genetic alterations and tissue replacement therapies can be implemented in a timely fashion with minimal impact on the individual but limiting health problems and costs down the road.

The way in which the data, at an individual and group level – and with respect to societal aspects of environment, pollution, etc. – are gathered, will have shifted considerably. Wearables will have evolved to a certain extent into implantables which gather information not only on ‘typical’ parameters like heart rate, blood pressure, breathing frequency, temperature, but also capture metabolic parameters like glucose, pH, oxygen saturation and a range of -omics. These parameters will be transferred automatically to the patient’s health record, which combines these measurements with information from their medical history, including genetics and their lifetime exposure to influencing factors (exposome), to derive epigenetic insights and to predict their future health. These tools will act like decision support tools, answering ‘what if?’ questions on a variety of topics: what if I lost weight, exercised more, drank less alcohol… how would that influence my future health? What if I opted for this diagnostic test as opposed to that one… what are the risks involved, what information will I get or miss, how will this influence any therapeutic decisions down the road? What if I choose this therapy and not that therapy? How will it influence my wellbeing and feelings, how will it impact my family and social environment, what can I expect tomorrow and in 5 years as a result of this decision? Patients will have access to exactly the same information as the professional, but possibly with a different interface and presentation depending on needs and expectations.

II. EQUITY AND ETHICS

People with a lower socio-economic status often have a greater need for care. They also experience more obstacles in accessing and using information. To ensure they can benefit from the digital switchover in the future, measures are needed to make health care more accessible and to provide specific training and assistance for these target groups (e.g. by providing smartphones as part of health care insurance).

But technical solutions or hardware alone will not make the ultimate difference. Changing behaviour, providing training, and embedding new solutions in a changed culture and attitude are essential. The choices individuals make regarding their present and future health are very dependent on their history, social and psychological background. To state that each individual is personally responsible for all of her/his choices and that the consequences are thus also that individual's sole responsibility is an undeniably overreaching interpretation of the deterministic nature that governs decision-making as a whole. So, everyone needs help to a certain extent in making the right decisions. Personal responsibility remains, but the level field for making decisions needs to be supported by personalised decision-making tools. This implies two difficulties: how to determine the 'correct' need at a certain moment? How to help an individual make the right choices to achieve a desired outcome? Here again the care system of the future has an essential role to play: to co-decide with the individual in her/his best interest, on a varying scale from offering only supporting data, giving information, and providing insight to the direct suggestion of different options.[9] The individual will always make the final decision, but depending on the specific situation it is clear that the way in which the care professional offers input and advice will have a major impact on that final decision. Ethical aspects play a major role, which cannot be fulfilled only by external ethical advice for every situation, but will need to be part of the intrinsic skillset and motivation of the care professional.

III. INDIVIDUAL AND SOCIETY

With the expected shortage of care professionals in mind, but even irrespective of such a limitation in human resources, two solutions will be in use in the future: much more emphasis (again) on the community surrounding individuals in various aspects, and automated 'bots' for which technical and social solutions will have to go hand in hand. The world has become a much more individualised but also a lonely place in which 'help' in its many facets is outsourced to professionals due to ever-increasing demand and continuous solicitation placed on the working individual. While a great economist of the past (Keynes, 1930) predicted that the increase in productivity would provide more free time for individuals, this has not really occurred. On the contrary, we have less free time and even that time is used to pursue ever-increasing needs: the insatiability issue. This expanding need for more goods and services has led to a rat race, leaving many individuals more frustrated than happy, and has profoundly changed our interactions both at the family and the community level. It has also had a serious impact on our environment, the effects of which we are now witnessing, and it will further impact health and wellbeing unless a fundamental change is realised.

Another aspect of this emphasis on individuals rather than community and society is the demand for personalised or individualised medicine and care. While this is a correct demand in view of

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[9] Copenhagen Institute for Futures Studies (2019). *Nordic Health 2030*, pp. 35-39. https://www.nordicinnovation.org/sites/default/files/2019/Nordic%20Health%202030%20Magazine.pdf

varying needs and expectations, to which better data could provide part of the answer, the downside is the financial and practical implications: if everything has to be possible and done for every individual and every individual demand, this will overload the system and the underlying solidarity principles. A balance needs to be found, which can only be decided by society itself and cannot be solved within the individual-carer relationship. This requires a much more involved and educated society that better understands and embraces explanations about health care problems and solutions: it is a major task for the care professional of the future to provide society with the necessary information, insight, and knowledge to help to make these concerted societal decisions.

IV. FINANCES

This inevitably brings about questions about the financial methods and incentives of the care system of the future. Most stakeholders agree that the present system, still based for the most part on payment per activity, is not compatible with the future care options of increased teamwork and collective responsibilities. The focus on teamwork may lead to a shift in terms of legal responsibility from the individual care providers to the team. This also includes participation of non-care professionals as indicated above. What will replace the current system remains unclear as every system has its advantages and disadvantages and can be ‘played’ by both the recipient and the provider of care. More societal impact and responsibility with direct input by citizens to avoid bureaucracy and undesired political influences seems appropriate.

V. TECHNOLOGY

The second part of the solution for unavailable human professional resources is the use of various sorts of bots, which will not only provide information about simple and repetitive everyday matters, but which will have evolved by 2040 into more powerful and intelligent systems. This does not necessarily mean that by that time general AI will be available and bots will be able to mimic the combined empathic and intellectual capabilities of trained care professionals. But for many tasks, bots will be able to free up time for these care professionals so that they can focus on providing more demanding support towards real informed co-decision-making. Such co-decision-making will be a hallmark of the self-learning care system of the future.

B. WHAT IS NEEDED?

I. ACCESS TO INFORMATION

As individuals want to make their own decisions and choices with respect to their health and wellbeing, providing the required information to make such decisions on an optimally informed basis has become a major task for the care system and its providers. As the capability to access and acquire new information and turn it into knowledge and insights to make individual, informed decisions still varies considerably in the population as a whole, education, and specific and flexible approaches to support co-decision-making are needed and the skills to interact with individuals about these have become an essential part of the care system’s requirements. Decision support tools aimed at and developed specifically toward precise target groups, citizens, patients, carers, and care professionals, are mainstream and both heuristic and AI methods support them. The overload of medical, societal and individual data precludes a complete human overview, and more and more people rely on these tools for preparing the decision-making process. As we have seen with the interpretation of massive genetic data, these support tools are essential for interpreting vast amounts of complex, interrelated data, while precisely this complexity and completeness of coverage of the various aspects governing our individual health and disease balance are the drivers of more individualised care. The focus of care workers, therefore, is increasingly to interpret, position and deliver these decision options to individuals, both preventive for citizens and diagnostic/therapeutic for patients. But also, the individuals concerned need to improve their skills to interpret the proposed decisions, to be able to truly co-decide. This points to the second important shift in health care focus: education and explanation about the mechanisms behind decision support tools and the medical, social, and ethical aspects governing them. A major component here is statistical insight or at least enough comprehension of the statistical nature of decision support tools. This in itself requires specific tools to display results in an easily understandable manner.

II. NOVEL METHODS OF EVALUATION

As more information is more continuously being gathered about all aspects of our health, societal decisions about risks versus benefits regarding the use of specific diagnostic and treatment options will be taken in a totally different manner. Where decisions about market access and reimbursement of diagnostic and therapeutic actions were previously taken on the basis of pre-market evaluations, including randomised clinical trials and quality assessments of the procurer with a mostly all-or-none result, more emphasis is now being placed on real-life results and experiences with shorter evaluation cycles and more nuanced results looking at smaller populations and even specific individuals and their reaction to the proposed diagnostic or therapeutic action. Also, other more general experiences and reactions are taken into account in addition to the usual clearly defined clinical endpoints like mortality, hospitalisation and cost. As such more (big) data about fewer people will be required. There is also no contradiction between the big data (societal) and the personalised approach: large datasets about many different people in variable contexts will feed decision-making about individuals; conversely any data about an individual should be part of the larger, societal dataset in an ever reinforcing, self-learning health environment. Similar to software development, this is a shift from a waterfall system to an agile methodology in which repetitive shorter cycles of information gathering and knowledge development alternate with the implementation of decision support tools and guidance aids to implement the policies that have been decided on. While this enables a much more personalised approach, it also places a considerably greater decision burden on the individual person and the care provider, who will need to be better informed and equipped to make these personalised decisions.

III. TEAMS AND HYPERSPECIALISTS

Medicine and care in general have become ever more specialised over the past decades, with expanding study and training periods. Some sub-sub-specialty training periods have become almost as long as the professional’s ultimate productive period. Demand for this hyperspecialisation has been fuelled by an ever-expanding knowledge on detailed topics, which has led to individuals knowing more and more about less and less. While this can improve the desired outcome for some specialised problems, it has led to balkanisation of health care, leaving ever fewer people to take care of the person as a whole, let alone for that individual in a group or community. General practitioners are taking on this role, but with the ageing of the population and ensuing multimorbidity and multi-pathology, this has become a major challenge. As no individual will be able to hold all the required knowledge and experience to address these complex and complicated problems, only a team effort can solve it. But this team effort requires a different financial system better geared towards taking care of an individual and a community than towards individual acts. A stratified entry into the system has been proposed as another solution or 'gatekeeper', but this starts far too much from a 'provider' rather than from a 'demand' perspective: the level at which our present system can best address a problem depends on the needs of the individual and the group. This layered system will have changed profoundly by 2040, with less emphasis on the hospital and much more on the ambulatory and home/family/community environment.

IV. AUTOMATION

Robots and AI systems are taking over more and more tasks from humans and the medical world is no exception in this regard. The virtual and real world are becoming more and more intertwined. As for decision support tools, delivering and implementing the chosen approach is being done more and more by specialised robots and software applications or bots. Avatars have already replaced humans for less critical and repetitive tasks of delivering information and guidance. But even for more important and vital interactions, avatars are increasingly being used and sometimes preferred because of their neutral, consistent, and non-impressionable actions. As trust and transparency are the crucial ingredients of this evolution, designing, testing and continuously updating these bots and avatars has become an important care profession in itself, which requires a combination of medical, engineering and IT backgrounds. But as with every care professional, the most important characteristic is the embedded aim to help individuals and society as a whole toward a healthier future at a reasonable cost.

V. THE ROLE OF THE HUMAN IN THE CLINICAL CONTEXT

Besides the many tasks taken over by robotic systems, a very important role remains for human interaction, not only because the robotic systems do not yet have sufficient technical capabilities, but also to take on the critically important empathic role. These two aspects (technical – empathic) are needed in different proportions depending on the circumstances. The Lillrank system, with its distinction between prevention, acute care, one-off intervention, solution shop, focused factory, cure, and care, can provide some guidance here (Lillrank et al., 2010; Peltokorpi et al., 2011; Lillrank, 2012; Peltokorpi et al., 2016; Lillrank, 2018). Lillrank has presented an analysis of the organisation of health care starting from the demand of the individual/patient. When no overt complaints or problems are present, *prevention* is of the essence, and it will receive much more emphasis in the future as it is much more effective and efficient. It will be embedded in every aspect of our organisations. The need for prevention will not only affect the care organisation, but the whole structure of our society. The next point is *urgency*. If there is a need for an immediate reaction, then acute care is required, with a very specific organisation and skill set. The following question is: can this be solved with *one contact*? Again, this requires a specific layout and organisation. The next questions are about the type of problem. Is the problem very standardised or complex and requiring diverse investigation tools? This is the *focused factory* versus the *solution shop*. Typical examples here are very standardised surgical procedures like hip replacements and coronary surgery versus fever of unknown origin or vague abdominal pain complaints; of course, there are also intermediate problems. The last two 'modes of operation' relate to a prolonged sequence of mixed interventions, but with an ultimate *cure* versus the inability to really solve the problem and thus the need to alleviate symptoms and complaints as much as possible (*care*). In a world with more multimorbidity and chronic patients, basic care will certainly remain relevant and even grow in importance. In this basic care setting, empathy and thus the intervention of human carers is probably the most essential.

Lillrank's most important contribution is his observation that to be effective and efficient these modes of health care should not be mixed, as they require different resources, skills, and organisations. Most health care organisations presently go against these principles and either over-organise and over-resource for simpler problems, thereby wasting resources and losing efficiency, making resources unavailable for other needs. Obeying these rules has led to some very effective and efficient organisations and hospitals, with very good quality patient outcomes albeit for very specific focused factory type of activities. The future care system of course needs all of Lillrank's modes, but keeping them and their providers somewhat separate might be a good option. Care professionals could still move from one mode to another, but probably not during the same day shift or in the same environment. The need for empathy also varies with these modes and so will the possible input and balance between human and technology. In acute situations, prompt action is required; in the focused factory setting a standardised approach tends to realise the best results; in care and end-of-life situations the empathy provided is crucial.

Care professionals and communities are not the only providers of health solutions. Indeed, the environment itself can also be a healing factor and embedding these healing environments into our solution portfolio could provide both a preventive and therapeutic answer.

VI. NUDGING

Delivery of preventive measures remains a challenge as individuals are much more driven by what they feel than what they rationally think or know for a fact. Proactively influencing or nudging individuals toward healthier behaviour is an accepted methodology, but as the ability to make the right choices is much determined by social and environmental determinants, care providers have the task to determine, together with ethicists and societal responsible instances, where helping individuals to achieve the desired health status ends and where manipulation starts. As financial implications of care delivery have the potential to overrule the benefits for the individual, the care system has a duty to keep the right balance. Transparency about what is suggested to an individual or a group/population, on what basis, on which assumptions and with what level of accuracy and proof, is essential. Involving the public and patients in defining the extent to which nudging is used and applied is imperative in order to preserve trust in the system. This can also be achieved by involving the public and patients in the setup of trials, inclusion/exclusion criteria, outcome parameters as well as tools for evaluation.

C. WORKING IN TEAMS

In 2040 the roles required in this data-supported health context will require new combinations of education, knowledge, experience, and attitude. Embracing technology and integrating it into everyday clinical reasoning is an essential step in keeping health care contemporary and adaptive, for example through decision support using 'smart' record analysis and pattern recognition. As such the division in medical, caring, nursing, allied professional and technological professions and educational programmes will have disappeared to make way for a more generic baseline education on medical, ethical, societal, technical, and psychological knowledge. Needs can vary at any moment according to the distribution of the supply, but also according to the changing environmental, infectious, and other challenges combined with evolving technical and modelling skills. So, individuals active in the care system will adapt to this combined evolution of expectations and capabilities by continuous learning and testing their own skills. As many requests from individuals and society will grow increasingly complex in view of the interplay of so many factors, not only will the help of data supported decision tools be needed, but also the input of several care professionals. Working in a team and making joint decisions, together with the individual/patient, will be the standard. Reimbursement will be linked to performance as a team. Legal responsibility, moreover, will no longer be an individual care professional's role but will be taken on by the team or system. This requires a shift in the internal mechanisms of such teams as trust and collaboration are key, not envy and competition. Since complacency could be a negative aspect of such a system, continuous quality assessment of the outcomes will be essential. Keeping individuals as healthy as possible, and for as long as possible in view of their specific background and context, will be the overreaching goal. For this aspect, data support is also essential.

A crucial role is reserved for coaching individuals in this new reality and for weighing proposed (algorithmically and AI-determined) decisions against expectations and life goals in order to arrive at informed co-decisions. Many of the possibilities offered by technological evolution will have an enormous impact on the individual, on the family core and on society (social, financial) and cannot be weighed up at an individual level: there is an absolute need for a framework that is established at the societal level. For this co-creation of health care policy at a societal level, care professionals have an important if not crucial role to play: the care professionals will be expected to present the options with their advantages and disadvantages, alternatives and implications to those who are politically responsible. This requires a combination of medical, social, ethical, and psychological knowledge and experience.

This future will happen in steps, sometimes with gradual evolutions, sometimes with sudden leaps in the form of innovative breakthroughs. Both the individual and the health care system must adapt to this data and technology driven reality, which will increasingly exceed the comprehension of the individual and the health care provider.

5. COMPETENCES OF THE FUTURE CARE WORKFORCE

Societal developments, technical and scientific evolutions, and expectations of the population with respect to health care, require health care professionals with competences that can address the current and future needs of individuals and communities for optimizing health and wellbeing. Previous competence frameworks for health care have mainly focused on discipline-specific competences. This allowed the disciplines to define their unique contributions to health care. It has also informed the development of training curricula for several care professions, ensuring that the key features of the discipline were covered in the education of the future workforce. A major disadvantage of such a discipline-specific approach is that different health care professions have evolved in isolation from each other, yielding disconnected silos of disciplines. Within these silos, general and specialised profiles have been differentiated. However, the boundaries and interfaces of the different disciplines have seldom been determined in consultation with other disciplines, thus ignoring overlap between disciplines. In addition, aspects of care provision may fall in between the boundaries of the disciplines, resulting in gaps of care provision (i.e. aspects of care that are not taken up by any profession). As we have seen in the previous chapters, this organisation cannot offer an adequate answer to the challenges that society in general and the care sector more specifically are facing.

Silos of disciplines become an even bigger problem when there are shortages in the workforce. Indeed, Chapter 1 has documented that the Western world is already being faced with shortages of nurses and physicians. When the availability of specific professions is lower, the risk for missed care becomes bigger. One proposed solution for this problem is task shifting, i.e. specific tasks being assigned to health care workers with a different or lower level of education. Countries with a significant shortage of physicians, for example, may be tempted to authorise nurse practitioners or physician assistants to perform medical tasks. Such a substitution can indeed cover the needs within one silo, but it does not bridge the gaps between the silos.

A real and more sustainable solution would be to break down the silos. If different health care professionals can be assigned to patients in a more flexible way, but within their area of competence, there would be fewer gaps in care, and health care organisations would be able to deal more appropriately with fluctuations in care demands. For instance, where vaccination in Belgium is typically done by physicians, the COVID-19 pandemic has clearly shown that other professions, e.g. pharmacists, can also safely provide vaccines. Another example is the start of early rehabilitation by nurses, when physiotherapists are not immediately available. Such a flexible deployment of health care professionals entails two requirements. First, all health care professionals need a common, generic set of basic competences. In the present chapter, we will elaborate on the competences that the future health care workforce ought to master (at least to some extent), in order to be flexibly deployed and to address the demands for care and wellbeing. Second, a system of credentialing needs to be in place. Instead of merely relying on the basic professional training, the health care worker should demonstrate having the competences to work in a particular setting and to perform particular tasks/interventions. For instance, some nurses may be well equipped to insert central catheters, better than some physicians, whereas other nurses do not have these competences. Being credentialed (and keeping track of the competences of each health care worker) would ensure that health care workers do not perform interventions beyond their scope of experience and expertise. In the final part of this chapter, we further elaborate on the pros and cons of a system of credentialing.

A flexible deployment of health care professionals has an impact on the composition and organisation of teams. Currently, teams are often organised within care settings, e.g. hospitals or home care. The future of collaborative teams should be more fluid, as members of different settings are working together on specific needs of the patients. Such groups of health care workers are described as co-acting groups. Established teams and temporary co-acting groups need to be determined for different settings, and sometimes even at the level of individual patients. These teams will have to take shape and operate both within and between organisations. In this document, we intentionally avoided offering a narrow definition of teams, to allow the implementation of teams and co-acting groups as appropriate.

This chapter will mainly focus on the competences of future care professionals. As discussed in Chapter 2, an important question is whether health engineers should also be seen as care professionals. In any case, breaking down the silos also has important consequences for health engineers. An important message is that future health engineers should start from knowledge of the human body and mind and then, in the next step, develop technology according to the needs of the user: going from biology to technology. This seems obvious, but in practice this is presently – and often – done the other way around, with the question being asked whether a newly developed technology can also be applied to other fields, such as e.g. medicine. Integrating existing knowledge in health technology is also important. In order to be a good integrator, one needs to be able to talk to experts in the language of the different professions and understand it. Going a step further, one might argue that the future of health engineering is about developing technology that allows health experts to be involved in the health process in the same way that human pilots are involved in flying a plane: most of the time an aircraft is flying on automatic pilot, but human pilots are still needed for critical decisions and/or taking over during critical phases. This means of course that these human pilots need enough experience and exposure to do so. In the present vision, care providers need to become more familiar with technology, but there might also be other options. For example, classic medical group practices might, in addition to a physiotherapist, dietician, psychologist, etc., also employ a human health engineer whose task is to analyse the data and discuss and interpret them in collaboration with the fellow health care providers in the group practice. Centralising data and analyses across different group practices might even further increase the knowledge base and help generate more insights, allowing better and more preventive care.

Given our dynamic perspective on the future organisation of health care in which flexibility and credentialing are crucial features, and it is of paramount importance not to create separate silos, we have deliberately refrained from constructing a list of ‘new care professions’. Rather than focusing on ‘professions’, we focus on flexible roles within teams, which can be filled by professionals with a different background. We thus propose a generic list of competences that should be acquired to a greater or lesser extent by all care professionals.

A. CANMEDS: A FRAMEWORK TO DESCRIBE THE COMPETENCES OF CARE PROFESSIONALS

CanMEDS is a framework that has been developed by the Royal College of Physicians and Surgeons of Canada to identify and describe “the abilities physicians require to effectively meet the health care needs of the people they serve”.[10] Whereas CanMEDS was originally developed for physicians, it is now

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[10] https://www.royalcollege.ca/rcsite/canmeds/canmeds-framework-e and Supplementary Table

used as a framework to describe the competences of many allied health care professions, such as nursing, pharmacy, or orthopedagogics. This illustrates that CanMEDS has generic aspects and can be used in a wide spectrum of care professions.[11]

In the CanMEDS framework, the competences are grouped thematically under seven roles (see Figure 23). A competent health care professional seamlessly integrates the competences of all CanMEDS roles. The term 'medical expert' in the centre of the CanMEDS model should, of course, be replaced by 'health expert' or even 'care expert' when using it beyond the scope of medical training and practice. Doing so, we make this model also relevant for the training and integration of health care assistants and social care workers.

B. GENERIC ROLES OF CARE WORKERS

In the sections below, we aim to take a detailed look at the roles of the future care workforce, by stipulating generic care competences, in line with the requirements defined in the previous chapters of this paper. As will be shown, generic and transferable knowledge and skills of health care professionals will be more important than ever.

Figure 23. The seven roles of the CanMEDS framework (source: https://www.royalcollege.ca/rcsite/canmeds/canmeds-framework-e)

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[11] There are many different competence frameworks for care professionals, most of which were initially developed for physicians. Some, such as CanMEDS, have been extrapolated to other professions, and are now extensively used to guide and structure a wide range of health educations. Although the frameworks may look different in the thematic structure, the underlying abilities and competences are largely overlapping. Therefore, the choice of any framework is arbitrary. In the present chapter, we do not aim to repeat or confirm existing frameworks. We want rather to expand and elaborate on competences that require explicit attention in the discussion about the future of care professions. Given that CanMEDS is widely used and has been adopted by many institutions for higher education, we use this framework to structure the present chapter.

I. THE ROLE AS PROFESSIONAL

Acting as a professional is the core of what each health care provider does. It entails commitment to patients, society, the profession and the self.

COMMITMENT TO PATIENTS

One of the major challenges in times of far-reaching specialisation is to maintain an integrated perspective on the patient as a person. In order to be committed to patients, care professionals need to focus on the human being 'as a whole', not as the sum of sub-systems. As explained in Chapter 3, this requires an integral approach, integrating bio-psycho-social and meaning-making aspects of health and wellbeing. In addition, commitment to patients implies that care professionals need to be competent to use a personal approach, taking individual needs and expectations into consideration. Personalised health care, which includes precision medicine, will gain traction. In this new way of practicing medicine and providing care, the key question that every care professional should ask for each patient is: 'Which approach would work best for this patient and under which circumstances?'. Care professionals need to have a good knowledge of the range of possibilities and will need excellent coaching skills in order to achieve informed shared decision-making with patients and their families.

Recent scientific developments, as described in the previous chapters, require new competences among health care providers. First, previous chapters have provided in-depth insight into innovative technologies that are finding their way into prevention, diagnosis, treatment, and care. The care workforce will need highly trained specialists who are able to use these advanced technologies to the best advantage of the patients. However, every care professional will need basic knowledge of the options, to be able to translate the technical possibilities into the needs of the patients. Likewise, all care professionals will need an understanding of how technologies are developed, to be willing to participate in the co-design of innovations, embrace technologies and integrate them in their workplace, and support patients when using or being confronted with advanced technologies.

Second, new technology will result in a vast amount of data (including genetic and epigenetic information), which will not only become available for care workers, but also for patients. Health care professionals will need the competences to interpret and position these data, and/or to understand the scientific conclusions drawn by others. This requires a basic understanding of data-analysis and statistics, as well as the competence to explain statistical findings to patients. Again, care workers will need the competence to guide patients through the amount of data, in order to make decisions on an optimally informed basis, both in preventive as well as in diagnostic and therapeutic settings.

Third, the perceived need to focus more on prevention in addition to diagnosis, treatment and care, described in the previous chapters, entails that care professionals will need to be competent in preventive action. Especially with respect to primary and secondary prevention, this presupposes competences in health promotion, in behavioural change, and in early detection and intervention, not only in clinical settings, but also in society, within a life course perspective. Knowing what is best does not suffice for behavioural change as there is a clear gap between cognition, good intentions and actual action. The approach to behavioural change should encompass the creation of: (i) a sufficiently strong need at a relevant moment, and (ii) a relationship, in which intrinsic motivation towards the desired behaviour can grow. This requires that care providers are trained and equipped for preventive action and ready to commit to their role as a health advocate. They should also bear in mind that behavioural change in respect to health improvement is not exclusively a personal choice because of major influences from 'outside', and is therefore not easy to realise and above all to maintain. For each care profession there are specific opportunities to be actively involved in prevention and they should assume this responsibility as part of their professional activities. The preventive potential of health care assistants who take care of people on a day-to-day basis should not be underestimated.

COMMITMENT TO SOCIETY

The commitment to society is strongly related to the role as health advocate (see below). Furthermore, care professionals need to be able to take a 'meta' perspective and look at health care from a systems perspective. Conceptual thinking is an important competence in this respect.

Our current society is characterised by a high degree of diversity: ethnic, cultural, religious, gender and sexual orientation, social class, language, educational level, disability, etc. Hence, an important competence that care professionals need to master is sensitivity for and dealing with diversity. Cultural differences make certain therapeutic or care options effective and/or acceptable and others not. A culturally diverse workforce will facilitate the adoption of culturally sensitive care.

Commitment to society also relates to competences to reach out to the most vulnerable people in our society. Moreover, it requires documenting benefits and weaknesses of specific approaches from real-life experiences, to provide guidance and support for decisions made by health authorities.

COMMITMENT TO THE PROFESSION

Promoting the profession, and safeguarding codes of ethics are typical expressions of commitment to the profession. In line with this, care professionals need to be trained in methods of peer review and professional development. Furthermore, they need to be open for the evolution toward a learning health care system. For instance, continuous data capturing on the work floor can be used to improve the system. A positive attitude to such continuous monitoring should be developed, aiming for better performance and higher quality.

An alternative view on commitment to the profession is the development and use of technologies that facilitate the work. The shift from the 'Internet of things' towards the 'Internet of action' will also imply a shift in competences of care professionals. This obviously requires a positive attitude towards such developments, and care professionals have to understand how the systems work and how they serve care.

Commitment to the profession may also manifest itself in a competence to express and reflect on the professional identity, as a point of departure in relation to other professions (see also the role as collaborator below). This professional identity needs to be flexible and agile, however, in order to deal with the changing needs of our society. Of course, this professional identity is broader than professional deontology, but at the same time closely related to it. Rigid deontological rules (and rigid controlling institutions) cannot work well in a flexible environment. Commitment to the profession also means reflecting on its specific deontology and participating in the institutions that are created to control it. The present institutions, as described in Chapter 1, will need to be reformed to offer the necessary space for this commitment.

COMMITMENT TO THE SELF

Given the high rates of burn-out and addiction among health care professionals, they will need to learn how to take care of themselves. Indeed, proper self-care is indispensable, not only to serve as a role model (see also the role as health advocate), but even more so for their own health and wellbeing. This requires self-reflection, self-evaluation, and self-care. To achieve a change in attitude among the future care workforce, the 'glorification of busy', and by extension the cultivation of sleep deprivation, should be stopped.

The rebalancing of roles within interdisciplinary teams gives the role configuration of each person in the care process a much more dynamic character. Continuous portfolio management should be carried out based on both individual and team characteristics and needs. For individual staff members, this means focusing on strengths (at a certain point in her/his career) and varying according to the evolution of needs. Such an adaptive model of job design is the best remedy against burnout because of the context-driven role configuration, always adapted to needs at a particular moment in life and career. However, the reduction of burn-out risks will not be the only effect on the work volume of this multi-disciplinary team approach to care. The fact that the team model departs from standardised job content will mean that an adapted role configuration can be crafted and formed at any moment in a person's career, not as a curative measure but as a productive, anticipative strategy. This is an approach that equally combats a too early exit (whether at the beginning or the end of the career).

II. THE ROLE AS COMMUNICATOR

Care professionals need to have the competences to communicate at two levels: (i) directly with patients and families, and (ii) with society at large. Communication within care teams, which is equally important, is described as 'collaboration' and discussed below under this role. Every care professional should be required to have adequate communication skills, suited for the specific function they have.

At both levels, care professionals need to have the competence to communicate about uncertainty. They need to be able to convey the fact that recommendations and the implementation of interventions are based on evidence that has varying levels of uncertainty. When patients and the lay public understand that uncertainty is inherent to health care, it is less likely that they will see uncertainty as an indicator of incompetence, which is important for trust in individual providers and in the health care system at large.

In communication with patients, families and society, care professionals also need to take cultural diversity and health disparities into account. Therefore, care professionals need to have insight into the meaning of health and disease in diverse cultures and the impact of being part of a minority on disparities in health and health care access.

COMMUNICATION WITH PATIENTS AND FAMILIES

As described in the previous chapters, empowerment and health literacy are of paramount importance to patients, playing a role in their health and care. Therefore, care professionals ought to master communication skills that enhance empowerment and health literacy, to reach an adequate level of patient self-management. Care professionals need to be sensitive to behavioural factors that are indicative of low health literacy, e.g. missed appointments, (apparent) non-compliance, incoherent narratives, asking fewer questions, etc.

Care professionals need specific competences to adapt their communication strategies to low health literacy, e.g. by using empowering, concrete and visually augmented communication. Diversity-sensitive communication includes being sensitive and adaptive to individual cultural, social, gender and sexual differences and relies on clinician self-understanding and reflection, with awareness of one's own values and beliefs as an essential ingredient. Universal design or 'design for all' is also important in diversity-sensitive communication. People with disabilities often lack access to crucial health information. The central idea is that access and communication in health care should be as inclusive as possible, reducing the need for adaptation or specialised communication for specific target groups.

Specific communication techniques are relevant for health promotion and prevention. A crucial example concerns motivational interviewing. This consists of counselling techniques based on the health care professional's ability to demonstrate empathy, open-mindedness, and attentiveness to the patient, while providing guidance in a non-judgmental way. It shifts the dynamic of a conversation so that people feel empowered to make healthy lifestyle choices, which is proven to increase the likelihood of sustained behaviour change. Front office care workers, such as health care assistants, spend a lot of time with patients/clients. As such, they are well-placed to communicate with and empower the people they care for. Hence, communication training should be an integral part of the vocational education of these care providers.

Communication technology can facilitate communication with patients and their families. In this respect, care professionals need telehealth competences. This includes (but is not limited to) using technology to support shared decision-making, providing self-management tools, tailored health information, etc. Chapter 2 explored the impact of technology on future health care, and the roles that can be taken over by robots. However, technology, including robots, will never be able to replace all human functions, precisely because robots will not be able to respond to very specific situations, will have difficulty seeing a person 'as a whole', and in using empathy. The latter is key to person-centred health care and is a foundational competence for health care workers.

COMMUNICATION WITH SOCIETY

All care professionals will (at least to some extent) be involved in 'science communication' and hence need the competences to explain difficult topics (regarding prevention, diagnosis, treatment, care) in a way that it is understandable for the lay public. 'Fake news' is not a new phenomenon. It has existed from time immemorial. However, with the emergence of social media, information and opinions can be distributed by everyone and very fast (see Chapter 1). 'Fake news campaigns' have even been initiated by 'troll factories' to create distrust in foreign societies and jeopardise public health. Therefore, care professionals require to have the competence to serve as 'fact checkers', to refute fake news, to listen to the underlying questions and uncertainties of the public, and to answer adequately. This does not require so much 'one size fits all' answers, but answers that are tailored to a specific target group, with specific concerns. Also care workers who provide basic care, and who are trained at vocational level, need to be able to distinguish between reliable and unreliable sources of information.

III. THE ROLE AS SCHOLAR

There are various levels at which care professionals can express their role as scholar, from generating new knowledge to applying it in clinical practice. Moreover, being a scholar means to be open for co-design, both with patients as well as with researchers.

GENERATING NEW KNOWLEDGE

Some care professionals will take up roles as researchers. The main aim of conducting research is to generate new knowledge that can have a direct or indirect impact on assessment, diagnosis, treatment, or care in the short or the long term. Not all care professionals need to have the skills to be a researcher. However, in a self-learning health system, each interaction with individuals is an input for learning, improvement and change; so every caregiver becomes a researcher to a certain extent. All care professionals will thus need to have adequate insights into the scientific process, so that they understand how and why research is critical to inform clinical practice. If care workers are trained in the research process, they may be more prone to participate in research or motivate patients to partake. They will also better understand why there are uncertainties in clinical decision-making or public health and be more capable to identify trustworthy information. For this reason, the research process should not only be part of the curricula of academic training, but also in vocational training of care providers, such as health care assistants.

It is also important that care professionals understand that the so-called gold standard research paradigm of clinical efficacy, i.e. the randomised controlled trial, might be less appropriate for questions about organisation of care, or to evaluate the impact of personalised health care. Having a broad view on different methodologies and their appropriateness for answering different research questions is hence key to design research projects, participate in research, interpret the findings, and handle accordingly (see further).

USING AND APPLYING EVIDENCE

To be able to use and apply scientific evidence in clinical practice, care professionals ought to have the competence to search, appraise and understand reporting of empirical research, and to translate this information for patients. This forms the basis for evidence-based practice (EBP). EBP is “the integration of best research evidence with clinical experience and patient values” (Sackett et al., 2000). It is a paradigm that started in medicine and has found its way to other health care professions. EBP does not imply that every care professional has to be a researcher, but every professional needs to have sufficient understanding of the research process, the levels of evidence and basic statistics. The competences to search for scientific information, to critically appraise this information, and to apply this information to clinical questions are key lifelong learning competences. Other competences of equal importance in this regard include the ability to reflect on one’s own practice (where possible based on external feedback) and to determine learning objectives. Overall, care workers need to be self-directed learners.

CO-CREATION AND CO-DESIGN OF INTERVENTIONS

All too often, new health care interventions are developed by researchers, care providers, and technologists, without involvement of the end-user. Such new interventions often disappoint at the adoption stage because they do not meet the true needs of the end-users. When patients are the end-users, it is important to involve them in the needs assessment and the development of such interventions. Co-creation and co-design are methodologies to develop new interventions together with patients. Even in the early stage of research, for instance when identifying the needs of specific populations, patients can be involved as 'patient research partners'. In short, care professionals need to be aware of the importance of patient involvement in intervention research and development and/or be able to motivate patients to take part in this type of research. Likewise, care workers need to be involved in intervention and technology development when they are the end-users. Hence, care workers also need competences to participate in co-creation/co-design and share their views and opinions to contribute to the quality improvement of health and social care, especially those who are working with patients and families on a day-to-day basis, such as health care assistants.

IV. THE ROLE AS COLLABORATOR

While multidisciplinary collaboration in health care has been advocated for a long time, an interdisciplinary and even a transdisciplinary approach is believed to be more effective. Multidisciplinary collaboration refers to the situation in which people from disparate disciplines work in conjunction with each other to achieve specific goals. Interdisciplinary collaboration is the situation in which the different disciplines have common goals and work together with shared responsibilities. In transdisciplinary collaboration, team members collaborate across the boundaries of their own discipline. As already stated at the beginning of this chapter, transdisciplinary collaboration is needed to break down the silos and to ensure that workforce capacity is sufficient to meet future care challenges. New professions may emerge or become more important – such as health coaches, medical engineers, genetic counsellors etc. – in the margins of the existing disciplines.

Core competences that care professionals must acquire to be a collaborator pertain to team dynamics, conflict resolution, making decisions as a team, patient handover, and transition of care. Also, peer assessment and feedback can be seen as important components of transdisciplinary collaboration.

The Interprofessional Education Collaborative[12] formulated four key competences for collaborative practice: (i) working with individuals of other professions to maintain a climate of mutual respect and shared values (values, ethics); (ii) using the knowledge of one's own role and those of other professions to appropriately assess and address the needs of patients and to promote and advance the health of populations (roles, responsibilities); (iii) communicating with patients, families, communities, and professionals in health and other fields in a responsive and responsible manner that supports a team approach to the promotion and maintenance of health and the prevention and treatment of disease (interprofessional communication); (iv) applying relationship-building values and the principles of team dynamics to perform effectively in different team roles, to plan, deliver, and evaluate patient/population-centred care and population health programmes and policies that are safe, timely, efficient, effective, and equitable (teams and teamwork). These four key competences are easily linked

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[12] https://www.ipecollaborative.org/

with the roles described in the CanMeds model, indicating that collaboration is at the very heart of being a care professional, and that being a care professional requires collaboration to maximise the effect of taking up each of the CanMeds roles.

The safeguarding of overviews and coordination are important in collaborative efforts. One of the team members needs to serve as a 'case manager' who keeps the common goals for each patient at the centre of attention, and keeps the team aligned around these goals. That case manager needs to be embedded in the team and needs to have the skills to take up this role. In truly transdisciplinary teams, every one of the team members should have the potential to serve as the case manager of a number of patients. Hence, in an ideal situation, all care professionals have competences in coordinating care and managing transdisciplinary teams around common goals.

Technology will play an essential role in facilitating coordination, communication and information sharing in transdisciplinary teams. In the health care of the future, all care professionals will have access to a common platform where not only medical information is stored, but also comprehensive health information, information on common goals, aims and preferences of patients, assessment and follow-up of goal-attainment, ... Therefore, care professionals need competences to report properly, and to access and use the information in a professional way.

V. THE ROLE AS HEALTH ADVOCATE

Being a health advocate refers to responding to both an individual patient's needs, and to the needs of communities or populations. In this role, care professionals must work with patients and their families as well as with communities or populations to increase opportunities to adopt healthy behaviours and to have access to needed health services or resources, and participate in the public debate (see also role as communicator and role as professional) to contribute to the improvement of health. The role of the health advocate is becoming increasingly important because of growing insights into the environmental and social determinants of health.

SOCIAL AND ENVIRONMENTAL DETERMINANTS OF HEALTH

Economic status, neighbourhood and physical environment, education, food, community and social context, and the health care system are acknowledged social determinants of health. These determinants are all too often neglected because health is approached from an individual perspective, and not from a system perspective. In addition, it is not clearly understood that several of these social determinants of health are actionable. Indeed, a system approach is required to influence health determinants. 'Health in all policies', which is defined as "an approach that promotes collaboration between government sectors and non-government stakeholders to maximise the health benefits of government policies and reduce health inequalities such as differences in life expectancy" (WHO, 2015), may be a solution to tackle the disparities in the social determinants. Care professionals, and by extension all disciplines that may have an impact on policymaking (e.g. law, economics, urbanology, ….) need to know how to develop 'health in all policies'. This requires skills to develop partnerships and engage with patients, support networks, community organisations, administrators, and policymakers.

Due to the organisation of the current training curricula, health care professionals are power houses and preoccupied with 'the problem' (disease) solving approach, typically at the time when the patient presents with a clinical situation. However, they are less familiar with primary prevention strategies, especially at group or population level, and taking into account a patient-centred, multi-disciplinary approach with acknowledgement of confounding contextual factors and needs for improved communication and solution-focused coaching skills.

BEING A ROLE MODEL

Patients and populations rely in part on the demonstrated health behaviours of care professionals. Indeed, the impact of care professionals as role models for good health cannot be underestimated. They need to embody practices of health promotion and protection.

VI. THE ROLE AS LEADER

Even if not all care professionals end up in a hierarchical management role, each of them will be involved in discussions and decisions about the organisation of care, quality improvement, priority setting and financing/remuneration. Therefore, care professionals need to have competences to participate in such discussions at the system level. More specifically, they need to be knowledgeable about the structure, organisation, and financing of the health care system; health care administration; management of small and larger teams; human resources management; methods of quality improvement and assurance; change processes; and leadership development. Moreover, care professionals need the competence to provide society with the necessary information, insight, and knowledge to make societal decisions, including presenting the different options with their advantages and disadvantages, alternatives, and implications.

At a micro-level, all care professionals will need competences to manage their own practice, i.e. to carry out professional duties in the face of multiple, competing demands, to set priorities and to establish plans for ongoing care. Likewise, being a leader also entails being able to manage a career and to implement processes to ensure personal practice development.

VII. THE ROLE AS CARE EXPERT

In the CanMEDS model, being an expert refers to the integration of all the CanMEDS roles, and applying knowledge, skills, and professional values in the provision of high-quality and safe patient-centred care. More concretely, it refers to practicing within the defined scope of practice and expertise. In line with the need to assign tasks to care professionals in a more flexible way, taking up a role as expert entails that care professionals only perform tasks for which they are credentialed, and do so in a skilful and safe manner. Hence, being an expert also requires reflecting on one’s own competences, defining learning objectives, and referring correctly if the necessary competences are lacking. Everyone who is taking care of patients and families ought to be seen as expert in the field, from providers who received vocational training to those who are academically educated.

C. CHALLENGES

I. COMPETENCES: TO BE DEVELOPED AT THE LEVEL OF THE TEAM, OR AT THE LEVEL OF THE INDIVIDUAL?

In the previous sections, we elaborated on the roles and competences that need to be developed by all care professionals. We have indicated that some professionals might need advanced competences in a given domain, while for others basic competences might be sufficient. The question that remains unanswered is to what extent the competences should be considered and developed at the level of the team, and how an ideal skill mix can be obtained. At the level of 'expertise' (expert role) it is clear that a mix in competences is required to tackle complex problems. But is this also the case for the other roles described in the CanMEDS model? One might assume that in a team, some care professionals take on a more communicative role, while others focus more on management roles. But what if the team composition changes? Or what if care professionals work in different teams, with a different skill mix? Or how do we balance individual preferences and learning objectives with team needs? And what if there is a shortage in the workforce?

If care professionals need to be deployed in a more flexible way, it is clear that each individual has to develop the different roles described above to a certain extent, and that, depending on the composition of the team, a specific role can be assigned, according to the individual's strengths and preferences. This requires critical self-reflection of each of the team members, thorough management of the teams, paying attention not only to the differences in technical skills, but also to the possible roles that each of the team members can take on. The additional question then is whether this steering/management should be external, or whether teams should be self-managing, in a way in which strengths and limitations when taking on specific roles can be shared and listened to.

II. THE IDEA OF FRONT-OFFICE AND BACK-OFFICE PROVIDERS

Although each care provider needs basic communication competences, there will be providers with stronger communication skills than others. Also, some positions in health care require more frontline communication than others. This means that it might be useful to elaborate on the idea of having front-office providers and back-office providers. The communication skills of the front-office providers obviously need to be more profound than those of back-office providers. In some countries, for example, nurse practitioners are used on surgical wards and in outpatient clinics to maintain adequate interactions and communications with patients, while the time spent by surgeons in the operating theatre is at a high/productive and more technical level.

III. SETS OF COMPETENCES: CONVERGENCE

The competences required for the care professions of the future discussed in this chapter can be considered as emphases within and additions to the competence profiles that have been extensively documented for several care professions. Based on the previous chapters, three major evolutions of relevance for the future workforce came to the fore: a shift towards more technological approaches to health care; a vast increase in the availability of health data; and a perceived need to focus more on prevention in addition to diagnosis, treatment and care. All three aspects have implications for the professional roles described in the CanMEDS model, require specific competences of care professionals, and create converging accents across professional roles. For example: technological innovation in health care will require the knowledge and skills needed for the application of technology in prevention, diagnosis, treatment and care (c.q. the role of professional), but also communication strategies to explain or translate technology for patients, or to use technology for communication with patients (c.q. the role of communicator) or colleagues (c.q. the role of collaborator). The same applies to the vast increase in the availability of health data (e.g. competences to analyse and interpret data, to explain data to patients, or to use data for continuous monitoring and improvement at the patient level or for care organisation) and the need to focus more on prevention (e.g. knowledge and skills required for health promotion, behaviour change, early detection and intervention, and specific communication techniques such as motivational interviewing).

IV. SETS OF COMPETENCES: TENSION

Emphases and additions to the competency profiles also create tension. One cannot raise expectations in terms of competences indefinitely; an individual cannot excel at everything. This may make it necessary to think in terms of the required skill mix at the team level, as suggested above. But the same is true for the required level of flexibility. To what extent can we expect care professionals to change roles every so often, acquire new competences, and adapt to a new situation? While this can be a positive challenge for some, it might be very demanding for others. Hence, management of teams not only needs to focus on the required skill mix, it should also focus on the capability of care professionals to take on new roles, and on the wellbeing of the care professionals themselves.

Also, there is a tendency towards increasing specialisation in terms of competences, but at the same time there is a clear need for an integral approach, integrating bio-psycho-social and meaning-making aspects of health and wellbeing. Given that workforce and budgets are limited, ethical choices need to be made. How do we safeguard the balance between generalist and specialist care?

The answers given to these challenges will have immediate implications for the way we conceptualise the future education of care professionals. In the final chapter we will present a provisional and cautious attempt to respond to this issue.

6. TOWARDS THE FUTURE OF HEALTH CARE CURRICULA

This chapter looks ahead, reflecting on the question of future health care curricula and what they should look like, taking into account the previous chapters. The time frame for this exercise is the long term, e.g. 2040 and beyond. This has the advantage of not being constrained by the current legal or regulatory framework regarding educational programmes or health care professions. We therefore take an open and idealistic perspective, and assume that any regulatory hindrance will be removed in due course. We realise nonetheless that this will require a concerted effort at various political levels, both regional and national, as well as European.

Further, our proposals should be read at the conceptual level. They provide a framework to shape health care curricula in the future, but they do not address the specificities of curricular design or teaching, learning and evaluation methods. Nevertheless, it can be safely predicted that workplace based learning, virtual reality, simulation training, and experiential learning will complement the classical pedagogical approach in any health care curriculum.

Looking ahead, one can think of a variety of new health care curricula that may arise in the future. For example, by 2040 artificial intelligence and data mining/analysis will most likely make a substantial contribution to the delivery of health care. Therefore, a novel, dedicated health care artificial intelligence/big data training curriculum at the undergraduate level should already be envisaged in the short term. Similarly, one might imagine a combined physician/engineering curriculum to enhance technology innovation and adaptation in health care; or a training programme for case coordinators to ensure the integrated follow-up of chronic patients with multimorbidity across different segments of the health care system.

In line with our position in the previous chapter, however, we refrain from advocating specific new health care curricula. Indeed, creating new dedicated curricula for every (perceived) need carries the risk of multiplying high specialist profiles to the detriment of generalist competences and therefore of perpetuating the ‘siloing’ of health care professions. The implication of this choice is that current curricula should be sufficiently flexible and open to adaptation. For example, technology courses should be firmly embedded in health care curricula such that future health care professionals will not only be familiar with new technological solutions, they will also be capable of collaborating with engineers and scientists in health care innovation.

Finally, while continuous learning has always been important in health care, its necessity will only increase with the demands for versatility and adaptation to an ever faster changing environment and improved but more diverse capabilities. It will become very important, therefore, to have a solid but broad basis on which to build a specific, time-varying knowledge and expertise that needs to be evaluated and privileged to adapt to changing expectations of individuals and society and to administer the optimal care.

The following sections elaborate on the broad context and general guiding principles of health care curricula and conclude with a specific proposal for a health care basecamp. They should be read as a generic look ahead to all curricula that lead to professionals active in the health and care sector. Some of these curricula will be academic, others vocational; some will take many years to complete, others may be limited in time; and some will focus on care provision at home or in the daily life setting, whereas others will be directed at preventive, diagnostic or curative health interventions at home, in institutions (e.g. hospitals, primary care facilities) or in laboratories. Importantly, this chapter is written with no specific curriculum in mind. Rather, it applies to any curriculum in health and care, regardless of its specific nature and objectives, since in the end, delivery of care and health is an interdisciplinary and interprofessional team effort that necessitates a common training ground for the diversity of professionals. Taking this into account, the reader should be aware of the generic nature of the terminology in this chapter. A health care student or worker refers to anyone in training or in practice who has contact with people who need care or with patients; or those who contribute to care and cure through the development or support of technology. This group definition is used in the most inclusive way possible, i.e any student of worker who matches this definition, even partially, is assumed to belong to this group.

A. THE BROAD PICTURE OF HEALTH CARE EDUCATION

I. MATCHING COMPETENCES OF HEALTH PROFESSIONALS TO THE NEEDS OF PATIENTS AND THE POPULATION

The ultimate goal of all health curricula is to help realise the overall ambition of maximizing the health potential of every person, both at the individual level and at the population level (see Chapter 3). By extension, it would be desirable that the curricula of every education programme (e.g. law, economics, engineering) have the health and wellbeing of populations in mind. To this end, a 'health-in-all' mindset can be created (see Chapter 5). This ambition must be realised against a background of changes in technology, politics/policy, climate, environment, diversity (Chapters 1, 2 and 4). The formulation of competences must therefore be sufficiently generic and malleable to the evolving needs of the individual and the population (Chapter 5).

A particular question in this regard is to what extent degree qualification determines the license to perform specific health care acts. It is self-evident that only competent persons should be allowed to perform specific acts. However, too narrowly restricting professional performance to specific educational degrees risks siloing the health care workforce and possibly creating a shortage within the health care work force. A possible way out is to design health care curricula, or at least some of their components, in a sufficiently generic way so that health care workers across different degree qualifications share basic competences and can be professionally licensed. This will facilitate task shifting and optimal task distribution within the health care workforce. Furthermore, it will promote and improve collaboration between health care workers with a different qualification.

II. A CONTINUUM OF HEALTH CARE TRAINING STARTING FROM A COMMON FRAME OF REFERENCE

Health care training is a continuum that starts with an initial training that traditionally leads to a specific discipline-based degree. Depending on the profession, advanced specialty training is required to enter the profession. Once health care workers are professionally active, a broad spectrum of continuous professional education follows and is often obligatory to retain the professional license. Lifelong learning is essential for health care workers, not only to keep abreast of newly developing insights, technology and practices, but also to enjoy professional satisfaction through personal development.

From the very beginning of this continuum, it is important to include in all curricula a comprehensive and integral perspective on health care so that all care professionals – irrespective of their specific role – are familiar with and operate within a common frame of reference. This has specific implications for curriculum design. Initial training (e.g. undergraduate) should include a generic package that introduces students to the basic concepts of health care and that takes the patient perspective and care context as starting points (see below). Later, and at the level of continuous professional education, training activities should be preferentially organised in an interprofessional and interdisciplinary context with (in)direct input from citizens and patients to ensure relevance to the professional situation.

III. INTERWEAVING HEALTH CARE AND TECHNOLOGY

As elaborated in Chapter 2, there is a symbiotic relationship between health care and technology. The needs of patients and care workers are driving new technological developments, which then contribute to better patient care and quality of health care. It is thus imperative that health care students become familiar with the different aspects of health care technology early on in the curriculum, so that they are able to adopt new technology in their practice and can collaborate with engineers and scientists in the development and testing process. Conversely, it is important for engineers and IT/data professionals to understand the needs and expectations of health care and patients, and the specific context in which their innovations will need to function. Starting from both the health care and the technology educational track, mixed profiles will be needed to perform the required translations and to enhance mutual understanding and collaboration. In specific advanced phases of either the biomedical or the technology curricula, common workshops and courses should be designed to prepare for these mixed profiles.

IV. ASKING THE IMPOSSIBLE: THE HEALTH CARE WORKER AS SUPERHUMAN

When reflecting on the future of health care education, it is legitimate to expect that health care curricula are up to date and matched to the needs of patients and the population (see above). However, there is also a risk of unrealistic expectations. First, there is a growing tendency to involve health care professionals in a wide range of societal problems. Second, the broader the scope of health care (see the biological, psychological, social, and spiritual components of health and well-being), the more competences health care workers must acquire. Third, health technology is advancing at such a rapid pace that it is becoming a real challenge to stay abreast of new developments. Finally, the more specialisation in health care, the greater the need for someone who has an overview of the different subdomains and can convey this to the patient or the client. This evolution imposes enormous pressure on health care professionals, in particular general practitioners, and risks overloading health care curricula and their trainees. Thus, there is a fine balance to be struck: on the one hand, we should be ambitious in designing optimal health care curricula that fulfil the needs of patients and the population; on the other hand, we should temper unrealistic expectations toward individual health care professionals and their training. One way out of this conundrum is to embed health care in multidisciplinary teams so that patient and population needs can be met by the collective of the team rather than by any single health care professional. This could be facilitated by introducing privileging and legal responsibility at the team level.

B. GUIDING PRINCIPLES FOR FUTURE HEALTH CARE CURRICULA

Bearing the background described above in mind, an attempt is made here to define guiding principles for the design of health care curricula. The ambition is not to prescribe specific curricular content or pedagogical methods, but rather to lay down a set of generic principles with respect to learning outcomes, curriculum design, proficiency attainment and entrusting for all health care curricula. The said principles provide a frame of reference that programme committees at all levels of training can use to implement their specific curriculum.

I. THREE HIGHER-LEVEL LEARNING OUTCOMES FOR HEALTH CURRICULA

Every health care curriculum is based on discipline-based learning outcomes that specify the competences that need to be acquired in order to graduate in that specific field of health care. In addition, a set of overarching learning outcomes is proposed that apply to every health curriculum. Taking inspiration from the UK Foundation Programme,[13] we envisage the following higher level learning outcomes. Their relation to the CanMeds roles will be discussed in the following paragraph.

- *Expertness*, reflecting the discipline-specific expertise and competences to deliver health care in an evidence-based way.
- *Artfulness*, reflecting the professional competences to collaborate with other health care workers, to act according to legal, deontological, and ethical standards, to take responsibility for continuous professional development and to adopt a person/patient-centred approach.
- *Roles*[14] *adoption*, reflecting the growth process towards being an effective member of a collectively smart care team with shared expertise and alignment of vision, purpose, and values.

Expertness, artfulness and roles adoption can be thought of as the three dimensions of any health care training. Novices in a training programme start at the origin of the three axes (0,0,0 coordinates). The initial part of the curriculum focuses mostly on the acquisition of expertness and artfulness along the first two dimensions. The expertness dimension has a specific content tailored to the expertise of the discipline and profession. The artfulness dimension is of a more generic nature. As such it lends itself to consist of interdisciplinary and interprofessional modules that – at least in part – are shared with other health care training programmes (see below).

Later in the curriculum, and especially after the initial graduation during continuous professional education, roles adoption becomes more and more prominent (see below).

This three-dimensional representation of the curriculum also connects to the CanMEDS model as discussed in Chapter 5. Expertness can be seen as the equivalent of the health expert role and

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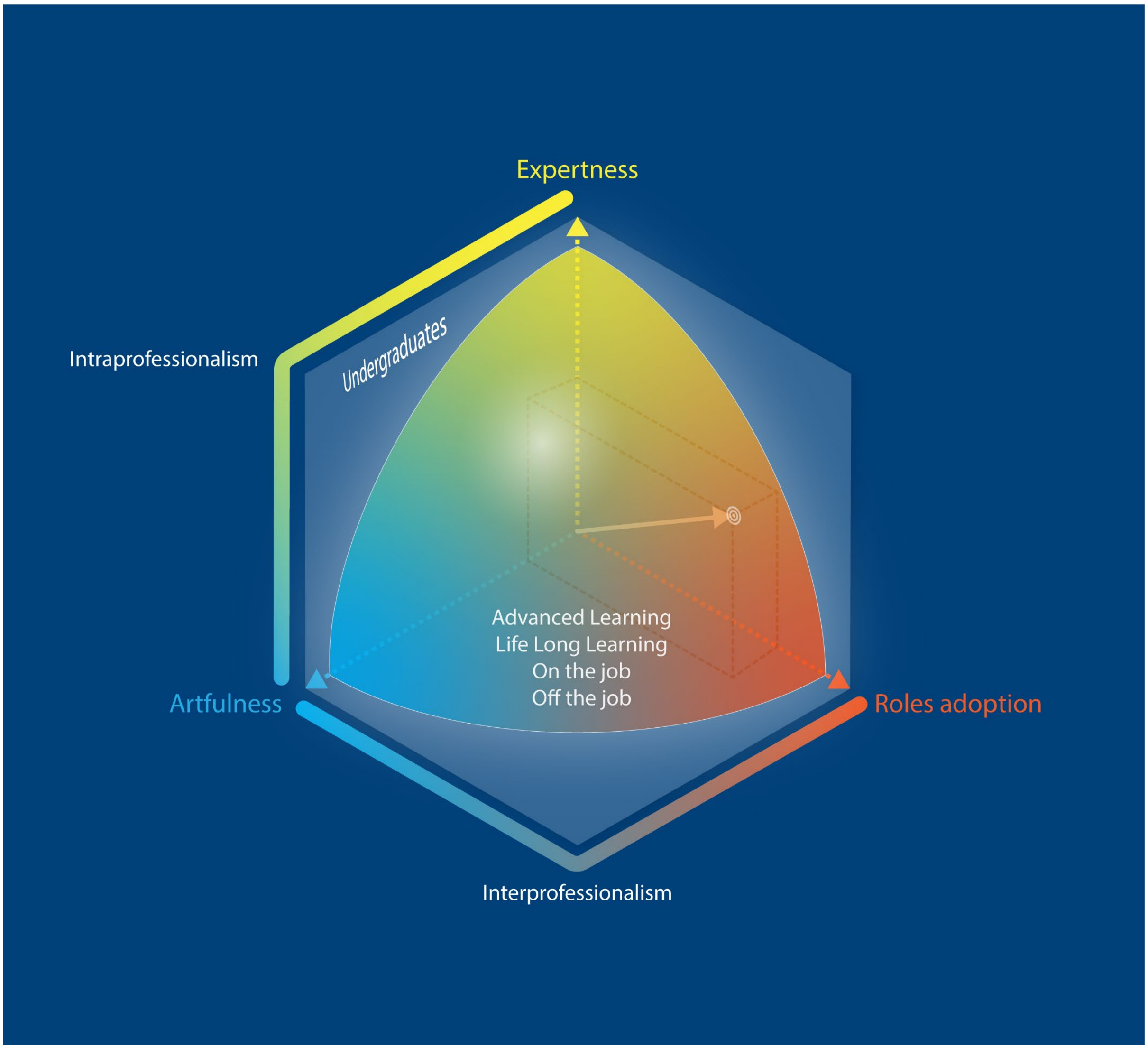
[13] This section is inspired by the UK Foundation Programme curriculum, which aims to form a bridge between undergraduate medical studies and postgraduate training. The programme thus forms part of the continuum of medical education and is the last generic stage of training before the doctor progresses to specialty or general practice training. See also https://foundationprogramme.nhs.uk/. The UK Foundation Programme is specifically developed for medical training, but we use it here as a source of inspiration and in a more generic way relating to all health care students (this term is used in the inclusive and generic sense as we defined it earlier).

[14] Since a health professional can assume different roles depending on the specific constellation of the care team, adoption refers to roles in plural.

artfulness as the combination of the other six, more generic roles (communicator, collaborator, professional…). The third dimension of roles adoption corresponds then to the progressive integration of the seven CanMEDS competences into an effective and working health professional.

Figure 24. The three higher level learning outcomes are represented along three axes representing an ever-increasing degree of mastery and competence. Initial training focuses predominantly on the quadrant between Expertness and Artfulness and can be conceived as training mainly within the profession. Roles adoption comes later in the curriculum and has a strong interprofessional component.



II. CURRICULUM DESIGN BASED ON CARE CONTEXT

To translate these higher-level learning outcomes into specific curricular pathways, learning trajectories can be anchored to the different contexts in which health care is delivered. As already mentioned in Chapter 4, a useful model for this exercise is the Demand and Supply-Based Operating Modes as proposed by Lillrank (Lillrank et al., 2010). Although these modes were initially defined from a managerial perspective, they can also be used to organise learning trajectories, since they are based on the patient's experience and perspective in different health care contexts. In short, the different contexts according to Lillrank are:

- *Prevention* or long-term health promotion in the absence of an acute health problem;
- *Emergency care* that requires immediate action;
- '*One Visit*', i.e. non-urgent, non-severe cases that are concluded in a single session;
- *Elective procedures* for conditions that can be precisely defined and scheduled;
- *Emergent cure* processes in which the full diagnosis requires a structured and stepwise process with interim assessment of the diagnostic results;
- *Care processes* that last until the end of life, e.g. chronic or terminal conditions;
- *Projects*, i.e. complex, rare and poorly understood that require an individual *ad ho*c approach.

Such a demand-based organisation of the curriculum allows for a patient-centred and patient-oriented learning experience across different health curricula. Each of these modes requires a different approach with variations in skills, expertise, and collaborative mode. Streamlining the curriculum along these modes ensures that students are familiarised with different care contexts. A (partial) example of such an approach can be found in the training of general practitioners in the Netherlands, which is structured along ten themes.[15] Four of these themes (chronic care, emergency care, short episodic care, and prevention) directly correspond to one of the Lillrank care contexts.

Since every care context entails a specific and different combination of expertness and artfulness, it follows that the various health care curricula will differ as a function of the care contexts that are relevant for the future profession. Thus, depending on the curriculum, the surface between the expertness and the artfulness axis will be differently implemented.

III. DIFFERENTIATION AS A FUNCTION OF PROFICIENCY LEVELS

The principles described above are meant to apply to all health care curricula, but this does not imply that every student in every training programme should master the content to the same depth and expertise. Curricula should therefore specify which level of competence is expected upon graduation.

A useful guide to define the proficiency level of expertness is to phrase the specific learning outcomes of the curriculum using the revised Bloom's Taxonomy (Anderson et al., 2001) that discerns six successive levels of cognition. These require progressively more in-depth and higher-order mastery: remembering, understanding, applying, analysing, evaluating, and creating. The latter two levels will often entail a research-based curricular component in which students explore the boundaries of current knowledge and practice. These six levels are often coupled to different knowledge dimensions: factual, conceptual, procedural, and metacognitive. Ultimately, this allows us to map learning outcomes in a two-dimensional table relating the six cognitive processes to the four knowledge dimensions (Krathwohl, 2002). For example, in a basic course it may suffice to aim for 'remembering factual knowledge', whereas a more advanced course may aim for 'creating procedural knowledge' with respect to a specific curricular item (e.g. palliative treatment of cancer patients). The Bloom's taxonomy is probably less suited to reflecting the different proficiency levels of artfulness, but conceptually one can also imagine a progressive and more in-depth mastering along this dimension.

The proficiency level can be visualised in the three-dimensional curriculum model by scaling the expertness and artfulness axis, e.g. from 1 to 6 according to Bloom's adapted taxonomy for the expertness dimension.

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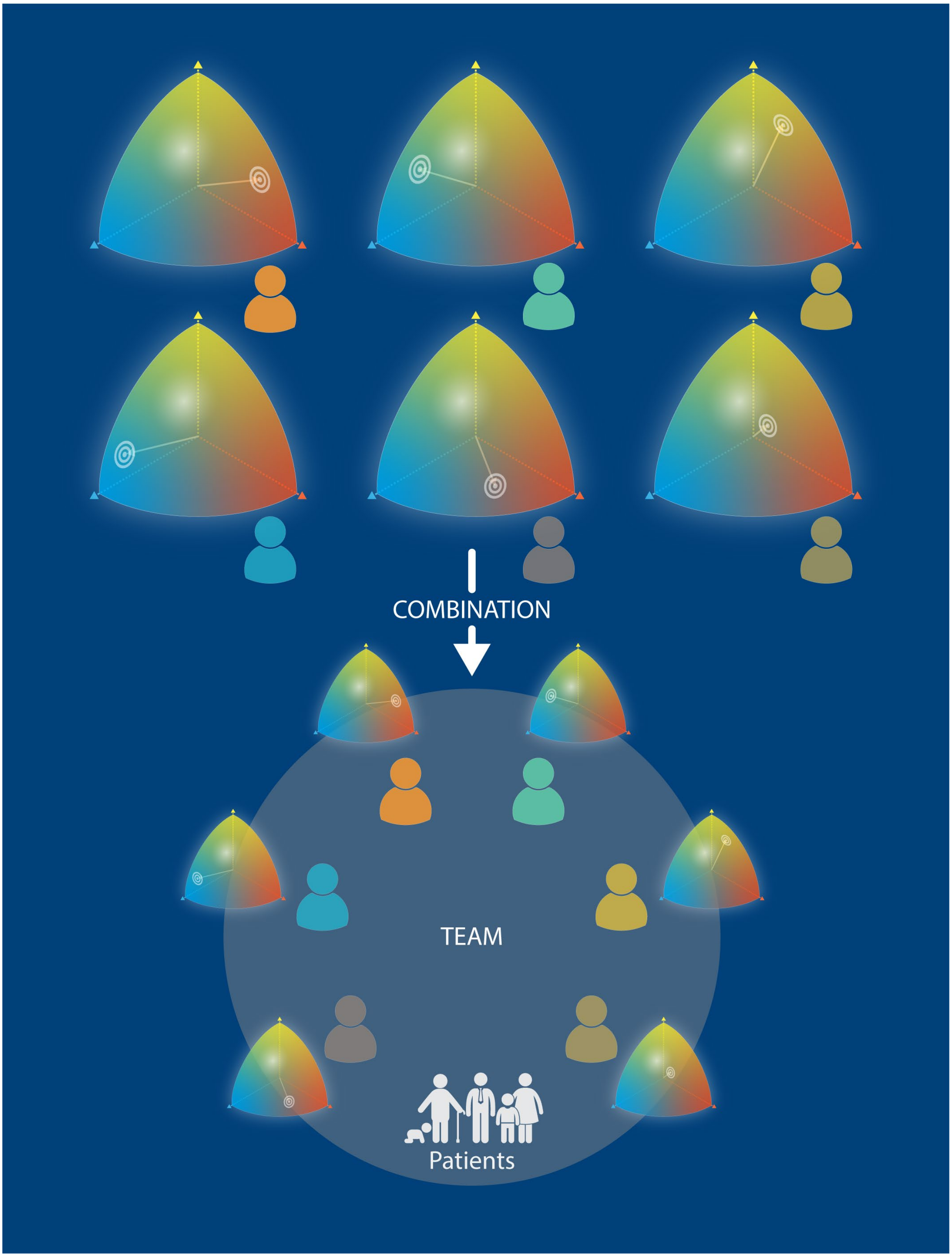
[15] https://www.huisartsopleiding.nl/opleidingsprogramma/themas-en-kbas/

IV. INCREASING EMPHASIS ON ROLES ADOPTION THROUGHOUT THE CONTINUUM OF HEALTH CARE TRAINING

Figure 25. Health care professionals with different disciplinary and curricular backgrounds join to form a multidisciplinary care team which also comprises the patient as a member.



Health care training is a continuum that starts with an initial training that traditionally leads to a specific discipline-based degree. Depending on the profession, advanced specialty training is required to enter the profession. Once health care workers are professionally active, they take up lifelong learning. A broad spectrum of continuous professional education follows and is obligatory to retain the professional license.

Such a continuum has specific implications for curriculum building. As previously described, the initial phase of the training continuum mainly develops along the expertness and artfulness dimensions that are applied to the different care contexts. During this stage, it is important to include in all curricula a comprehensive and integral perspective on health care so that all health professionals – irrespective of their specific role – are familiar with and operate within a common frame of reference, for example taking a patient-oriented approach to deliver integral health care. This idea is further developed in the next section, which proposes a foundational basecamp for all starting health care students.

Later, and especially at the level of continuous professional education, roles adoption becomes more and more prominent. This requires interprofessional and interdisciplinary course modules with (in)direct input of patients to ensure relevancy to the professional situation, in particular the functioning of a multidisciplinary care team.

V. ENTRUSTING HEALTH CARE TRAINEES BY CREDENTIALING AND PRIVILEGING

A crucial question with respect to health care trainees and professionals is how to guarantee that someone is capable of delivering the appropriate care at state-of-the-art quality. Different procedures exist to establish trust. Credentialing is the process of formally assessing whether someone possesses the required qualifications to practice in health care. Credentialing is the responsibility of an official body within the health care administration that is officially authorised to recognise professional qualifications such as degrees, certificates, previous licenses etc. Credentialing is useful for entrusting starting health care workers by linking the license to practice to a specific degree qualification. However, it is less well or even not suited to subsequent advanced training and during the professional career, where it is important to keep ensuring professional competences beyond the initially obtained qualification. This can be realised by the alternative procedure of privileging, in which health care workers are authorised to perform or deliver specific procedures and services based on an assessment of their actual professional competences. Privileges can be restricted to context (e.g. only in a hospital setting or under supervision) and time (requiring periodic updates) and they can be accorded at a local level, e.g. at the hospital level. Privileging also allows health care workers with different initial degrees (credentials) to perform similar procedures and services, which increases the flexibility of health care organisation and reduces the siloing of health care professions.

An important question here is who takes responsibility for the credentialing and privileging process. Ultimately, it is a shared responsibility of health care training programmes, licensing authorities, professional societies, and health care organisations to reflect on credentialing and privileging criteria and the way in which both procedures interact and complement each other during the training continuum. Weighing the (dis)advantages of both systems, one can state that credentialing is a standardised process, but it does not necessarily guarantee equal levels of proficiency among graduates. In contrast, privileging is probably more cumbersome to organise, as it involves individual competence assessments that should in principle certify equal levels of proficiency among trainees.

To put privileging into practice, one can make use of so-called ‘entrustable professional activities’ (EPAs) (Ten Cate, 2005). EPAs are “units of professional practice that constitute the daily practice of clinicians” (Ten Cate, 2020) and usually combine several competences, e.g. performing a sternal puncture requires medical expertise, communication and collaboration skills. Trainees or professionals can be trusted to perform a specific EPA once they have shown that they are capable of executing the EPA without supervision. Health care workers can thus be privileged for a specific clinical act as soon as they have acquired all the EPAs that are required for that specific act.

C. A BASECAMP TO LAUNCH HEALTH CARE STUDENTS

Finally, we suggest that every health care curriculum start with a basecamp[16] module. The underlying idea here is to immerse starting students – whatever their specific curriculum – in a common way of thinking and acting along shared principles for health care, to introduce them to the collaborative nature of health care work in different patient settings and to initiate reflection on their role as future health professionals. Importantly, we see such a basecamp as a steppingstone for all health care curricula, across different disciplines, across different educational systems (universities, university colleges, vocational training colleges, …) and across the spectrum of professional activities encompassing care, cure and prevention. Furthermore, a ‘return to the basecamp’ can be part of lifelong learning trajectories for health professionals.

I. SETTING THE HEALTH CARE SCENE AT THE START OF INITIAL TRAINING

Programming such a basecamp at the start of the curriculum has several advantages. First, it helps to strengthen the link between the initial basic training all students have to go through and their future professional aspirations. Second, it provides a unifying frame of reference for the often diverse set of course modules that constitute the programme. Third, it allows for interdisciplinary or interprofessional course activities with students from other programmes, thereby instilling from the very beginning the concept and value of teamwork in health care. As such the basecamp module provides the safe and secure stage from which the students can ascend the educational mountain.

For most health care curricula, it is self-evident to roster the basecamp at the very start, e.g. in the first bachelor year of nursing, physiotherapy, medicine, pharmacy. However, other curricula need not have the health care perspective from the very beginning. Here students can choose for a health care-oriented programme, e.g. clinical psychology within the psychology training or biomedical engineering within the engineering programme, later in their curriculum. In such curricula, the basecamp can be programmed at the beginning of the health care orientation of the curriculum.

II. CONTENT OF THE BASECAMP ‘HEALTH CARE PROFESSIONAL’

The goal of the basecamp should be to prime students with basic insights and principles of health care and how they will contribute as future professionals. Since it is positioned at the very beginning of the curriculum, such a basecamp should not deal with in-depth analysis or detailed elaboration of the

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[16] Inspiration for the basecamp was drawn from boot camps in specific health care disciplines, e.g. a geriatric care boot camp, see https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4438276/.

subject. Rather it is an initiation course that provides an overview, highlights core insights in health care and sets out the milestones for their learning path.

The basecamp content can be modelled upon the higher-level learning outcomes previously described, in particular along the second axis of valuable member of a health care team and professional. The following themes could be explored in the basecamp module:

- Patient- and person-centred approach of health care and how this translates into integral care at the biological, psychological, social and meaningfulness level, especially taking patient diversity into account.
- The different care contexts based on patients' needs (met or unmet) and how these affect the organisation, implementation and financing of health care.
- Locating the health care system in an broader context: global health, international centres of excellence.
- Understanding the determinants of health (and the underlying biological, psychological and socio-economic principles) and their repercussions for health care delivery at the level of the individual and the population.
- Basic economical, psychological and sociological concepts in relation to human behaviour, health care and medicine.
- The intertwining of health care, technology and innovation and adopting new technologies and practices without compromising patient safety.
- Becoming familiar with the development cycle of health technology, starting from the needs of patients and care workers and delivering solutions as part of patient-centred care and how this translates into future health (care) developments.
- The concept of clinical reasoning and decision-making in the context of uncertain or partial data and patient autonomy (shared decision-making), including basic principles of statistics, epidemiology and critical thinking.
- The interdisciplinary, interprofessional and collaborative nature of health care and how this necessitates teamwork and translates into the different and changing roles and responsibilities of the health care worker.
- The legal, deontological, and ethical framework and how to uphold professional standards.
- Steppingstones for a sustainable career by lifelong learning and maintaining a healthy work-life balance.
- Focusing on patient safety and quality of care by adopting a critical mind, an inquisitive attitude and self/team-reflection.
- Continually evaluating the processes and outcomes of one's daily work, sharing and comparing one's work with that of others, and actively seeking feedback in the interest of quality and patient safety.
- Tailoring communication to the context of patients, peers, and authorities.

III. PEDAGOGICAL APPROACH OF THE BASECAMP

With respect to implementation, as stated the basecamp module is an entry level course that sets the scene for the specific curricular content that will follow later in the programme. As such it concentrates on key principles and basic insights. This does not mean that such a module should be perceived as either superficial or abstract. On the contrary, several of the above-mentioned themes are preferentially taught using a concrete health care context. For example, coronary heart disease can be usefully employed to illustrate the context of prevention, emergency care and care processes. This requires an introduction to, e.g. epidemiology, cardiovascular anatomy and physiology, nutrition, metabolism, and pathophysiology, without delving too much into the subject details that will (and must) resurface later in the curriculum.

The proficiency level of such basecamp modules should also be tailored to the students' capacity and their anticipated role in health care, e.g. care worker, nurse, physician, pharmacist, ... Taking the example of coronary heart disease in prevention, emergency care and care processes, different aspects at different levels of understanding should be highlighted depending on the specific curriculum.

However, a basecamp is also the perfect setting for interdisciplinary and interprofessional learning. Indeed, to prepare students for the collaborative setting of health care, one might envisage mixing students with different curricular backgrounds in a multidisciplinary team that has to address a specific care problem. The expectation would not be to find all kinds of solutions to that problem, but rather to explore what the role of the different health care professions might be in this specific care context. As an extension, the authenticity of the learning process could be further enhanced by including patients in these mixed student teams. This would not only help students to clarify their own role, but also to value the contribution of other health care professions and to appreciate the patient perspective.

Furthermore, to increase the authenticity of such basecamps, patients and their families should be closely involved in the training so that starting students have a genuine experience of how disease affects the life of patients and their families, which obstacles they have to overcome, and how at the same time they manage to embed illness in their daily life.

A very ambitious implementation of an interdisciplinary and interprofessional basecamp would be to group all starting students in the different health care curricula in a common module during one semester, after which they split up and continue in their discipline of choice. Such a mixed setting in which starting students focus on the communalities of health care would hopefully set the scene for the rest of their training. Elements of the common basecamp could then be recapitulated later in the curriculum with an emphasis on the discipline-specific aspects. A common basecamp would also allow starting students to explore different health care profiles as part of their study orientation and selection process. For example, the common basecamp training may strengthen the initial study selection or, instead, may call the initial study choice into question and offer the possibility for study reorientation.

IV. RETURNING TO THE BASECAMP AS PART OF LIFELONG LEARNING

As previously described, the basecamp functions as a common starting point for health and care students. Moreover, it can also be envisaged as a place that advanced students and professionals return to later in the curriculum or during their career. Indeed, it has been stressed before that health care training is a continuum with continuous professional education and lifelong learning as essential ingredients. A revisit to the basecamp would allow advanced students and active professionals to integrate their learning and activities into the interdisciplinary and interprofessional context of health and care provision. A return to the basecamp could be incorporated in modules of life long learning and continuous professional education. Mixing starting students and active professionals in a basecamp would also promote transfer of competences between 'generations' thereby instilling a sense of responsibility towards the next generation of colleagues and promoting a sense of meaningfulness.

D. CONCLUSION

As observed in the introduction, this chapter provides a long-term vision that is not impeded by current regulatory, educational, or organisational constraints. If one wants to realise the scheduled ambitions, such constraints should, of course, be identified and solved, both at the national and European level. For example, although a Member State can define its organisation of health care, including the training of health and care professionals and the access to regulated professions, it is important to remember that new rules must be in conformity with the Treaty on the Functioning of the European Union and in particular with the free movement of workers, the freedom of establishment and the freedom to provide services. Moreover, the freedom to choose an occupation is a fundamental right. The Charter of Fundamental Rights of the European Union ('the Charter') guarantees the freedom to choose an occupation, as well as the freedom to conduct a business.[17] So, if new rules regarding a regulated profession are enacted, they should not constitute an unjustified or disproportionate obstacle to the exercise of those fundamental rights. These new rules have to be in conformity with existing Directives, such as the Directive 2005/36 of 7 September 2005 on the recognition of professional qualifications and the Directive of 2018/958 on a proportionality test before adoption of new regulation of professions. To put some recommendations into practice, an evaluation at the EU level of the current text of Directive 2005/36 might also be needed. When developing certain recommendations, we are aware that current legislation on the practice of the health care professions and on quality of practice may need to be adapted. This legislation reserves certain activities to persons with a specific diploma and accreditation. The development of new provisions may also require changes to legislation that is at first sight unrelated to health care, such as VAT legislation. This legislation provides, e.g. exemption regimes for persons who have a certain diploma and accreditation, but not necessarily for people who are competent to perform certain activities but do not have a specific diploma and accreditation.

Furthermore, this long-term vision does not preclude more immediate actions with respect to the design and implementation of health care curricula. First, technological advances in terms of artificial intelligence, data mining, robotisation, augmented and virtual reality, novel materials, … have already started to impact health care practice and will continue to do so. It is imperative therefore that we incorporate these in one way or another in the current curricula so that trainees and future professionals are familiar with these technological evolutions. Second, introducing a person-centred perspective and structuring the curriculum according to different care contexts are short terms steps that can be taken in anticipating later, more fundamental changes to the curriculum.

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[17] Directive 2018/958 of 28 June 2018 on a proportionality test before adoption of new regulation of professions, recital 1.

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