

CONCEPT DRAFT

DOMAIN PLAN HEALTH@BMS

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DRAFT

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Introduction

The Behavioural Management and Social Sciences (BMS) Faculty is currently engaged in a repositioning process. One goal of this process is to strengthen its Health theme, thereby contributing to a centralised University of Twente theme for interdisciplinary research and education in Health, Healthcare and Health Technology. Major demographic, social, economical and technological developments have triggered a series of developments in the health and healthcare sectors, which, in many senses, are quite radical.

Researchers working on the Health theme meet these challenges caused by these developments in order to improve and optimise health and healthcare. They do so by developing, evaluating and using innovative technology and methodology in an efficient and effective way. BMS health research anticipates on these developments, and prepares healthcare professionals, patients and stakeholders (i.e. health organisations, insurance, governance) to use and see these developments as opportunities to 1) improve their knowledge and skills, 2) to innovate work processes, organisations and financial systems, and 3) to empower the users of the health system in monitoring and managing their health behaviour and health outcomes as optimal as possible. Furthermore, BMS health research actively guides health technology development at the University of Twente, through early assessment of the stakeholder requirements and potential impact of new technology under development. The overall goal is to keep the overall health system flexible, dynamic, affordable, and at the same time resilient in order to professionalise healthcare and to improve quality of life of each individual, whether healthy or (chronically) ill.

BMS staff excels in research in several areas in health, healthcare and health technology, and contributes to education in several Health programs, tracks and specialisations in other educational programs which attract many students.

The following paragraphs describe the trends in demography, society, economy and effects on health and healthcare. The role of innovative technology in these trends and the challenges that our society is facing are delineated. Implementation of technology often requires transformation in healthcare and a change in behaviour of stakeholders. BMS staff uses specific methodology and 'big data' in their research to address these challenges. A paragraph on education describes how staff contributes for a very large part to the profile of the University of Twente's Health domain. The above leads to opportunities for BMS@Health and strategic partnerships. The last two paragraphs describe the expertise within the faculty and future investments needed to seize these opportunities.

Trends and challenges in Health & Wellbeing, Healthcare, Healthcare Technology

Several trends in health & wellbeing, healthcare and healthcare technology in our society can be identified. These induce multiple challenges, which influence the structure, organisation and finance of healthcare and the way health professionals work. These in turn lead to many questions which are yet unanswered.

With 'Health' we refer to the absence of illness and ability to adapt and to selfmanage health & wellbeing.

With 'Healthcare', we refer to the organisation of care (prevention, diagnosis, treatment).

With 'Healthcare Technology' we refer to the technology in the broadest possible sense referring to systems for medical diagnostics and therapeutic techniques and information and communication platforms and monitoring technologies.

Trends and challenges in Health & Wellbeing

- The general population is aging and in terms of healthcare, this is leading to increased incidence of: vulnerable elderly, individuals with chronic degenerative diseases (chronic obstructive pulmonary disease, diabetes, and cardiovascular diseases), patients with a malignancy and individuals with common mental disorders. Many have co-morbidities. Due to this in Dutch called 'dubbele grijze druk' the impact on health and healthcare (such as public health, hospitals, nursing homes, general practitioners, residential home care, and informal care) is large.
- Public Health Prevention, ranging from youth to elderly, plays an important role in society to prevent illness and to support a healthy lifestyle. The population is getting older, but the extra years gained are not lived in good health, leading to more cure and care, which are therefore expensive. The goal of prevention is to increase the number of healthy years by preventive health behaviour as early in life as possible and to reduce the number of unhealthy years. This will generate a better quality of life and substantial savings in healthcare costs. Prevention should be inclusive, addressing health literacy and social-economic health and should take into account somatic and mental health status (such as differences in life expectation and in healthy life years). Primary prevention so far is clearly the domain of governmental agencies. Increasingly, a tailored and personalised approach is necessary to empower self-regulatory health behaviour. Thus providers in the curative sectors are increasingly challenged to play their role in stimulating health behaviour, smoking cessation, etc. as they are in close contact with their population. The concept of "positive health" is increasingly leading this development. But which preventive measures should be taken? When, by whom exactly and focusing on who? How to implement a tailored and personalised approach by providers such as general practitioners, mental care providers and hospitals? Which business models can be developed for preventive actions? National and local governments and providers are facing these challenges and do not yet have clear answers.
- Besides the increase in number of patients, these patients demand high-quality facilities for their diagnosis, treatment and care. They also want access to new, comprehensive diagnostic instruments and therapeutic options that are often more costly than existing care, while their effect may not have been proven (yet). Research groups and industry all over the world are producing innovative

technologies at an incredible speed. What does indeed have a clinical effect? What are patients' preferences? And what is cost-effective? The optimal balance between early access to new technology (asked for by patients, while not yet proven effective) and thorough evaluation of its benefits (demanded by stakeholders, often time consuming) is a topic of substantial debate.

- Most (but not all) patients want to retain a sense of control for health, therefore self-management attitudes and competencies are of essential importance as well as preferences and meanings of illness for everyday life. This requires new skills and education. Self-management is not solely focused on managing disease-related aspects as adherence to medication and lifestyle prescriptions, but contains coping with impaired health and the consequences of a disease (e.g. by emotion regulation) and finding meaningful societal roles as well. Personalised health tailored to the individual will play an even more important role over time. Shared-decision making, i.e. decisions regarding diagnoses and treatment are taken by the physician and the patient, is more or less established already. How to tailor personalised health? How to make self-management programs work and efficient? How does society value improved capacities of individuals in the context of reimbursed care?
- At the same time, socio-economic differences are increasing, leading to inequality in health and access to healthcare. Life expectancy of an individual with a low socio-economic status is 7 years less than that of an individual with a high socio-economic status. The difference in years experienced in good health is even 18 years. Preventive measures and campaigns have a relatively low impact on these vulnerable groups. Finding the causes of these differences asks for multidisciplinary analyses and should lead to an effective intervention. What are causes? How to decrease these socio-economic differences?
- Furthermore, there is an increased focus on positive (mental) health, which entails a shift from cure to prevention. It is important to develop new perspectives on health as more than the absence of illness. The maintenance and promotion of well-being, also with chronic, degenerative, or mental disorders becomes an important goal in healthcare. Increased demand on productivity asks more from the mental health and resilience of employees. This warrants new, technology-based services to monitor and promote well-being in the work domain.

Trends in Healthcare

Healthcare refers to the organisation of (public) healthcare, in the context of logistics, engineering and finance.

- The way healthcare is organised is changing. Policy makers stimulate a shift from hospital-based care to home care, close to the patient (care at a distance). However, so far rather limited results of real substitution of care out of the in-patient setting to other providers have been shown. New technologies seem promising to make this shift possible. As a consequence integrated care is becoming increasingly important: general practitioners, hospitals (often involving several wards), rehabilitation centers, home care providers and informal caregivers need to focus on more

coordinated and integrated care provision. An alternative model in which providers deliver care in new settings is emerging, such as hospital@home, tele-Intensive Care Units (ICU) services and so on. So far, there is too little awareness of the impact of this shift on patients, healthcare providers and informal caregivers. Not only the home situation of the patient will change, but they also need to know how to use these new technologies appropriately and how and with whom to communicate when something fails. How can their behaviour be influenced in a positive way?

- As a consequence of the aforementioned trends, healthcare providers are increasingly specialising to provide specific care, to capitalise on economies of scale and economies of focus. This greatly affects the organisation of healthcare, and raises the challenge how to organise the logistics of integrated healthcare in such a way that it balances the interests of all stakeholders, along the entire care pathway? A consequence for organisations is that their responsibilities change, and we do not know how this impacts patients and health professionals.
- The costs of healthcare are rising due to aging and the complexity of treating patients with comorbidity, due to an increasing demand for care, and due to demand for new technologies. The challenge is to keep the healthcare costs in control while at the same time providing optimal care and using cost-effective technologies. Care providers appear to have little grip on their spending, which obscures the remaining perverse incentives in healthcare's financing structure. Transparency is needed of healthcare procurement costs, in order to identify opportunities for optimising / redesigning the financial cost structures.
- The innovation in healthcare technology and new diagnosis and treatment opportunities contribute to the increased spending of healthcare. (Early) Health Technology Assessment enables to prospectively assess the cost-effectiveness of such innovations. In other words, is the least expensive care option always the most affordable one for health insurances and society?
- As hospital length of stay, and places in nursing homes are reduced, more care is provided at home. Furthermore, chronically ill patients need less health checks in the hospital setting because of remote technology. In the latter a population of complex patients who need special care will reside. Do these innovative technologies tap into unmet needs that were so far neglected? How should a hospital be built to deal with this new situation? It is a great challenge how to organise home care, involving all parties involved along the care pathway. How to organise home care, in a cost-effective way?
- Due to budget cuts in care for patients the demands on informal caregivers and on specific healthcare services, such as emergency services, are increasing. To be able to deal with these changes, organisations need to be prepared in the type of health professionals employed, and they need to reorganise and transform healthcare structures. What educational efforts should be undertaken to prepare health professionals for these demands? How to reorganise such structures? How can logistic processes be optimised? Do we need to increase willingness to informal care, and how to organise informal care delivery? Which technology can be supportive to integrated healthcare systems and services, and to shared decision making?

Trends and challenges in Healthcare Technology

- Technology development and implementation in healthcare is expensive, and costs will only increase given more and more strict regulations on data collection, evaluation and validations, for example, in clinical trials, self-management interventions and for creating integrated infrastructures for data-sharing . As a result, it is crucial to be able to evaluate the potential benefits of new technologies in very early stages of product development. Involvement of stakeholders (end users, providers, payers etc.) is needed during all stages (development, design, evaluation and implementation) to collect evidence that is convincing and maintaining in different situations and circumstances. What models and methodology are optimal for iterative and systematical evaluation of new technologies during development process? How to optimal involve and engage stakeholders during development process? How to quantitatively assess the business opportunities for new technology and the likelihood it can be brought to market?
- Many new technologies investigate mechanisms or markers of disease and can therefore potentially be applied across a range of diseases. For example, detecting cancer cells in blood may help diagnosing different types of cancer, or monitor disease progression during treatments for different cancers. Therefore, the added value, and cost-effectiveness, of such technologies depend critically on the application that is assessed. How to identify the most valuable and optimal application for such technologies? How can the value of a new technology be assessed across multiple, different applications in healthcare?
- The benefits from new healthcare and consumer technologies will only actually accrue to stakeholders (patients, healthcare providers etc.) when these technologies are used appropriately by the end-users (formal, informal care providers or patients). Although, in general, barriers and facilitators of the use of new healthcare technologies are widely known, how these aspects influence adoption of and adherence to technologies should be examined in depth. Quantitative and qualitative methods should be used to understand the (long-term) use and to optimise the design of healthcare technologies that are adaptive, tailored to users and context of use. Moreover, disruptive innovating technologies may require large changes to the healthcare system, and the way care providers work, to be successfully implemented. How do business models in healthcare and organisation of healthcare influence adoption of new (disruptive) technologies? How do clinical guidelines, networks of care professionals, and technology mediated behaviours impact such adoption processes? What implementation efforts could be valuable and cost-effective to speed up such adoption processes? How to develop and implement novel technologies to engage users to self-manage health & wellbeing? How to integrate technology mediated healthcare with traditional care delivery (blended care)?
- Technology breaks the wall of knowledge. Anyone with Internet access can get the same information as the information used by most prominent experts. This will impact the role of patients ('no longer being a patient') and the relationship between patients and care providers. Pervasive technology breaks the wall of connectivity and data: relying on technology, such as wireless connectivity, a new completely pervasive environment embedding sensing technology networks (IoT) is surrounding individuals,

penetrating inside humans and continuously producing high volumes of data. This implies novel ways of managing the flow of data and methods, i.e. machine learning, artificial intelligence, to understand the data and to create knowledge for self-care (data wisdom).

The role of technology and the challenge of implementation in healthcare

With introducing technology in health and healthcare questions arise how to develop, implement and evaluate technologies that meet the demands of various stakeholders. In order to guarantee high standard and inclusive healthcare, and to support proactive self management of health and wellbeing, while keeping costs of (public) healthcare manageable, technology should be given a prominent role. How to achieve this? Examples of technology and its use in health and healthcare:

- diagnostic and therapeutic techniques, such as biomarkers, imaging, image guided treatments, point-of-care tests, surgical procedures, coronary stents, clinical prediction rules, eHealth systems, medical devices;
- wherever they may be, patients can get immediate digital access to their hospital data
- across healthcare institutions patients can exchange and share data using web-based platforms connected to new technologies;
- persuasive and engaging interface designs can be used to motivate and nudge people to healthier and better lifestyles;
- an enormous amount of data is becoming available ('big data') which can be personalised to individuals using new methods (machine learning, artificial intelligence) and tailored coaching/feedback systems. It can also be used to analyse and optimise the performance of healthcare delivery processes and systems;
- technologies are delivered by industrial companies (Google, Amazon, Facebook) providing facilities to employees and consumers, blurring traditional care delivery;
- monitoring and coaching technologies support people in their self-management and well-being, taking prevention and treatment out of the institutions into the everyday lives of people, and providing or discussing the results with healthcare staff.

Cost-effectiveness, budget impact, and stakeholders

Many new health technologies are being pushed onto the market, making it difficult to decide if these indeed should be implemented in healthcare. Do different stakeholders (i.e. patient, physician, healthcare workers, and managers) actually need these? And if so, how to choose the most cost-effective and efficient technology? What is the total budget impact, for stakeholders involved, and who is going to pay? Who will be the owner of such technologies? How to deal with privacy and ethics to use technologies in healthcare? Often, the impact on clinical effects, costs, quality of life of individuals, quality of care, and organisations are poorly understood. New technologies often fail and relatively few technologies are eventually implemented in healthcare due to problems with regulations, upscaling and lack of evidence. It is essential that the development and implementation of technologies is guided by all stakeholders. Users, patients, healthcare professionals, providers, technological companies, governance all have their own interests, perspectives and justification. The implementation of these technologies in daily life and medical practices needs knowledge of several overlooked aspects like safety, connectivity and responsibility. This also requires the involvement of authorities, regulators, administrators. How to manage the ownership of technologies and maintain the quality for healthcare? How to evaluate the success and failures of the use of these technologies and its' impacts on society? In view of increasing financial pressures, it is likely that the issue of (possible) cost-effectiveness will be raised much earlier in the translational research process than

now commonly is the case. This asks for innovative methods to perform technology assessment in dynamic and uncertain circumstances.

Transformation in healthcare

The introduction and implementation of new technologies and other innovations asks for effective transformation processes in healthcare. Guiding effective transformation processes in healthcare, exceeds the introduction and implementation of technology. It requires an all-over strategy, based on collaborative governance and high-level interprofessional practice and evidence based approaches. While technological possibilities are on the rise and demographic, societal and economic changes increasingly impact healthcare as-we-know-it, the healthcare domain is in a state of transformation. These developments result in the mounting challenge for healthcare systems to concur disruptive effects on day-to-day practices, roles and responsibilities in the domains of health and social care. Although technological innovations offer unprecedented possibilities, they can have far-reaching ('boundary crossing') impact on roles and responsibilities of healthcare professionals as well as for users, patients, informal caregivers and families. Moreover, transformative changes in healthcare also require authorities, regulators, administrators and other stakeholders to renew their 'social contract' with society.

Optimisation of healthcare processes

The healthcare system contains many siloes. The trend of specialisation leads to an increasing amount of providers, and even within hospitals, departments are single-cost centres, leading to a siloed governance structure. From a patient's point of view, his/her needs surpass this fragmented structure. It is a great challenge to organise the patient's care pathway integrally and transparent. There is a need for innovative planning and control structures that result in both effective and efficient care delivery. BMS research focuses on the design and optimisation of such structures, using mathematical models (e.g. queueing models, mathematical programming) and computer simulation to prospectively assess the impact of these structures on all stakeholders, thus providing evidence for decision makers.

Behavioural change in health and well-being

As roles and responsibilities change, these technological innovations require changes in users' behaviours to promote their health and well-being. There is a need for a persuasive, engaging interface of technologies to support proactive decision making of users in work practices and daily lives and routines. Research in the area where technology intersects with human behaviour is crucial if innovations are to be implemented effectively. Individuals just want to stick with what they know, and this is often something of a bottleneck when it comes to introducing technology. Before logistical changes and technological innovations can be introduced successfully, it is essential to understand technology mediated behaviours. Knowledge of this kind is needed to develop and evaluate the success of technologies. It can show how to develop systems that are persuasive, personalised and intuitive, and that individuals really want to use. Behavioural scientists' expertise is equally indispensable during the development and implementation process. For a technological innovation to become a real success, stakeholders must be actively involved as co-creators from the early start of thinking how technology can support health and healthcare.

Methodology and the use of 'big data'

To address the challenges in health and healthcare expertise in the area of methodology is required, such as:

- the further perfection methods for development, implementation and evaluation of novel technologies in healthcare and daily life;
- the optimisation of methods for user and stakeholder involvement during development process;
- development of methods for choosing between new and existing technologies, based on what the public, patients, healthcare providers and management deem necessary;
- methods and techniques to design and optimise (integral) planning and controlling healthcare processes;
- methods and techniques to screen patients for mental disorders;
- methods and techniques to analyse therapy change processes;
- methods and techniques to model or simulate healthcare processes in order to enable effective prospective analyses of management interventions;
- methods for tracking clinical effects, quality of life and quality of care as a result of a new technology, including the effect of an individual's behaviour;
- methods and techniques for identifying the optimal way to use new technologies, for example regarding timing, frequency, and threshold, of repeated use of a novel biomarker
- methods and techniques for calculating and predicting the cost to organisations, society, ministries, insurers, etc.: cost effectiveness, budget impact analysis; business modelling for implementation and upscaling of care delivery;
- an understanding of the methods used to predict and track effects on the organisation (integrated care), and to optimise them;
- an understanding of how the need to meet certain conditions affects the way new technology is implemented, to ensure it is not 'doomed' before it even gets off the drawing board;
- expert-advanced statistical knowledge of 'big data', to analyse the huge amount of data generated by monitoring technologies (like mobile technologies; pervasive technologies) and to develop novel coaching systems to provide personalised, adaptive feedback at the individual level (real time);
- knowledge of new organisational designs, ethics and regulations for care that involves technology;
- methods and techniques to map in a non-invasive and effective way the actual costs of healthcare activities;
- methods and techniques to analyse process data in order to optimise functioning of healthcare organisations.
- Big data analytics that allow a better analysis and insight in human behaviors that are important in maintaining health and well-being, like emotional expression and regulation;
- Just-in time, real time coaching support adaptive to preferences of users.

Cutting-edge methods and research techniques are essential for the applications of technology associated with innovations in healthcare. Extracting meaning from data is a strong profile within BMS, involving data analytics, visualisations focused on data wisdom and data mining. For example the departments of Research Methodology, Measurement and Data Analysis and Psychology, Health and Technology designed a multidisciplinary toolkit with tremendous potential in terms of research into context-driven design,

implementation and evaluation. Furthermore, the department Health Technology & Services research has a strong track record in elicitation methods, to assess preferences, beliefs and performance estimates from stakeholders for technologies where experimental data is still limited.

Health @ BMS potential

An integrated approach to evaluating and using new technology is essential if society is to reap the full benefits of these new trends and to deal with the accompanying challenges. If healthcare is to be substantially improved while at the same time keeping costs under control and stimulating self-management, then an interdisciplinary approach, based on cost utility research and patient outcome, is essential. All trends and related research questions include different aspects of health and healthcare, such as policy, design and interaction of systems, interaction of persons and individual behavior. These can therefore only be efficiently explored and studied in an interdisciplinary team as available in faculty BMS. BMS provides the required combination of knowledge and expertise to facilitate the myriad of processes and shifts that accompany the implementation of technology and the necessary healthcare transformation. Current and future investments will increasingly deliver the necessary evidence based insight and best practices to facilitate organisations, regions, professions and citizens in effective transformation. There are already strategic partnerships in place (see chapter strategic partnerships). Researchers working on the Health theme at the Faculty of Behavioural and Management Sciences have an excellent position to play a role at the forefront of these challenges, as is shown by the list of Principal Investigators and (Associate) Professorships focusing on the Health theme (see chapter expertise within BMS). Additional professorships would will the gap and bridge specific expertise areas (see chapter further investments).

Education in the Health domain

The faculty of BMS contributes for a very large part to the profile of the University of Twente's Health domain. There is an enormous student interest in this area.

Important parts of the 'Twents Onderwijs Model (TOM)' are projects in which students work in a team to find a solution for a problem. These projects are derived from actual relevant present-day problems in health, healthcare and society. Students are stimulated to gain knowledge, to design, to work independently from a teacher (student driven learning), to work together with others, to apply knowledge and to develop self-insight. Students are in various ways frequently confronted to current day practice. For example by solving a problem during a tutorial, by teachers who have knowledge or are also working in practice (e.g. hospitals or healthcare institutions), by internships, or by working on a thesis in which they have to solve a realistic problem. Students use what they have learnt during the modules in the Bachelor and Master programs, e.g. on 'Optimising healthcare processes with technology' in which quality and safety, operations management and health information systems are central themes. Other examples are health economic modelling, stakeholder preference elicitation and decision support, innovation in public health and personalised monitoring & coaching.

The faculty of BMS has its own educational programs in the social, behavioural and management sciences. Health is increasingly a focus and an area of application within specific Health Tracks and Specialisations in Industrial Engineering and Management, Psychology, Communication Studies, and Public Administration. Examples are The Health Care Technology and Management track of Industrial Engineering Management, and the Positive Psychology and Technology and Health Psychology and Technology specialisation of the program Psychology. Students per program:

- Industrial Engineering and Management: This program has 110 students in the Bachelor program and 110 students in the Master program, of which 30 students choose the Health Track.
- Psychology: Each year approximately 250 students (range between 200 and nearly 400) start with the Bachelor Psychology, of whom 50 % choose for a health related Bachelortheses (N=73 in 2016/17). About 65% of the Masterstudents psychology enter the two health-related master tracks in psychology (Positive Psychology and Technology and Health Psychology and Technology) (N=96 health related Master theses in 2016).
- Public Administration: In the Bsc. Programme several modules have health-related projects in the modules. In the master program, with an enrollment of appr. 40 students, a health domain specialisation is currently being developed.

Moreover, staff members from BMS are involved in teaching Bachelor and Master students from the independent Programs Health Sciences, Technical Medicine and Biomedical Engineering. These attract each year respectively 45, 110 and 100 students in the Bachelor and 60, 100 and >50 in the Master programs. The Faculty of Science and Technology (TNW) is currently engaged in repositioning Health Sciences, with significant and substantial involvement from various BMS groups in the curriculum development and coordination of master tracks.

Several of the Health Tracks and Specialisations show an increase in the number of participating students and also attract students from abroad. Currently, within the program Health Sciences, there is a need for a teacher in organisation and structure of healthcare systems, who also has knowledge about the financial economic perspective. Furthermore, the program could use support in teaching optimisation of healthcare processes and in teaching personalised and persuasive coaching. These are all areas where the faculty BMS logically should contribute but is currently lacking the manpower and specific expertise.

Besides courses focusing on students, BMS also offers executive courses for policy makers, care providers, and research scientists. Moreover, BMS regularly organises conferences and symposia for care professionals in all health related disciplines.

Education in the Health domain is not only focused on the University itself, but knowledge is also transferred through international training courses and handbooks, in addition to the regular education programs. Extremely popular is the E-health Massive Open Online Course (MOOC). One major theme involves learning new competences and skills in the context of medical technology and the transformation of healthcare. It forms an obvious link to the domain of postdoctoral education, the University of Twente's Lifelong Learning (LLL) strategy. Also, in the Nanotechnology for Health: Innovative designs for medical diagnosis MOOC, a separate topic is devoted to Health Technology Assessment is present to promote (early) assessment of the full benefits of new technology.

As trends and challenges in healthcare change over time, also the specific contents of all health programs constantly adapt. Overall, a large number of students are involved in these programs and health tracks and specialisations.

Strategic Partnerships

To use these opportunities strategic partnerships have already been effectuated. The faculty of BMS cooperates with a very large network of all kinds of healthcare institutions and partners. BMS attaches great importance to alliances with public and private parties, both from the region and elsewhere. Dual appointments of clinical and associate professors are in place. The BMS Health staff have clear anchor points on national research agendas (Nationale Wetenschaps Agenda, NWO- themes) and International health programmes (i.e. Horizon 2020).

Good contacts with healthcare institutions are vital in terms of:

- recognising and solving real-world problems;
- clinical expertise, in addition to methodological knowledge (bridging function);
- access to patients and to data;
- exchange of researchers and training students.

Formal strategic cooperation agreements have been signed with:

- The Comprehensive Cancer Centre of the Netherlands (IKNL) (Prof. Siesling, HTSR);
- Rijnstate Hospital, Arnhem, which is a member of ‘Samenwerkende Topklinische Ziekenhuizen (STZ)’ and of MProve, a network of 5 ambitious STZ hospitals (Dr Doggen, Prof. van Harten, HTSR – also chair of the Executive Board Rijnstate and Research group leader Netherlands Cancer Institute (NKI));
- Jeroen Bosch Hospital, 's Hertogenbosch, also a STZ hospital and MProve member (Prof. Kusters, HTSR);
- Medical Spectrum Twente, Enschede, a STZ hospital and Santeon member (Prof. von Birgelen, HTSR, Prof. Van der Palen, OMD, Prof. Van der Laar, PGT);
- Dimence Group, Mental Healthcare Institute (Prof. Bohlmeijer, PGT);
- Zorg Group Twente (Prof. van Gemert-Pijnen, PGT);
- University Medical Center Groningen (faculty of medicine, Prof. van Gemert-Pijnen, PGT);
- University of Waterloo (MOU, Canada; Prof. van Gemert-Pijnen, PGT);
- Transfore, Forensic Psychiatry (Prof. van Gemert-Pijnen, PGT);
- GGNet Mental Healthcare Institute (Prof. Westerhof, Prof. Bohlmeijer, PGT);
- Roessingh Research & Development, cluster Telemedicine (Prof. Schreurs, PGT).

All of the above healthcare institutions and university partners have a large volume of patients (leading to possibilities to work on and with ‘big data’), have already a longstanding relation with the faculty of BMS, and are eager to do scientific research, as is shown by the numerous PhD students that have finished their PhD in the last 10 years and researcher and student exchanges. For example, for almost 10 years faculty members cooperate successfully with the cardiovascular research group of Thoraxcentrum Twente, and the department of Rheumatology (MST, Enschede). Besides these strategic partnerships BMS has numerous other collaborations with many healthcare institutions, some of which last a few months, others several years and several are long-standing collaborations for over 10 years. These

concern joint research, PhD students working at the University and at a healthcare institution and student internships. The strength of the UT lies in this very independence, to be able to work with several different parties, and in the open-mindedness it entails.

In the regional context, BMS faculty cooperates with a Twente-based General Practitioner's association for the Eastern Netherlands (THOON), Twente-based Academic Collaborative Centre for Young People (AWJT), the Municipal Health Centre (GGD), district nursing and home care centers (e.g. de Posten), and the Nedap and Thales companies. BMS cooperates with organisations such as Livio, the Sint Maarten Care Group in care for older persons and GGNet, Dimence, Transfore, Mediant, Tactus, Human Concern, and the Roessingh rehabilitation centre in the field of mental healthcare.

There are also (inter)national collaborations with the University Medical Centers (University of Münster, Leiden University Medical Center, Erasmus Medical Center, University Medical Center Groningen), and organisations such as Buurtzorg, ZorgAccent, Amstelring, NEVI (the Dutch association for purchasing professionals), Medicinfo, and Intrakoop (the largest non-profit collaborative organisation for healthcare providers in the Netherlands).

Expertise within BMS

BMS has a great deal of knowledge that is applied in the Health domain. Our strength lies in the further integration of expertise in the main important levels in health, healthcare, health technology: individual, professional (inter-)organisational and societal. The trends and challenges we identified above can best be studied and addressed using this intergrated and interdisciplinary approach.

At professorial and department chair level, this involves the following (in alphabetical order):

- *Von Birgelen (HTSR)*: Innovations in the interventional treatment of cardiovascular diseases; assessment of novel technologies in registries and randomised trials; risk assessment and reduction; diabetes; gender aspects of diseases, symptoms, and treatment; patient perspective on care and research;
- *Bohlmeijer (PHT)* : promotion of mental healthcare using technology, rehabilitation, outpatient treatment, intervention techniques, personalisation of healthcare;
- *De Jong (CS)*: health and healthcare communication, public health campaigns
- *Doggen (HTSR)*: clinical epidemiology, innovative technology, health services research, quality of care, healthcare pathways, organisation, cardiovascular diseases, emergency services;
- *Van Gemert-Pijnen (PHT)*: Persuasive Health Technology; Participative development (user and stakeholder involvement); Design for engagement and adherence to support self-care (Diabetes, Heart Failure; Dementia; Forensic mental Health) and safe care (Infectious diseases) (chairholder retires 2020).

- *Hans (IEBIS)*: healthcare operations management, development and optimisation of healthcare planning and control, facility management, logistics in major disasters;
- *Van Harten (HTSR)*: Quality Management and Healthcare Technology. Improvement in hospital operations, especially oncology. Early stage assessment and evaluation of safe and successful technology implementation in curative medical care. E-Health, shared care and process improvement in especially oncology;
- *Kusters (HTSR)*: Economics of laboratory diagnostics. Effectiveness of innovative and current diagnostic technologies on healthcare delivery and patient outcome. Early health technology assessment of innovations in laboratory diagnostics. Improvements of diagnostic pathways by implementation of innovative technology, datamanagement and diagnostic services;
- *Van de Laar (PHT)*: Patient perspective central in Healthcare, Psychosocial aspects of rheumatic diseases, Improving quality of healthcare through innovative information technology, Collecting and monitoring patient-reported data, health assessment, health outcome research, patient reported outcome measures;
- *Need (PA)*: public health innovations, youth care, prevention;
- *Van der Palen (OMD)*: pulmonary medicine, self-management of asthma and COPD, big data analysis, machine learning, and diagnostic research into bacterial infections, chemical technology, home care, clinical epidemiology, behavioural interventions, diagnostics research, computer adaptive testing;
- *Sanderman (PHT)*: supporting health psychology with technology, E-health, behavioural support from both therapists and patients; (chair ad interim until July 2018)
- *Schreurs (PHT)*: using technology in diagnostics and treatment of chronic pain and fatigue, E-health, Self-management, Personalised care; (retires July 2018, succession under construction)
- *Siesling (HTSR)*: outcomes research, decision support, tailor-made cancer care, organisation of cancer care, variation between hospitals, clinical epidemiology;
- *Telgen (TMS.)*: public procurement among others in local care (chair retires 2018)
- *Torenvlied (PA)*: macro health systems, network organisation, local and regional care;
- *Veldkamp (OMD)*: health analysis, health assessment, computerised adaptive testing, personalised healthcare, data/health analytics, decision-support;
- *Verbeek (PHIL)*: ethics, philosophy, emerging technology

- *Westerhof (PHT)*: narrative technology that supports patient-centered care; design and evaluation of e-health in the fields of aging and mental health; big data analytics and science of verbal and nonverbal behaviors; patient perspective;
- *IJzerman (HTSR)*: health services research (accessibility of organisation, care systems), health technology assessment (testing new products and medications), significance for patients and healthcare providers, personalised medicine, molecular diagnostics, discontinuation of treatment, implementation of guidelines, compliance by physicians and patients. (part time chair as of May 2018)

Future Investments

To enhance the strategic partnerships and to bridge specific expertise areas of the existing professorships, augmenting the Health domain at BMS – in relation to other faculties – is both feasible and desirable. This conclusion is supported by BMS's contribution to Health Education at the University of Twente. We opt for four Tenure Track and Professorial positions. Below these are described in a few lines. An elaborate description of these positions can be found in the appendix [\[aanvulling decaan volgt\]](#).

The four Tenure tracks/Professorial positions are related to the BMS Health, Healthcare and Health Technology ambitions to develop integrated healthcare systems, to make use of the possibilities that 'big data' offers, to promote personalised, tailor-made healthcare and to develop persuasive health technologies to improve health & wellbeing, and to create and transfer knowledge in the area of healthcare procurement.

Healthcare systems engineering (1.0)

BMS excels at research into the services and systems side, especially in assessments of technological developments at all stages of the translational research chain. In the Health domain, there is a greater need than ever before for new strategies for coordination and other forms of systems integration. The field of analysis is evolving in the direction of community-based distributed systems and networks for healthcare. This evolution is being driven by technology and by the individualisation of care and services. This is an ideal area in which to excel and from which to establish links between departments and with other faculties.

Data-driven health services research in teaching hospitals (1.0)

Academic hospitals are increasingly focusing on rare diseases and high-tech interventions. However, the majority of patients are treated in general hospitals, thereby concentrating huge amounts of data in these organisations. This concerns data which contain essential information of the "average" patient. The joint appointment of a professorship (50-50) with Rijnstate teaching hospital will provide the University of Twente access to large numbers of patients, research-oriented medical specialists and advanced data management. Especially the use of advanced methods to strengthen health services research in the clinical practice setting with data mining, -analytics and algorithm construction is a promising field of cooperation between Rijnstate and the University of Twente. It has great significance and added value both for parties in medical practice and from the point of view of modern health analytics and methodology development. Rijnstate Hospital will, in turn, obtain access to the university's academic environment as well as a boost to its in-house scientific infrastructure. In this regard it can be relevant that Rijnstate is leading the datamanagement track in the mProve cooperation, a cooperation between 5 topclinical teaching hospitals (Albert Schweitzer ziekenhuis in Dordrecht, Isala in Zwolle, Jeroen Bosch Ziekenhuis in 's-Hertogenbosch), Máxima Medisch Centrum in Veldhoven and Rijnstate in Arnhem.

Health psychology and persuasive technology (1.0)

The aim of this professorship is to innovate health and healthcare with persuasive technology strategies integrated with health psychology theories and models. The chair will operate in the area where social sciences interact with engineering sciences. Accordingly, this will require an interdisciplinary approach in education and research. Persuasive Technology is seen as an essential element in the promotion of tailor-made health and healthcare. This Tenure Track will build on current developments in health psychology

and persuasive health technology. The goal is to develop innovative, adaptive and tailor made solutions for personalised health, with the involvement of the public, patients, professionals and other stakeholders. Technology will provide the infrastructure to develop persuasive technology to support the monitoring and coaching of psychological and behavioural processes (both implicit and explicit) in members of the public, patients and professionals. This involves the use of technologically innovative and motivational measurement methodology, and the use of technology as a way of collecting, analysing and translating big data into behavioural interventions.

Healthcare procurement (0.6 – 1.0)

The main focus of the Tenure Track/Professorship will be knowledge creation and knowledge transfer in the area of healthcare procurement. The chair will cooperate with HTSR, IEBIS (CHOIR), and PA, by tackling research into – and the improvement of – healthcare operations. The fields of study involved are 1) Group purchasing in the healthcare sector and 2) Purchasing process improvement in the healthcare sector. Under the impact of far-reaching technological developments and conditions, as well as transformations in the provision of (local) care, this domain is increasingly being seen as one of the grand challenges in international socio-technical and socio-economic development. NEVI and Intrakoop have expressed an interest in formal cooperation, and are prepared to provide funding. The University of Twente can realistically expect this Tenure Track to transform it into the central procurement hub for Dutch healthcare research.

Detailed profiles are available for these four chairs. The individuals appointed to these positions will be expected to make active contributions towards strengthening the health domain within BMS, in relation to developments at other faculties and ‘New Style’ University of Twente institutes.

Talent development

In addition to these plans and aspirations at the level of Tenure Track, various new appointments involving PIs, Postdocs and Assistant Professors are envisaged over the next few years. Also, it is anticipated that vacancies will arise due to mobility within the faculty and to the growth of various teaching programs with a strong health component. As a result, it will be necessary to recruit new talent to ensure the future development of the faculty. Its appeal lies in the ability to offer enormous freedom and extensive facilities, self-evidently broad themes, an effective infrastructure, and the opportunity to operate within a large group that has sufficient ‘critical mass’ to sustain a major focus at national and international level. This will make it possible to develop an integrated, overall strategic HRM plan for the Health@BMS domain. Linking the recruitment of Tenure Track and Full Professors to the broader recruitment of new talent for the health domain at BMS will also strengthen the University of Twente’s position in the labour market.