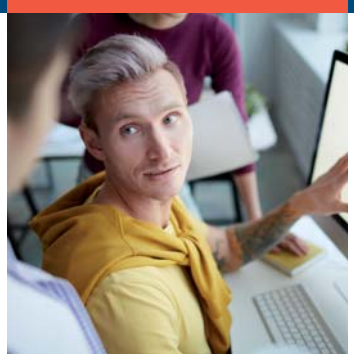
Memorandum
“Work and Technology 4.0 in Professional Care”

Paul Fuchs-Frohnhofen, Andreas Blume, Kurt-Georg Ciesinger,
Helga Gessenich, Manfred Hülsken-Giesler, Michael Isfort,
Marc Jungtäubl, Andreas Kocks, Martina Patz, Margit Weihrich

Memorandum



Imprint

Memorandum “Work and Technology 4.0 in Professional Care”
ISBN 978-3-9820402-4-0
2nd Edition, November 2018

Karl-Carstens-Straße 1, 52146 Würselen, Germany
Photo: fotolia.com

This memorandum is the result of the cooperation by five research groups in the funding priority initiative “Preventive measures for safe and healthy working tomorrow” from the German Federal Ministry of Education and Research:

- “empCare – Care for carers: development and establishment of an empathy-based relief concept in care work” (FKZ 02L14A150 - 02L14A153) represented by Andreas Kocks, Nursing Scientist at the University Hospital Bonn
- “ITAGAP – Technique and Work Process Development for Health in Outpatient Care” (FKZ 02L14A240 - 02L14A243)
- “Pflege-Prävention 4.0 – New models for prevention in the care of the elderly against the background of occupational biography orientation, diversity of services and high-tech” (FKZ 02L14A180 - 02L14A184)
- “PräFo – Prevention of stress and strain in formalised work in services and technical development” (FKZ 02L14A250 - 02L14A253)
- “Stress-Rekord – SeriousGame-based information and learning environment for reducing physical and psychological stress amongst caregivers” (FKZ 02L14A230 - 02L14A233)

This collaboration within the scope of the focus group, “New Approaches to Occupational Health and Safety in the Care and Services Sector”, formed the basis for discussions on the future design of “Work and Techniques 4.0” in care. The result of these discussions can be found in this memorandum. The research and development projects are funded by the German Federal Ministry of Education and Research (BMBF) as part of the research programme, “Innovations for the Production, Services and Work of Tomorrow” and overseen by the Karlsruhe project management agency (PTKA). Responsibility for the contents of this publication lies with the respective authors.

SPONSORED BY THE

Federal Ministry
of Education
and Research

Memorandum
“Work and Technology 4.0 in Professional Care”

Part A: Summary

The following memorandum “Work and Technology 4.0 in Professional Care” represents the joint positioning of the signatories for the sustainable, long-term design and implementation of technical innovations in the field of nursing care.

The starting point for this statement is an understanding of care as interactive work for and with people that requires special organisation and valuation.

The undersigned agree that nursing staff should benefit more from technology than in the past. To this end, they must be involved in the design of the technology that concerns them and their actual practical work.

This is the only way to ensure that employees can benefit from the increasing use of technology in professional nursing practice. So far, there has been empirical evidence of inadequate integration of professional care in technology development and introduction processes. In this way, the innovative potential of new technologies in care work is not being utilised with a view towards the future.

For successful organisation of Work 4.0 in nursing, consistent, interdisciplinary and targeted development, introduction and impact assessment of socio-technical innovations together with professional nursing are required. The use of technology in nursing work must have a preventive and continuous supporting effect in the interest of health and the “good work” of caregivers as well as in the interest of the quality of life of care recipient.

The undersigned of this memorandum propose:

- to recognise the special importance of care work as interactive work, to evaluate it (also economically!) and to consider it in every change process,

- to examine existing care-supporting or care-relevant technology, to subject it to critical examination and to adapt or introduce it to promote job satisfaction and wellbeing, respectively,

- to develop and implement processes for technical support in professional care as socio-technical innovation processes,

- not only to develop technical functionality, but also to consider the integration of new technologies into nursing work and organisational processes, including their specifics, in a timely and adequate manner,

- to explicitly involve the relevant actors in nursing care in these processes and to plan sufficient resources for their participation and qualification,

- to define practical testing as an important success criterion for new technologies in nursing,

- to develop suitable measures to mitigate existing pressures and future risks to which care workers are exposed as a result of the (digital) technology-driven formalisation of work processes,

- to recognise the improvement of health as well as the work and quality of life of both caregivers and care recipients as target criteria for the use of technology,

- to make technology assessments that take into account the intricacies of professional nursing as an integral part of technology development in the field of nursing care.

The memorandum is addressed to politicians and associations, to managers and employees in care institutions and to companies in the field of care-related technology development; it is also addressed to research sponsors, foundations and the scientific community.

We call on the responsible actors to take these suggestions into account when developing, planning and introducing new technologies for improving the organisation of Care Work 4.0.

We expect politicians to create appropriate framework conditions for nursing work and to take the above-mentioned guidelines into account when developing tenders and funding programmes.

Memorandum
“Work and Technology 4.0 in Professional Care”

Part B: Extended Version

1. About this Memorandum

This memorandum is the culmination of cooperation between five research alliances under the funding priority “Preventive measures for the safe and healthy work of tomorrow” by the German Federal Ministry of Education and Research. This collaboration within the focus group “New approaches to occupational health and safety in the care and service sector” formed the basis for discussions on the future design of “Work and Technology 4.0” in the care sector. The result of these discussions can be found in this memorandum.

This memorandum is to be widely published. The website http://www.memorandum-pflegearbeit-und-technik.de/ offers all those who support the content of this memorandum the opportunity to register on a list of endorser

2. The Care Service Sector

The creation and safeguarding of nursing care for the general population and the requisite (working) conditions for nursing staff are mega topics in the current social debate.

Key words such as:

- economisation (and commercialisation) in healthcare,
- reduction in the number of hospitals (i.e. centralisation),
- demographic change,
- increase in the need for care,
- increase in multi- and co-morbidity and chronic disease,
- decrease in family care capacities,
- further medical advances,
- digitisation and mechanisation in the context of Work 4.0,
- shortage of skilled workers or a state of nursing emergency and
- general nursing training as well as
- academising of care

characterise developments in all sectors of health- and care-related services, which present themselves as challenges but which, under certain conditions, (can) present opportunities. For professional caregivers, the current challenges in all care sectors focus on aspects of work concentration, patient and resident safety, as well as their own physical and mental health safeguarding - aspects that are only briefly described here.

The focus of nursing work is on the sectors of outpatient care, partial and full inpatient long-term care and acute care in hospital. As of 2016, around 1,950 hospitals were recorded. According to care statistics (2015), 13,300 outpatient care services and 13,600 partly and fully inpatient care facilities are registered nationwide.

The high number of facilities corresponds to a high number of employees in nursing profession

Looking at key figures from federal health personnel accounts, a total of 836,000 people are employed in the professions of health care and (child) nursing and 559,000 in the professions of nursing care for the elderly. Nursing professions are already considered to be in short supply today. Prognostic studies assume that demand will continue to rise and that there will be a growing shortage of professionally qualified staff.

Various research studies on occupational health and safety in the various nursing fields show that nursing is associated both with high physical stress (e.g. through lifting, carrying, storage, shift work) and with psychological stress. In some cases, nursing staff are only able to cope inadequately with this due to a lack of resources (scope for action, recognition, staffing).

The handling of people in sensitive, intimate and partly critical situations (patients, relatives), the experience of suffering, dying and death, as well as interruptions in work, lack of a holistic approach to work, fragmentation of work, high economic pressure and excessive volume of work as well as shift work and demarcation problems, all of which substantially belong to the occupational field, create strong stress patterns, which are often already apparent among younger nurses.

At the same time, continuous processes of increasing digitalisation of medical technology, administration and logistics in the healthcare sector are underway, which also have pertinent effects on nursing work.

This memorandum aims to encourage the design of future development and introduction processes for technology that affects nursing work in such a way as to reduce stress and improve job satisfaction.

3. Understanding the Professional Care Service

Definitions and theories of care cannot be set out in detail in this memorandum. In order to understand the text as a whole, however, a few selected aspects should be mentioned which appear relevant from the authors' perspective to classify possibilities and limits of supporting nursing work through technology-oriented innovations from a starting point.

Care as a professional service includes all aspects of preventive, rehabilitative, curative, palliative and compensatory care of people with existing or anticipated needs[1]. It comes not at the end of the care chain, but rather intervenes at all times of health and care-related processes in acute and chronic conditions using professional concepts. Furthermore, nursing work also has to take into account social care aspects – also with respect to the goals of the new concept of nursing needs[2]. Professional care is thus intrinsically tied to the interaction between the (health) system and the world in which people live (the recipient of care).[3]

In order to make decisions, implement and verify suitable nursing interventions, nurses have a clinical ability to assess the complexity of the particular situation, the problems at hand and the wishes of patients or residents (internal evidence). Findings from occupational science point out that in this context interactive work (cooperative work, emotional work, empathetic work and subjective work action)[4] and – associated with this – situational action as well as informal practices are of particular importance. Situational-related action in specific interaction matches the nursing staff with the respective current knowledge of the identified problem (external evidence).

Nursing action is thus based on a case-oriented combination of findings from research and the specific situation of the person in need of care. Like medicine, nursing can derive and justify its particular duty exclusively from this "double-sidedness" of a scientifically as well as practically based determination of the situation. It also fulfils its social duty of mediating medically and socially oriented treatment and socially oriented nursing exclusively via this "double-sidedness" of scientific foundation as well as empathic, situational interaction work.

Such an understanding of professional nursing work points to the fact that nursing cannot be described alone by performance-oriented activities and individual achievements, but represents a complex professional achievement for existentially affected people.

---

[1] Ströbel und Weidner 2003
[2] Wingenfeld und Büscher 2017
[3] Hülsken-Giesler 2015
[4] cf. e.g. Böhle et al. 2015

4. The Importance of New Technologies in Professional Care

The application of new technologies is regarded as an important strategy to meet the challenges of professional care outlined above. Initial development cycles focus primarily on functional support for nursing work[5] (e.g. in the area of nursing documentation, technologically assisted recording of vital parameters, physical relief, etc.).

Increasingly, however, this development is also aimed at supporting educational, advisory and informational services for professional carers.[6] It is expected that these technologies will play a significant role in health and care in the future as they have, on the one hand, the potential to increase the autonomy of people in need and, on the other hand, to contribute to the mental and physical easing of the burden on carers.[7]

The use of technologies in nursing is justified in many places by the expectation that it will make a contribution to compensating for the shortage of skilled nursing personnel. At the micro level, nursing technologies also explicitly target aspects of quality development, be it through systems that contribute to error prevention (e.g. in the area of drug management), be it through an improvement in the quality of nursing planning or even through enhanced networking among nursing staff (personnel control, work process control) and with other service providers (interdisciplinary and inter-sectoral communication).

Most new care technologies currently being developed via external subsidies are still in the pre-market phase, but a number of products have already reached market maturity.[8] Digital information and communication technologies also play an important role in many care-related technologies in the fields of documentation, assistance, mobility support and spinal support, sensor technology, robotics, actuators or telecare, and so on[9]. In view of the current state of developments, the following assessments are made in the field of nursing care:[10]

- ICT-supported care technologies are a relevant area of development for care providers.
- So far, project development has focused on direct support for service recipients.
- There are more ICT solutions for out-patient and acute care than for long-term in-patient care.
- The technology perspective and not the application perspective dominates ICT projects in nursing.
- Caregivers are inadequately involved in technology development and technology implementation processes.
- Technological language dominates technology development and implementation, while there is no link between language and everyday nursing topics.
- The lack of further and advanced training programmes in the field of technical competence potentially hampers the digitalisation of nursing.
- The ICT-based exchange of information between actors in the care and health sector is insufficient.
- ICT care solutions have thus far encountered a lack of acceptance.
- ICT solutions in nursing (such as the digitisation of nursing care as a whole) are inadequately communicated and/or are inadequately practical and practicable, with the result that acceptance on the part of nursing staff is reduced and the meaningfulness of technology (its use) is not made apparent.

[5] Weiß et al 2013
[6] BMG 2017
[7] Bundesanstalt für Arbeitsschutz und Arbeitsmedizin 2015
[8] cf. e.g. Bundesministerium für Gesundheit 2013; Wegweiser Alter und Technik [o.J.]
[9] cf. Rösler et al. 2018; Bräutigam et al., 2017
[10] cf. e.g. BMG 2017, Fuchs-Frohnhofen et al. 2017b u.c, Krings et al. 2012, Merda et al. 2017, Elsbernd et al. 2014

- The ability of ICT solutions to be invoiced and refinanced poses challenges.
- Security and protection of personal data are decisive for the acceptance of ICT solutions in nursing care.
- Beneficiaries call for greater involvement in technology development and improved information.
- Caregivers call for better networking of actor groups and more support in the utilisation of ICT solutions.

In this context, the concerns set out in this memorandum are of particular relevance.

5. Work 4.0 in Nursing – Technology Supports Nursing Work Processes

Decision-makers in the various care sectors have the responsibility, together with carers, to review existing care support technology and, amongst other things, to implement it in order to promote job satisfaction and wellbeing.

There are already many technical aids on the market today that have the potential to positively support the work of nursing staff and the life situation of people in need of care[11].

Mechanical/electrical support can relieve strain on the body, especially with regard to back strain caused by typical postures, especially during lifting and holding work in the context of nursing activities[12]. For example, mobile standing aids can provide a large proportion of the power needed to mobilise the patient[13].

In addition, a user-oriented approach to technology also offers the opportunity to reduce psychological stress: Technologies used to monitor, prevent and support patients and employees that, for example, reduce the risk of falling of those being cared for, can reduce the frequency and/or severity of the caregivers' confrontation with these psychologically stressful situations as well as the feeling of stress caused by unsafe situations. This applies in particular, for example, to the monitoring of (life-saving) vital parameters. Similar results are associated with other monitoring applications that provide caregivers with information about the activity of patients or residents with restricted mobility or poor orientation as well as support their safety, even in the absence of a caregiver[14].

For this reason, this memorandum seeks to encourage the increased examination of existing nursing support technology and its implementation to support nursing staff. In doing so, attention should be paid to the tangible consequences of using this technology for practical work activities and any (new) unintended side effects associated with it.

[11] cf. Weiß et al., 2013, https://www.wegweiseralterundtechnik.de
[12] cf. Landau et al. 2014
[13] Weiß et al. 2013, p. 115
[14] Sowinski et al. 2013, p. 40

Development and implementation processes for technical support in professional care are to be conducted as socio-technical innovation processes.

In the interim, it has often been pointed out that previous efforts to develop new technologies for nursing care do not take sufficient account of actual healthcare-oriented and profession-specific nursing needs[15].

More generally, innovations in the field of healthcare and nursing are regarded as "innovations in healthcare that represent an improvement compared to what already exists for at least some of the actors"[16]. Social innovations are needed that "generate new social practices that respond to the needs of nursing and social professions and act as a significant support in solving different problems in the context of work"[17]. In the future, however, it will increasingly be a question of thinking and designing care in terms of a "reflexive production of the new"[18]. Reflexive Innovation in nursing means the consideration of practices, guidelines and processes in nursing as well as the interplay of developments and dynamics (e.g. professionalisation, civic engagement and technology development) in the field of action, "whereby the course of one innovation is observed, shaped and managed with respect to its various institutional embeddedness, discursive justifications and with respect to the forms and courses of other innovations"[19].

Innovation in nursing – particularly innovation via technical improvements – must therefore be conceptualised against the background of reliable insights into the conditions prevailing in the field of activity, taking into account the many factors influencing nursing care, in relation to further dynamics in the professional field and in society as a whole. Technology development in nursing thus has to consider the complex socio-dynamic context of using technology and, as a socio-technical development, particularly the consequences (and unintended side effects) of its development.

Technological development is successful in the long term if elements of implementation into organisational and working systems are anticipated. In this respect, nursing facilities should be understood as socio-technical systems: "Human work activities mainly take place in work systems that consist of a social and a technical subsystem, each of which has to be analysed separately and in its relationship to one another, but must be structured jointly"[20].

The implementation process of new technology for nursing work should be structured in such a way that, taking into account findings from the field of ergonomics, the nursing work process is improved both with regard to the interaction between nurses and technology as well as between nurses and those in need of nursing care and their relatives; the use of technology is adapted to the environmental conditions; and implementation is perceived as a management task[21].

It is important not only to develop technical functionality, but also to take sufficient account of the integration of new technologies into nursing work and organisational processes in a timely manner.

A primarily additive integration of new technologies in nursing does not come close to meeting these challenges – even if fragmented evaluation processes can be ensured. Particular attention should be paid to ensuring that questions of process analysis, work process development and organisational development in nursing and beyond in the overall organisation are observed sustainably and systematically. This is in order to identify and communicate actual (and where appropriate technology-supported) innovations in nursing as well as undesirable developments at an early stage.

[15] cf. e.g. BMG 2017; Elsbernd et al. 2014; Krings et al. 2012
[16] Heyen und Reiß 2014, p. 245
[17] Hinding und Kastner 2015, p. 2
[18] Hutter et al. 2011
[19] Ebd., p. 7
[20] Ulich 2013, p. 4
[21] cf. Fuchs-Frohnhofen et al. 2017a, p. 34

The relevant actors in care must be expressly involved in these processes of technology development and implementation (alongside those in need of care and their relatives, for example), and sufficient resources must be made available and taken into account for involvement and qualification.

The participatory involvement of all process-relevant actors, especially the carers themselves, is an essential prerequisite for effective innovation processes in nursing support technology. This also includes enabling the actors involved to participate in processes of technology development, utilisation and evaluation. The characteristics of the technologies presented and their conditions of use will result in long-term demands on the skills required of potential users. In addition to determining the competencies that carers and other users require in dealing with equipment, machines and technical solutions, there is also the task of integrating them into initial, further and advanced training[22].

One step towards identifying the future requirements for those involved in technically supported care is recognition that the use of these technologies in the respective work contexts can lead to significant changes in work and communication processes, responsibilities and jurisdictions, which are also linked to the actors' professional self-perception[23].

For some time now, the importance of computer literacy for the performance of care activities has been emphasised: "The rapid expansion of such technology into every aspect of modern nursing suggests that the 21st century nurse must establish and maintain computer competency"[24].Research work with the aim of developing a competency model for nursing staff, such as that of the Informatics Competencies for Nurses, which was anchored as the result of a Delphi study for three competency levels and four practical levels, also shows a strong connection to basic knowledge of computer science and data processing[25].

Based on this expert assessment, the proposal has been developed to initiate corresponding qualification processes across the spectrum of nursing education with the following objectives,

- to apply basic knowledge on the subjects of technology and informatics during nursing training and to anchor an examination of issues relating to nursing informatics as part of initial, further and advanced training (in particular in the area of academic primary qualifying training), and
- to establish technology-specific specialisations within the nursing profession in order to train multipliers and networkers in order to enter into a dialogue with representatives of technology development and application.

In addition, the aim should be to give nurses the opportunity to further their education in such a way that they can classify, assess and reflect on the introduction and use of new technologies in nursing work contexts and, if necessary, pass them on to other persons[26].

Ultimately, caregivers should and will define for themselves how the understanding of their own profession develops in this regard.

Practical experience must be defined as an important success criterion for new technologies in nursing care.

Today, innovation projects for the development and implementation of new technologies in nursing often end too early. Promising utility models are proposed, but their everyday application in

[22] cf. Hülsken-Giesler 2010, 2017
[23] cf. e.g. Manzei 2009; Remmers und Hülsken-Giesler 2007; Courtney et al. 2005; Badura und Feuerstein 1996
[24] Hobbs 2002, p. 63
[25] Staggers et al. 2002a, 2002b, 2001
[26] Hülsken-Giesler and others use the terms content-related-cognitive, social-communicative, emotional and reflexive competences (BMG, 2017, p. 67), cf. also the discussion on "participation qualification" in older work on user-oriented technology design (e.g. Sell/Fuchs-Frohnhofen, 1993, p. 102)

real work processes over a longer period of time is not evaluated. Practical testing should be defined as an important success criterion for new technologies, even in publicly funded projects for technology development and implementation. If there is a case for any innovations under competition and subsidy law, this should also be addressed.

Suitable measures should be developed to reduce existing burdens and future risks to which nursing staff are exposed as a result of the (digital) technology-driven formalisation of work processes.

Those who work in nursing understand that work processes are becoming increasingly formalised. Everything a nurse does should be documentable, justifiable and formally communicable. Due to their formalistic character, digitalisation and technical development are also driving this process forward. This is further reinforced by the fact that the use of equipment itself is formalised.

Still, employees get into a dilemma if they have to comply with formal requirements and simultaneously work with people. That is because nursing work is always interactive work. Situational activity, feelings and a sensitivity for the condition of the people to be cared for play an important role. All of this is put under pressure by the logic of formalisation. Nursing staff are faced with a special task: they have to constantly recreate scope for action, which is essential for interactive work, and establish elaborate strategies for this – this is stressful and does not always succeed. Good work, employee health and – in the worst-case scenario – the health of the people to be cared for are endangered.

It is vitally important to develop design measures for (technically) formalised work in nursing. Firstly, the special skills of employees in interactive work must be recognised; this also includes the skills needed to integrate formalisation requirements into interactive work. Secondly, formalised specifications and processes must be adapted to the requirements of interactive work; this includes in particular securing scope for action. And thirdly, employees must be involved in the evaluation and design of existing and new guidelines and processes; they are the experts in their work and know best what facilitates and hinders good work (and thus also good care)[27].

The improvement of the health and quality of life of caregivers and persons in need of care is to be recognised as a target criterion for the use of technology.

The health and well-being of the caregiver and the person being cared for must be an essential target criterion of the use of technology. Socio-technical design processes must therefore be combined in principle with prospective assessments of the consequences for the health of employees (in the sense of the WHO definition). The legally enshrined risk assessment – applied preventively – is a suitable instrument for the design of good, low-impact and healthy work in the care sector, but one that must be constantly developed further against the backdrop of dynamics in the field of action.

A technology assessment taking into account the specific characteristics of professional nursing should be made an integral part of technology development in the field of nursing care.

Initiatives for the technical support of professional care must be accompanied and examined with a view to their medium to long-term effects in the field of application and, in particular, their interactions with other development and innovation dynamics. In particular, unintended side effects should also be taken into consideration. Only on the basis of these findings[28] can further development demands be derived from the field of activity.

[27] cf. Weihrich 2017; Jungtäubl et al. 2017
[28] cf. TAB 2017, DAA 2017, Steinmüller et al. 1999

6. List of authors

Dr.-Ing. **Paul Fuchs-Frohnhofen** is Managing Director of MA&T Sell and Partner GmbH and spokesman for the Federal Ministry of Education and Research focus group, "New Approaches to Occupational Health and Safety in the Care and Service Sector".

Andreas Blume is Innovation Consultant in the field of innovation management at Johanniter-Unfall-Hilfe e.V.

Kurt-Georg Ciesinger (Dipl.-Psych/Dipl.-Arb.wiss.) is Senior Project Coordinator at the Department of Development and Marketing at the Deutsche Angestellten-Akademie GmbH.

Helga Gessenich (Dipl.-Pflegemanagerin (FH)/MA) is a researcher in Dept. III at the German Institute of Applied Nursing Research (DIP).

Prof. Dr. **Manfred Hülsken-Giesler** (Univ.-Prof./Dr. phil.) holds the Chair for Community Care at the "Philosophical Theological College Vallendar" and is Dean of the "Faculty of Nursing Science".

Prof. Dr. **Michael Isfort** is Deputy Chairman of the Executive Board and Head of Dept. III at the German Institute of Applied Nursing Research (DIP).

The social and humanities scholar, **Marc Jungtäubl**, is a research associate and doctoral candidate at the "Research Unit for Socioeconomics in the World of Work and Employment" (Prof. Dr. Fritz Böhle) at the University of Augsburg.

Trained nurse, **Andreas Kocks**, works as a Nursing Scientist (BScN, MScN) at the Nursing Directorate at the University Hospital Bonn and is spokesman for the "Association of Nursing Directors at University Hospitals and Medical Colleges in Germany".

Martina Patz (occupational health and paediatric nurse/Social Work (BA)/Leadership in Social and Health Management (MA)) is a research associate on the "PräFo" sub-project, "Prevention of stress and strain in formalised work in inpatient nursing" in the nursing division at Augsburg hospital.

Dr. **Margit Weihrich** (Dipl.-Soz.) is a research associate at the "Research Unit for Socioeconomics in the World of Work and Employment" at the University of Augsburg.

7. Bibliography

Badura, B.; Feuerstein, G. (1996): Systemgestaltung im Gesundheitswesen. Zur Versorgungskrise der hochtechnisierten Medizin und den Möglichkeiten ihrer Bewältigung. Weinheim [et al.]: Juventa.

Bräutigam, C.; Enste, P.; Evans, M.; Hilbert, J.; Merkel, S. & Öz, F. (2017): Digitalisierung im Krankenhaus: Mehr Technik – bessere Arbeit? Study Hans-Böckler-Stiftung Nr. 364, Düsseldorf, p. 60

Böhle, F.; Stöger, U.; Weihrich, M. (2015): Wie lässt sich Interaktionsarbeit menschengerecht gestalten? Zur Notwendigkeit einer Neubestimmung; Arbeits- und Industriesoziologische Studien, Jahrgang 8, Heft p. 1, 37-54.

Bundesagentur für Arbeit (Hrsg.) (2016): Der Arbeitsmarkt in Deutschland – Fachkräfteengpassanalyse. Statistik/Arbeitsmarktberichterstattung, Juni 2016. Nürnberg: BA.

Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (Hrsg.) (2015): Intelligente Technik in der beruflichen Pflege. Von den Chancen und Risiken einer Pflege 4.0. Berlin: Bonifatius.

Bundesministerium für Gesundheit (2013): Unterstützung Pflegebedürftiger durch technische Assistenzsysteme. Abschlussbericht. Berlin: VDI/VDE Innovation + Technik GmbH.

Bundesministerium für Gesundheit (Hrsg.) (2017): ePflege. Informations- und Kommunikationstechnologie für die Pflege. Studie im Auftrag des Bundesministeriums für Gesundheit. Online verfügbar unter http://www.pthv.de/fileadmin/user_upload PDF_Pflege/Projektberichte/Roland_Berger_BMG_ Studie_ePflege_web.pdf, last checked 17.10.2017.

Courtney, K. L.; Demiris, G.; Alexander, G. L. (2005): Information technology: Changing nursing processes at the point-of-care, In: Nursing Administration Quarterly 29(4), 315-337.

DAA-Stiftung Bildung und Beruf (Hrsg.) (2017): Digitalisierung und Technisierung der Pflege in Deutschland – Aktuelle Trends und ihre Folgewirkungen auf Arbeitsorganisation, Beschäftigung und Qualifizierung; Hamburg: DAA.

Elsbernd, A.; Lehmeyer, S.; Schilling, U. (2014): So leben ältere und pflegebedürftige Menschen in Deutschland. Lebenslagen und Technikentwicklung. Lage: Jacobs.

Fuchs-Frohnhofen, P.; Altmann, T.; Döring, S.; Felscher, A.; Weihrich, M. (Hrsg.) (2017a): Neue Ansätze des Arbeits- und Gesundheitsschutzes im Pflege- und Dienstleistungssektor. Weimar: Bertuch

Fuchs-Frohnhofen, P.; Bogert, B.; Palm, G.; Kerger, K. (2017b): Anwendungschancen moderner IT- und AAL-Technik für stationäre Pflegeeinrichtungen. Forschungsbericht des ArWiSo e.V., Würselen, und der St. Gereon Seniorendienste, Hückelhoven. Würselen: Verlag der MA&T GmbH.

Fuchs-Frohnhofen, P.; Schlüpmann, J.; Ciesinger, K.-G. (2017c): Pflege 4.0 – Pflege-Arbeit 4.0 – Chancen und Risiken künftiger Entwicklungsszenarien zum Technikeinsatz in der Altenpflege. Online verfügbar unter https://www.researchgate.net/publication/320947686_Pflege_40_-_Pflege-Arbeit_40_-_Chancen_ und_Risiken_kunftiger_Entwicklungsszenarien_zum_Technikeinsatz_in_der_ Altenpflege, last checked 16.11.2017.

Heyen, N. B.; Reiß, T. (2014): Das Gesundheitswesen aus Innovationsperspektive: Acht Thesen und Handlungsmöglichkeiten. Teil 1. Sozialer Fortschritt p. 63, 245-252.

Hinding, B.; Kastner, M. (2015): Einleitung. In: Hinding, B.; Kricheldorff, C.; Kugler, C.; Kastner, M. (Hrsg.) (2015): Innovations- und Demografiemanagement in Gesundheits- und Sozialberufen. Lit-Verlag, p. 1-6.

Hobbs, S. D. (2002): Measuring Nurses' Computer Competency: An Analysis of Published Instruments, In: Computers, Informatics, Nursing 20(2), 63-73.

Hülsken-Giesler, M. (2010): Neue Technologien in der häuslichen Umgebung älterer Menschen – Anforderungen aus pflegewissenschaftlicher Perspektive. In: H. Remmers (Hrsg.): Pflegewissenschaft im interdisziplinären Dialog, Göttingen: Vandenhoek & Ruprecht unipress.

Hülsken-Giesler, M. (2015): Professionskultur und Berufspolitik in der Langzeitpflege. In: Brandenburg, H.; Güther, H. (Hrsg.): Lehrbuch Gerontologische Pflege. Bern: Hogrefe, p. 163-175.

Hülsken-Giesler, M. (2017): Dynamiken im Berufsfeld Pflege und Folgen für die Fachkräftequalifizierung. Berufsbildung in Wissenschaft und Praxis – BWP 1/2017, p. 6-9.

Hutter, M.; Knoblauch, H.; Rammert, W.; Windeler, A. (2011): Innovationsgesellschaft heute: Die reflexive Herstellung des Neuen. Technical University Technology Studies. Working Papers 4-2011. Online verfügbar unter https://www.ts.tu-berlin.de/fileadmin/fg226/TUTS/TUTS_WP_4_2011.pdf, last checked 17.10.2017.

IEGUS – Institut für europäische Gesundheits- und Sozialwirtschaft GmbH (Hrsg.) (2017): Entwicklung der Angebotsstruktur, der Beschäftigung sowie des Fachkräftebedarfs im nichtärztlichen Bereich der Gesundheitswirtschaft. Studie im Auftrag des Bundesministeriums für Wirtschaft und Energie (BMWi). Unter Mitarbeit von WifOR GmbH und IAW – Institut für Angewandte Wirtschaftsforschung e. V., Berlin, Darmstadt, Tübingen.

Jungtäubl, M.; Weihrich, M.; Daufratshofer, K.; Porschen-Hueck, S. (2017): Prävention von Belastungen bei formalisierter Arbeit in Dienstleistung und technischer Entwicklung - Das Projekt PräFo. In: Fuchs-Frohnhofen, P.; Altmann, T.; Döring, S.; Felscher, A.; Weihrich, M. (Hrsg.): Neue Ansätze des Arbeits- und Gesundheitsschutzes im Pflege- und Dienstleistungssektor. Weimar: Bertuch, p. 15-18.

Krings, B.-J.; Böhle, K.; Decker, M.; Nierling, L.; Schneider, C. (2012): Serviceroboter in Pflegearrangements. Online verfügbar unter http://www.itas.kit.edu/pub/l/t/ preprint.htm, last checked 17.10.2017.

Landau, K.; Diaz Meyer, M.; Weißert-Horn, M.; Jacobs, M.; Stern, H.; Raske, H.-W. (2014): Zur Belastung und Beanspruchung beim Patiententransfer von Schwerstpflegebedürftigen. ASU Zeitschrift für medizinische Prävention 49, 850-861. Online verfügbar: http://www.asu-arbeitsmedizin.com/ASU-2014-11/Zur-Belastung-und-Beanspruchung-beim-Patiententransfer-von-Schwerstpflegebeduerftigen,QUIEPTYxODAxOCZNSUQ9MTEwNTc2.html, last checked 13.03.2018.

Maier, T.; Afentakis, A. (2013): Forecasting supply and demand in nursing professions. Impacts of occupational flexibility and employment structure in Germany. In: Human resources for health 11, p. 24. DOI: 10.1186/1478-4491-11-24.

Manzei, A. (2009): Neue betriebswirtschaftliche Steuerungsformen im Krankenhaus. Wie durch die Digitalisierung der Medizin ökonomische Sachzwänge in der Pflegepraxis entstehen. In: Pflege & Gesellschaft, Heft 1, Jg. 14, p. 38-53.

Merda, M.; Schmidt, K.; Kähler, B. (2017): Pflege 4.0 – Einsatz moderner Technologien aus der Sicht professionell Pflegender; Forschungsbericht für die BGW, Hamburg.

Remmers, H.; Hülsken-Giesler, M. (2007): Zur Technisierung professioneller Pflege – Entwicklungsstand, Herausforderungen, ethische Schlussfolgerungen, In: Groß, D.; Jacobs, E. (Hrsg.): E-Health und technisierte Medizin. Neue Herausforderungen im Gesundheitswesen; Münster: Lit, 193- 212.

Rösler, U; Schmidt, K.; Merda, M.; Melzer, M. (2018): Digitalisierung in der Pflege. Wie intelligente Technologien die Arbeit professionell Pflegender verändern; Berlin: Geschäftsstelle der Initiative Neue Qualität der Arbeit. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin.

Rothgang, H.; Müller, R.; Unger, R. (2012): Themenreport „Pflege 2030". Was ist zu erwarten – was ist zu tun? Hrsg. v. Bertelsmann Stiftung. Gütersloh: Bertelsmann Stiftung.

Sell, R.; Fuchs-Frohnhofen, P. (1993): Gestaltung von Arbeit und Technik durch Beteiligungsqualifizierung. Opladen: Westdeutscher Verlag, p. 252

Sowinski, C.; Kirchen-Peters, S.; Hielscher V. (2013): Praxiserfahrungen zum Technikeinsatz in der Alten-pflege (Stand November 2013). Online verfügbar unter https://www.boeckler.de/pdf_fof/91394.pdf., last checked 12.3.2018.

Staggers, N.; Gassert, C. A.; Curran, C. (2001): Informatics Competencies for Nurses at Four Levels of Practice, In: Journal of Nursing Education 40(7), 303-316.

Staggers, N.; Gassert, C.; Curran, C. (2002a): A Delphi Study to Determine Informatics Competencies for Nurses at Four Levels of Practice; In: Nursing Research 51(6), 383-390.

Staggers, N.; Gassert, C.; Curran, C. (2002b): Results of a Delphi Study to Determine Informatics Competencies for Nurses at Four Levels of Practice. Finial Master List of Nursing Informatics Competencies. Online verfügbar unter http://www.nursing-informatics.com/niassess/NIcompetencies_Staggers.pdf; last checked 13.03.2018.

Statistisches Bundesamt (2017a): Gesundheitspersonal nach Geschlecht, Einrichtung und Beruf. Statistisches Bundesamt. Wiesbaden. Online verfügbar unter http://www.gbe-bund.de, last checked 02.11.2017.

Statistisches Bundesamt (2017b): Grunddaten der Krankenhäuser. Wiesbaden (Fachserie 12 Reihe 6.1.1). Online verfügbar unter http://www.gbe-bund.de, last checked 02.11.2017.

Statistisches Bundesamt (2017c): Pflege im Rahmen der Pflegeversicherung – Deutschlandergebnisse 2015. Wiesbaden (Pflegestatistik des Bundes). Online verfügbar unter http://www.gbe-bund.de, last checked 02.11.2017.

Steinmüller, K.; Tacke, K.; Tschiedel, R. (1999): Innovationsorientierte Technikfolgenabschätzung; in: Simonis, G.; Bröchler, S.; Sundermann, K.: Handbuch Technikfolgenabschätzung. Berlin: edition sigma, Band p. 1, 129-145.

Ströbel, A.; Weidner, F. (2003): Ansätze zur Pflegeprävention. Rahmenbedingungen und Analyse von Modellprojekten zur Vorbeugung von Pflegebedürftigkeit ; Zwischenbericht 2002. Hannover: Schlüter (Pflegeforschung).

TAB – Büro für Technikfolgenabschätzung beim Deutschen Bundestag (2017): Informationen zum Projekt „Robotik und assistive Neurotechnologien in der Pflege – gesellschaftliche Herausforderungen"; online verfügbar unter http://www.tab-beim-bundestag.de/de/untersuchungen/u106002.html; last checked 13.03.2018.

Ulich, E. (2013): Arbeitssysteme als Soziotechnische Systeme – eine Erinnerung. In: Journal Psychologie des Alltagshandelns 6 (1), 4-12.

Wegweiser Alter und Technik (o.J.): Karlsruhe: Forschungszentrum Informatik am Karlsruher Institut für Technologie. Online verfügbar unter https://www.wegweiseralterundtechnik.de, last checked 17.10.2017.

Weihrich, M. (2017): Interaktionsarbeit in der Krankenpflege. In: Gute Arbeit. Arbeitsschutz und Arbeits-gestaltung 9, 13-16.

Weiß, C.; Lutze, M.; Compagna, D.; Braeseke, G.; Richter, T.; Merda, M. (2013): Abschlussbericht zur Studie: Unterstützung Pflegebedürftiger durch technische Assistenzsysteme. Berlin: Bundesministerium für Gesundheit.

Wingenfeld, K.; Büscher, A. (2017): Strukturierung und Beschreibung pflegerischer Aufgaben auf der Grundlage des neuen Pflegebedürftigkeitsbegriffs. Fachbericht im Auftrag des Bundesministeriums für Gesundheit. Bielefeld: Institut für Pflegewissenschaft an der Universität Bielefeld.