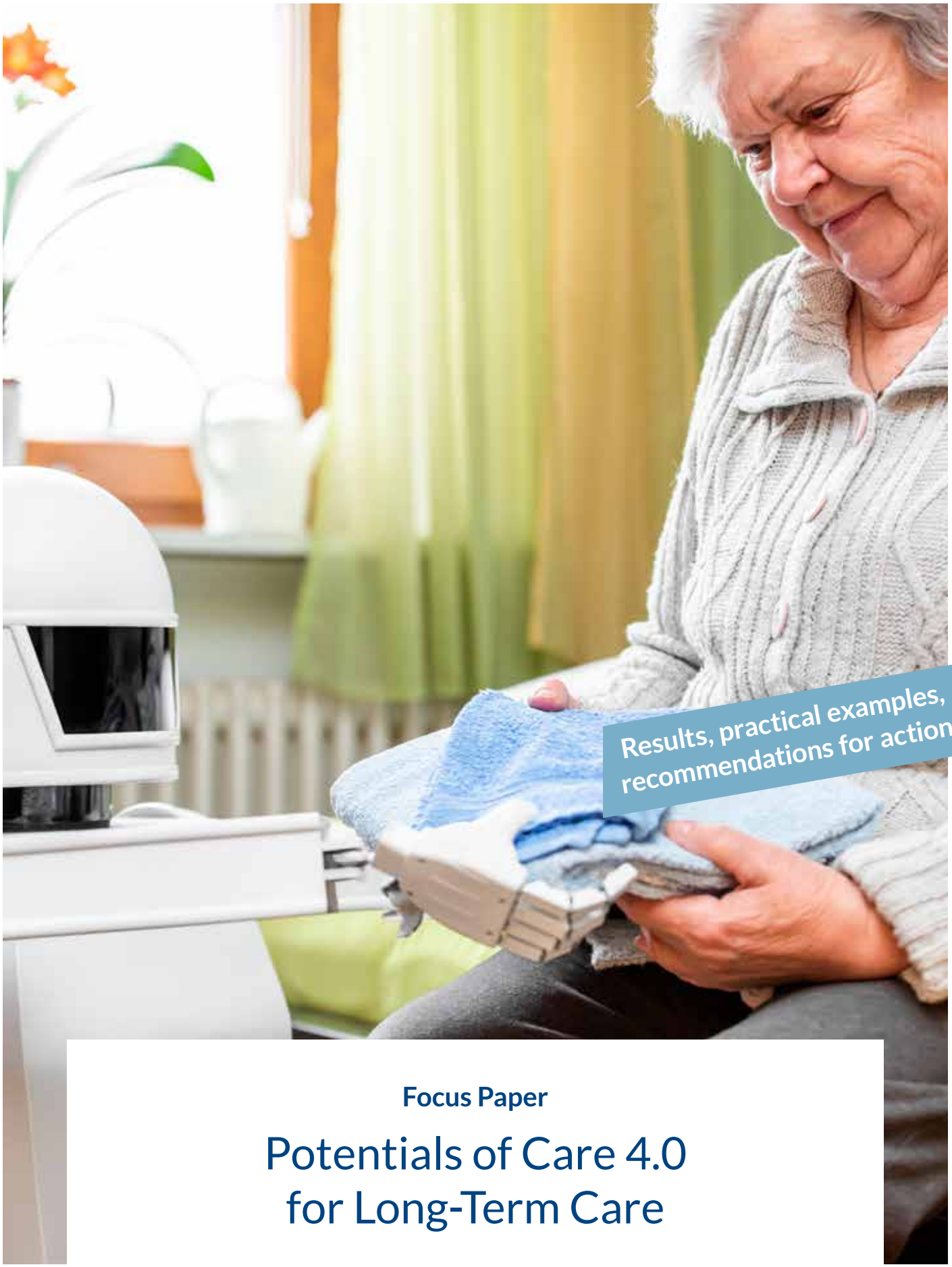

Results, practical examples, recommendations for action

Focus Paper

Potentials of Care 4.0 for Long-Term Care

BertelsmannStiftung

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Results, practical examples, recommendations for action

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Contents

1 Introduction

Germany's care system is facing some fundamental challenges in light of demographic trends, societal developments, and structural issues. Accelerated aging of the population is bound to increase the number of people in need of care in Germany from 4.2 million in 2019[1] to an expected six million in 2050.[2] With the care sector already struggling with a considerable personnel shortage, demographic factors are bound to render this lack of skilled workers ever more acute in future. The effects of demographic change are reflected in the caregivers' age structure as well: Nearly 37% of caregivers in geriatric care were at least 50 years old in 2017 (and numbers keep growing).[3] At the same time, the family care potential is declining. Relatives are the only caregivers for slightly in excess of half of the care recipients in Germany.[4] However, more and more people among the age cohorts that are going to enter old age in the next few decades, and that are likely to require care as a result, either have no children who may act as informal caregivers at all, or fewer descendants than previous generations did. At the same time, the distance between parents and their adult children has been growing for years due to increasing mobility.[5] In addition to suffering a personnel emergency, the care system is increasingly subject to financial pressure. The demographically induced rise in the number of people receiving long-term care alone is expected to more than double the expenditure of social long-term care insurance over the next two decades, and to roughly quadruple it by 2050.[6] At the same time, the working-age share in the total population is declining, as are their contribution payments and tax revenues.

While the demographic challenges are clearly going to impact the situation, in particular in the near future, the care system has already been suffering from structural issues for years. Working conditions in care are challenging, unattractive, and often stressful. Everyday working life there is characterized by a multitude of physical and mental demands, among them time pressure, shift work, high work intensity, and emotionally stressful situations. The DGB index "Arbeitsbedingungen in der Alten- und Krankenpflege" (Working conditions in geriatric and patient care) from 2018, covering the period from 2012 to 2017, states that nearly half the employees in care-related professions report that they have needed to accept a reduced work quality in order to be able to complete their job.[7] The perceived relevance of their profession, job security, and high intrinsic motivation of the care staff are not sufficiently compensating for such workloads in the long term. The sick-leave rate for employees in long-term care was 7.4% in 2017 (geriatric care: 7.5%) among those insured by the AOK, for example. This was far higher than in other professions (5.3%).[8] The BARMER Pflegebericht 2020 attributes the above-average periods of incapacity to work and early-retirement ratio to the high workloads as well.[9] The DGB index suggests that only a minority (general care professions: 22%, geriatric care: 20%) can imagine that they will continue to work as caregivers until they reach the statutory retirement age. The high mental and physical demands are compounded by comparatively low remuneration, in particular in long-term care. A "gender pay gap"[10] is evident in spite of the very high share of women working as caregivers (81% in healthcare and nursing, and 85% in geriatric care in 2017), though it is lower than on the overall labor market at 6.5%.[11]

New approaches must be found to improve working conditions and relieve the burden on care staff while helping to ensure high-quality care to make care sustainable in spite of these challenges. Expectations to the use of assistive technologies in handling the triangle of quality of care, quality of care work, and economic efficiency are high. However, caregivers view their work as being a rather "low tech" sector, where use of innovative technologies is not very advanced while social interaction takes the central position. Specific experience and systematic information on the effects that technology-supported care settings have on working conditions and quality of employment of nursing specialists is accordingly rare in the inpatient and outpatient areas alike. The influence of digital technologies on the quality of care is similarly little documented. The study "Potentials of Care 4.0 – How innovative technologies create relief and change the job satisfaction of nursing specialists in long-term care"[12] is to help reduce this knowledge gap while consolidating the discussion on "good work" and technology-based "Work 4.0" in inpatient long-term care. The Institut für Innovation und Technik used qualitative case studies to determine the effects that use of a variety of care technologies may have on the burden and relief of caregivers, the implications derived from this for the quality of work and care, and potential effects for Germany as a whole, based on quality-centric case studies in Germany and abroad on behalf of the Bertelsmann Stiftung.

This focus paper presents the key findings of our study in a condensed form. It starts out by offering a brief overview of the challenges associated with use of technology in care and the state of implementation of digital technologies in care practice, both in Germany and internationally. Subsequently, it points out the relief achieved by innovative technologies based on specific case studies conducted in Germany and abroad. It names preconditions as well as recommendations for action to allow even better realization of the potential effects shown in German care practice in the future.

2 Care and Digital Technologies – a Relationship Subject to Many Pre-requisites

2.1 Challenges in Using Technology in Care Settings

Care work is characterized by person-centric activities on and with people, essentially comprising interaction work and knowledge-based work. Interaction work refers to control of the interaction between the care staff, care recipients, and other relevant actors (e.g., doctors or relatives) along with the emotional work performed with the people in need of care, targeted at strengthening their emotional constitution and resolving conflicts. Interaction work poses particular emotional challenges for caregivers since it demands an emotional, open, situation-related approach that can barely be pre-structured, as well as an adequate way for the staff to deal with their own feelings. On top of this, advance planning is not fully possible here. The other person – the care recipient, the relative – frequently turns out to have some situation-related and, as a result, unpredictable needs. This lack of plannability prevents well organized work processes subject to the greatest possible efficiency or standardization. This kind of work is mentally demanding as well. Knowledge-based work, on the other hand, encompasses care and medical activities based on scientific findings. Caregivers must combine knowledge-based work based on generally accepted rules with the peculiarities and needs of every individual situation in their professional work. On top of the work performed on the person, scheduled rational work, including activities away from actual care and administrative routine tasks (documentation of performance records, preparation of medical care, etc.) form a substantial and time-intensive part of care work.

Use of digital technologies in interaction work comes with a risk of excessive formalization and standardization of activities at the expense of aligning care work with the situational needs from case to case. One possible consequence would be that interpersonal interaction, and the identity- or meaning-inspiring core of care as a result, may be marginalized. Another risk is that technology may become a disruptive artefact in the day-to-day care environment, standing in the way of interaction between the caregiver and care recipient. On the other hand, digital technologies (e.g., complex digital documentation systems, video telephony, smart TV) have the potential of promoting or improving communication and cooperation between caregivers and other stakeholders as well as relatives. Finally, sensor systems for motion analysis or fall prevention may help with handling unforeseeable incidents in everyday care.

Knowledge-based and physical work in particular can probably be supported well by digital technologies. For example, digital documentation or sensor systems bring a potential of obtaining additional information on care recipients, thereby improving care planning and assessment of care outcomes. A broad basis of information facilitates even predictions concerning the further course of development. Using different technologies also multiplies the options for delivering care interventions. However, this requires that caregivers be familiar with the systems that are suitable from case to case, as well as their potential effects. As is known from other sectors already, there also is a risk that the interaction of (partly) automated systems and people may lead to too little or too much trust in automation or in a

loss of situation awareness or manual skills ("de-skilling") in care.

The public discourse on the use of technology in care considers planned rational action the part of care work with a higher degree of standardization that can be supported, or at times even entirely replaced, by technology. Digital documentation, for one thing, simplifies the process of recording or ordering medication while reducing work effort.

2.2 Digital Technologies in Domestic and International Long-Term Care

Progress in use of technology is evident in care as well, even though this industry is not considered as technology-compatible as many others. The parties involved are willing to adjust processes on many levels – no matter if we are looking at the facilities directly, federal and state ministries (mostly in the form of subsidy projects), or the laws.[13] Studies also reflect an increasing curiosity and positive attitude of people in the care sector towards digital technology.[14] Technologies will only be accepted, however, if they support cooperation in everyday working life, design and development opportunities for caregivers, and their ability to reconcile their work with other areas of their lives.[15] At the same time, concerns prevail that digitization may negatively affect this kind of work, e.g., due to increased time pressure, redundancies, and closer monitoring. A recent survey by the IGES Institute showed that digital technology in long-term care facilities in Germany is found more commonly in the areas of administration and organization as well as in full inpatient care to date. The areas of care and support as well as the day-care and outpatient sectors are less developed here.[16] Technical systems are used in particular for physical relief (e.g., personal lifts), followed by sensor technology (e.g., for fall detection) and computer-based systems (e.g., Wii games) in inpatient care. The area of robotics, e.g., in the form of automatic eating aids, has only been integrated into everyday care in isolated cases so far. There is no cross-sectoral digital exchange between care facilities and doctors' practices in Germany yet, which can be traced back to a lack of incentive structures and interest on the doctors' side. Smaller care facilities are an exception here. Even though use of digital technologies is increasing in care, it is still subject to some inhibiting factors. The IGES Institute's survey found that financing issues, low acceptance among older employees, time-consuming training of employees before technologies can be introduced, double documentation (electronically and on paper), lack of interoperability between technological systems, and low maturity of the technologies are rendering implementation particularly difficult.

A glance at other countries and international care practice[17] shows that technologies for older people pre-dominantly start at home. "Ambient assisted living technologies" (in short: AAL technologies) mostly help people live independently in their own homes for as long as possible. Outpatient care is partly supported by networked technologies already as well, with examples ranging from applications linked to available care software for care staff to facilitate mobile documentation and route planning, to hands-free emergency systems for care recipients in the form of smart wristbands/pendants. The latter are linked to sensors that can detect falls and will send the geolocation information to pre-programmed phone numbers automatically. Long-term inpatient care around the world, in contrast, is rather in the earliest stages of deploying a variety of technologies, including some interlinked ones. One striking finding is that isolated solutions, e.g., for monitoring or communication of the elderly living in their own homes, dominate in countries such as the USA, Korea, or Japan, which are seen as very high-technology countries in some areas and particularly strongly affected by demographic change, while complex sensor technology and robotic systems are barely found there. Scandinavian countries – with Denmark, Norway, or the Netherlands in the lead – in contrast are not only technically advanced, but also very active where social innovations (e.g., in work organization) are concerned. There is a clear international trend towards the use of monitoring technologies. Care facilities in many countries only sporadically use networked

technologies linked to care documentation, for example. In the Scandinavian/Nordic countries, however, care practice relies more frequently on more complex systems with a large number of digital technologies to support care staff in care planning, monitoring, and documentation. This trend is evident all the way to care and empathic support for care recipients. There is an increasing focus on artificial intelligence and the associated pattern-recognition skills when analyzing sensor data to permit statements on individual changes in the health status of people in need of care in international care practice. Such technologies make it possible to plan deployment of care staff in a very specific manner, e.g., to avoid bottleneck situations.

3 Benefits and Relief Effects of Care Technologies in Practice

Methodological approach to the case studies:

What were we looking for?

In order to permit an explorative comparison, we were looking for technology-supported care settings where several technologies are linked to be as interoperable as possible and integrated into the care process or involved in the care work directly, both in Germany and in other countries. The systems examined were to have been in use in a nursing facility for at least one year in order to ensure that caregivers had a sufficient level of experience in using the technologies.

What did the research look like?

All in all, we researched technology-supported care settings in 23 countries. The countries were selected under consideration of the Digital Health Index. Cases were identified based on literature reviews, expert interviews, and exploratory interviews.

Where did we find what we were looking for?

We included a total of seven care facilities in our indepth analysis. Two of them are located in Denmark (Lergården, Lundbyescentret), one each in the Netherlands (tanteLouise) and in Canada (Villa Cathay), and three in Germany (Breipohls Hof, Evangelische Heimstiftung, Hösseringen).

Who were our respondents?

We conducted semi-structured interviews with 38 respondents in total, including nursing specialists, employees from IT, controlling, and innovation/digitization, and technology manufacturers.

3.1 Use of Technology and Understanding of Care in the Case Studies

Demographic aging and the increasing number of people in need of care are the main driving forces when dealing with digitization and use of technology in care for all examined case studies. The technologies used in care settings cover a wide range (see table 1). While all facilities rely on complex digital documentation systems, their levels of experience with them differ, with the foreign cases usually showing more diverse technologies than the German ones. However, the technological systems are barely interlinked in any of the case studies. In light of the diverse experience, the facilities can be considered advanced in their use of technology. All of them consider themselves to be early adopters and proactive players in terms of technical innovations.

Facilities often choose their care technologies in exchange with other care homes as well as with actors from universities. Implementation

and the scope of training both vary depending on how complex the technology is. A two-phase approach is often chosen, commencing with a pilot phase followed by rollout. Employee involvement is not yet part of the care facilities' self-conception, in particular in the German ones. As a result, it happens only in isolated cases rather than systematically. Education or training of particularly technology-savvy employees as technology officers is a popular concept.

The respondent nursing specialists essentially defined good care as being person-centric and including emotional work and a focus on feelings (interaction work). In this context, it is important for them to consider or strengthen what (health) resources people in need of care still retain. Dignity and independence of care recipients should be preserved in the care setting to the greatest possible extent. Cooperation with various stakeholders is central to the respondents' understanding of care, too, as is professional, evidence-based action in keeping with the standards of nursing science (knowledge-based work). The respondents consider the best parts of their work to be the intrinsic motivation to work, the feeling of being there for others, as well as the diverse forms of interaction in everyday care. They find particular challenges in the lack of time, the workload, ever-changing legal requirements as well as administrative and organizational tasks. Increasing time, personnel, and financial resources as well as improving work process organization are frequently named as

TABLE 1 **Care technologies in the case studies**

Technologie	tanteLouise	Lundby-escentret	Ev. Heim-stiftung	Villa Cathay	Breipohls Hof	Lergården	Hösseringen
Documentation system	✓	✓	✓	✓	✓	✓	✓
Sensor systems	✓	✓	–	✓	✓	✓	–
–Decubitus prophylaxis	–	–	–	–	–	✓	–
–Bed	✓	–	–	✓		–	–
–Chair	–	–	–	✓	–	–	–
–Movement	✓	✓	–	–	✓	✓	–
–Localization	–	✓	–	✓	–	✓	–
–Transponder	–	–	–	✓	✓	✓	–
–Incontinence material	✓	–	–	–	–	✓	–
Triage system	–	✓	–	–	–	–	–
Cameras	–	–	–	✓	–	–	–
Call system with hands-free function	–	✓	–	✓	✓	✓	–
ICT system for care recipients	–	–	–	–	–	✓	–
Video telephony	✓	–	–	✓	✓	✓	–
Smart data glasses	✓	–	–	–	–	–	–
Robot	✓	–	–	–	(✓)	–	–
–Interaction robot	✓	–	–	–	–	–	–
–Therapeutic robot	–	–	–	–	✓	–	–
Smart TV	–	–	–	✓	✓	–	–
Dementia tablet	–	–	–	–	✓	–	–
Tracking system for residents with dementia	✓	✓	–	✓	✓	✓	–
Hip protector	✓	–	–	–	–	–	–
Fall prevention app	–	–	✓	–	–	–	–
Circadian light	–	–	–	–	✓	–	–
AAL system	–	–	✓	–	–	–	–

desired changes as a result – typically with the goal of increasing the time available for those in need of care. In spite of the above challenges, the respondent nursing specialists feel that they can master the demands of their work. They state that they have a good constitution and are able to perform well (statement: "[high] personal energy levels"). They are generally open to using technology, provided that its implementation is aligned with practical needs and that it matches the situation of the individual case.

3.2 Effects of Care Technologies on Job Satisfaction among Caregivers

(a) Effects on activities, processes, and organizational culture

The introduction of care technologies has significantly influenced the activities and work processes of the respondent caregivers in some cases. Digital support has become available for some essential care elements – e.g., planning, routine procedures, communication, or evaluation of information. Digital documentation has virtually replaced paper-based work in all of the reviewed facilities. While it is essential in this context, the manner of its implementation differs between the case studies and clearly influences the reported burden and relief effects. Facilities that use mobile devices, e.g., tablets, for documentation (Lergården, Lundbyescentret, tanteLouise, Hösseringen) perform their documentation from the residents' rooms directly and in dialog with the care recipients. At best, this increases the focus of the documentation process on the care recipients (Lergården). Being able to record reports by voice on top of this accelerates collection of the information (Hösseringen). Mobile digital documentation also eliminates duplicate structures for the caregivers who no longer need to take notes on paper, to enter them into the digital system on the computer at a later time. Documentation on stationary computers not located at the "point of care", in contrast (Evangelische Heimstiftung, Breipohls Hof, Villa Cathay), interrupts the workflow and conversations with care recipients when care-relevant information is to be recorded in the system directly. Stationary documentation also tends to reduce contact with the residents.

PROFILE

tanteLouise, Bergen op Zoom in the Netherlands

Public sponsor, town location

Total of 17 facilities, approx. 1,650 care recipients, more than 1,800 employees

Digital concept: Dedicated digitization strategy, "early adopter"; dedicated research projects; represented in government-funded networks with other facilities; scientific innovation department; internal ethics committee

Implementation: A collaborative approach with other care facilities in the selection and implementation process; top-down and bottom-up approach to technology selection; two-phase implementation model: Pilot phase and rollout are typically supported by a service provider and/or research institution; monthly evaluation sessions; internal participation program; use of multipliers for technology implementation

Technologies used: Digital documentation system, sensor systems (incontinence material, mattress, movement analysis), hip protector, localization system for residents with dementia, interaction robot, smart data glasses, video telephony

Irrespective of the hardware constellation used, all respondents state that digital documentation simplifies their documentation work, i.e., data collection, care planning, review and adjustment of care measures as well as compilation of medication plans, fall and wound records. Medication orders are also rendered easier by this. Collecting care-relevant information in a single location increases the caregivers' sense of security, improves information flows within the team, and permits a more integrated perspective on the care recipients and their needs as information is less likely to be lost. The variety and real-time availability of data promotes knowledge-based action by caregivers. Digital documentation facilitates exchange of information with other care and health-related professional groups as well since visits and treatment plans can be coordinated both more immediately and more quickly across sector boundaries, and document exchange becomes

faster. All in all, this also has some positive effects on the person-focus of care (Lergården).

PROFILE

Lundbyescentret care home, Aalborg in Denmark

Public sponsor, town location

Approx. 66 care recipients, more than 100 employees

Digital concept: No dedicated digitization strategy, "early adopter"; dedicated research projects; represented in networks with other facilities, manufacturers, and the Center of public innovation; IT department, innovation management, internal ethics committee; annual budget: 1 million kroner

Implementation: Selection and implementation processes in cooperation with manufacturers, universities, and innovation managers – "co-creation"; supporting communication (newsletter, information events); resident survey; employee rating, e.g., for pitches; scope of training depending on complexity of the technology at hand

Technologies used: Digital documentation system, sensor systems (for movement analysis and localization), triage system, call system with hands-free function

The information in the digital documentation systems that is relevant for care comes not only from the data input by caregivers, but also from a variety of sensor-supported systems that significantly contribute to the work processes of the respondent nursing specialists. For example, the smart bed sensor system for decubitus prophylaxis in the tanteLouise facility now supports the wound expert in assessing care needs, specifying care targets, deciding on care interventions, and evaluating treatment results. Situations that deviate from what is expected can be recognized more quickly. The majority of respondents who work with different sensor systems report improved planning, less time pressure, and an ability to react to changes early or in time. Availability of sensor-based data and the systems' alarm functions have changed the working rhythm of the caregivers away from prescribed checks at fixed intervals and towards acting on an ad-hoc basis.

At the same time, use of diverse care technologies has increased the variety of tasks and autonomy alike for the majority of respondents. The many technical tools increase their options for action while giving them more space to make decisions in choosing the specific form of treatment, while a diverse data basis improves their confidence in making decisions on their own. However, care staff must acquire the skills and knowledge required for this before they can apply the technologies adequately from case to case and assess correctly whether developments actually correspond to expectations. Autonomy and self-determination can be improved additionally by giving caregivers their own mobile devices and allowing them to perform certain administrative tasks from home (Hösseringen).

PROFILE

Hösseringen, Suderburg in Germany

Private sponsor, rural location

25 care recipients, 25 employees

Digital concept: No dedicated digitization strategy, "early adopter"; no research projects; not represented in networks; provision of tablets and arrangement for working from home; trying out new work concepts

Implementation: The selection process takes place through direct exchange with employees, a desire to reduce costs, and dedicated research; implementation processes are accompanied by manufacturers; employees are trained

Technologies used: Integrated software solution (digital documentation system) for inpatient facilities, application via PCs and tablet computers

(b) Effects on physical strain

Use of technology only has a minor influence on the respondents' physical well-being in the facilities reviewed. Caregivers state that they use lifting systems where their work profile involves heavy lifting (Lergården, Lundbyescentret, tanteLouise, Breipohls Hof, Villa Cathay). Mobile care documentation on tablet computers right with the care recipient reduces walking distances for the respondents, as do call systems with hands-free or talk-back functions that permit direct communication with the residents at a distance (Breipohls Hof, Lundbyescentret). Where digital documentation on a stationary computer is concerned, sitting for long periods of time has

detrimental physical effects and causes greater eye strain (Villa Cathay). Care-givers in the night shift in particular report considerable physical relief from sensor systems, as smart floor coverings, for example, raise an alarm upon detecting conspicuous movement patterns of persons at risk of falling or after a fall (Lundbyescentret, tanteLouise), which significantly reduces the number of required routine rounds (in the case of tanteLouise: reduction from five or six routine rounds per night to going out only when the sensor technology is activated). A lower number of falls reduces the frequency of heavy lifting as well.

PROFILE

Lergården care home, Aabenraa in Denmark

Public provider, located in a small town

84 care recipients, more than 100 employees

Digital concept: No dedicated digitization strategy, "early adopter"; closely tied to Denmark's national digitization strategy; dedicated research projects; represented in municipal and supra-regional networks; cooperation with the municipality

Implementation: Selection and implementation processes in cooperation with the municipality; three-phase implementation model: prospective assessment, pilot test, rollout; scope of training depends on the complexity of the technology; technology-savvy staff share technology-related knowledge

Technologies used: Digital documentation system, sensor systems (decubitus prophylaxis, movement analysis, localization and transponder systems, incontinence material), call system with hands-free function, ICT system for care recipients, video telephony, localization system for residents with dementia

(c) Effects on the emotional and mental situation

Digital technologies can significantly reduce mental and emotional stress, e.g., from feeling rushed or a need to be everywhere at once (in particular in Lergården, Lundbyescentret, tanteLouise, Villa Cathay, Breipohls Hof). Even if digital documentation usually simplifies the documentation activity, thereby reducing time pressure, the experiences of the respondent care staff must be covered in greater detail: The nursing specialists in Germany in particular report that they feel no direct improvement since legal requirements keep increasing at the same time. Positive effects are also offset if the feeling of supervision and monitoring exceeds the perceived benefits from the broad information basis and comprehensive shared view of the care recipients among the care staff. Use of stationary computers may also lead to double documentation structures (analog and electronic), costing additional time (Villa Cathay). In one case, the software alarm function is described as demanding (Evangelische Heimstiftung). Other caregivers, however, experience the indication of errors when they record their work as helpful (Lergården). Time pressure is reduced for caregivers who document via mobile devices directly with the care recipients, due to timely documentation, avoidance of information loss, improved availability of information and ability to plan tasks, faster exchange of information across sectors and within the team, and simplification of medication management.

PROFILE

Evangelische Heimstiftung, care home Haus an der Metter, Bietigheim-Bissingen in Germany

Non-profit sponsor, town location

87 care recipients, 120 employees (more than 8,000 employees in total)

Digital concept: Dedicated digitization strategy, "early adopter"; dedicated research projects and research department; not represented in networks; based on a diaconal view of ethics

Implementation: Selection through internal research and exchange of experience with other actors in the field; implementation process partly happening in two phases: training depends on how complex the technology is; technology deployment through implementation at one pilot site and subsequent rollout to all sites; extensive training of care staff

Technologies used: Digital documentation system, fall prevention app, AAL system

Sensor systems on beds, chairs, floor coverings, or mats (Breipohls Hof – in apartments only, tanteLouise, Lundbyescentret, Villa Cathay, Lergården) as well as smart incontinence material

signal a need for action if a risk of falling or a certain degree of wetness are detected. This helps prevent unplanned incidents and time-consuming treatment of injuries. The same applies to GPS and sensor-based warning or transponder systems that can find people with dementia within and outside of the facilities or prevent them from wandering off (Lundbyescentret, Villa Cathay, Breipohls Hof), thereby reducing caregivers' concerns about missing risky situations, or recognizing them too late, and increasing their sense of security. The respondents also perceive such systems as reducing time expenditure by reducing the required number of routine rounds. Use of a communication robot (tanteLouise) to entertain the residents and stimulate them to engage in physical and mental activity achieves similar effects. As a result, the care staff can use the time freed up to focus on other tasks such as administering medication, distributing meals, or taking care of individual persons. The devices are not used to replace contact but to entertain the residents during times when a caregiver cannot be present because they can only take care of a limited number of care recipients at any one time.

PROFILE

Breipohls Hof, Bielefeld in Germany

Non-profit organization, town location

Approx. 80 care recipients, more than 100 employees

Digital concept: Facility-wide digitization strategy, "early adopter"; dedicated research projects; not represented in networks; innovation approach strongly tied to individuals; staff and specialist units for digitization

Implementation: Selection through diverse exchange (universities, reference facilities, dedicated research); start of the implementation process in pilot facility; technology-savvy multipliers take over responsibilities during implementation; transparent communication of responsibilities; participatory involvement and training of employees at selected points of time; opportunity for critical questions and feedback

Technologies used: Digital documentation system, sensor systems (for movement analysis, transponder system), call system with hands-free function, video telephony, smart TV, dementia tablet, localization system for residents with dementia, circadian light

Even though the sensor-based alarm technologies may increase the number of workflow interruptions, the respondent caregivers only ever considered these troublesome if there were repeated false alarms. The positive effect of prevention and the feeling of "having everything under control" appear to clearly outweigh any negative effects here.

All caregivers agree that technology barely improves complex decision-making situations. While the aggregated data support assessment and prioritization of needs for action, there is a great number of factors to be considered when analyzing the care recipient's individual needs and the specific care situation. The caregiver's personal experience is vital for this. Accordingly, with a single exception (Evangelische Heimstiftung), respondents are hardly concerned that care technologies may negatively impact professionalism. However, they feel noticeably relieved where technologies such as smart glasses (tanteLouise) allow them to examine wounds together with the attending physician to make a coordinated treatment decision.

(d) Effects on relationships with care recipients, relatives, other professions, and colleagues

Most of the nursing specialists report an improvement in communication and cooperation with residents through call systems (Breipohls Hof, Villa Cathay, Lergården, Lundbyescentret) and mobile documentation. The concern that the tablet computer may be a disruptive artefact that would interfere with exchange with care recipients is not confirmed. However, this requires explanation of the technology and involving care recipients in data recording (Hösseringen). One nurse notes that the growing share of work on a stationary computer comes at the expense of time and communication with the care recipients (Evangelische Heimstiftung). The assumption that the communication robot in the tanteLouise facility might impair interaction between care staff and the care recipients was disproven as well. In fact, the nursing specialist emphasizes that the robot's customizable modules and contents, based on the respective biographies, provide information on the residents and their interests instead, resulting in a more integrated overview.

PROFILE

Villa Cathay, Vancouver in Canada

Non-profit organization, town location

127 care recipients, 125 employees

Digital concept: No dedicated digitization strategy, "early adopter" and "copycat"; dedicated research projects; close exchange between management and care staff; represented in networks with other facilities; combination of external products and dedicated developments; absolute avoidance of reduction of interaction time; most important selection criterion: person-focused care

Implementation: Selection through diverse exchange (networks, dedicated research, internal feedback); implementation through rapid improvement cycles; complex systems are monitored externally; substitute care staff create time resources for learning; scope of training is determined by the complexity of systems; random exchange in everyday working life

Technologies used: Digital documentation system, sensor systems (smart chairs, beds, transponder, and localization system), call system with hands-free function, video telephony, smart TV, localization system for residents with dementia

The impact of technology on communication and interaction with relatives was also primarily viewed as a positive aspect by the respondent nursing specialists in all case studies. Tablets and smart TVs facilitate and speed up contact. This has helped maintain connections with families and provide a sense of security for loved ones in spite of the coronavirus pandemic. Use of sensor systems can increase trust and sense of security for family members as well (Lergården, Lundbyescentret, tanteLouise, Villa Cathay, Breipohls Hof). In some facilities, such as tanteLouise, relatives receive access to the documentation. Rendering data and information in layman's terms is definitely perceived as very time-consuming and potentially troublesome, however. Family involvement by video conferencing may be challenging when family members want to be involved while disregarding the care recipient's privacy (Villa Cathay).

Cross-sectoral communication with physicians derives the greatest benefits from use of technology, through synchronous communication via video or smart glasses (e.g., for wound treatment) as well as through asynchronous coordination via messaging. Some facilities (Villa Cathay, Lergården, Lundbyescentret) also involve other professions, such as physiotherapists or nutritionists. Technology increases the quality, though not the frequency, of intersectoral exchange. The foreign case studies show that caregivers and other healthcare specialists making use of a common database allows them to provide treatments on a broader information basis, promoting a multi-professional approach to complex issues and decisions. The respondents from two case studies (Hösseringen, Villa Cathay), however, state that not all physicians are open to this form of co-operation.

The respondents rated the effects on communication within the team and team dynamics as predominantly positive as well, citing three main reasons: (1) improved professional exchange and easier handovers due to digital documentation and sensor technology, (2) faster flow of information and easier coordination of tasks through messenger functions, and (3) software-based support for role-specific task sharing. This avoids conflicts due to roles not being clearly specified (tanteLouise, Lundbyescentret, Hösseringen). On the other hand, one respondent nursing specialist says that the relationship between colleagues has rather deteriorated since the work demands of digital documentation do not leave them with enough time for personal conversations (Evangelische Heimstiftung). Communication channels and times should be coordinated clearly in order to meet different expectations in internal digital communication (Villa Cathay). Increased digital exchange among the team may also render integration of new employees more difficult (Villa Cathay). It is, therefore, important to have a combination of digital and analogue communication channels in order to create places for personal encounters, to strengthen the basis of trust and to promote team building.

The vast majority of respondents reported that the communication culture was good even before the technology was introduced. This shows that a good dynamic and culture of exchange can be expanded further by use of technology but cannot be built on it alone.

TABLE 2 **Burden and relief effects in the technology-supported care setting at a glance**

Effects on ...	Burden −−−	Relief +++
Activities and processes	• More activities in the scope of documentation	• Greater transparency, better control, fewer mistakes • Support in designating care goals and monitoring progress through digital documentation • Better internal information transfer (handovers) • Patient-focused documentation • Better exchange of information between sectors • Better planning of tasks • Professional improvement of work (e.g., acquisition of new technical competences) • Greater variety of tasks, reduction of monotonous tasks • Increase in autonomy and self-determination • New opportunities for participation • Elimination of administrative tasks (e.g., ordering medication) • Technology as an impetus for organizational change
Physical constitution	• Sitting at the PC and strain on the eyes	• Taking over heavy lifting (lifting systems, lifters) • Shorter distances due to mobile documentation, sensor systems, call systems • Less time pressure due to communication at a distance
Mental constitution	• Increasing demands on documentation (due to digitization and legal requirements) may increase time pressure and stress • "Double" documentation • Danger of alienation from the job due to increased amount of digital work on the stationary computer (less contact with the residents) • Concern that technology may reduce professionalism • Not enough time to integrate technology into the daily work routine. • Problems in use • False alarms and error messages	• Information in one place and at a glance • Administrative tasks have been made clearer by the digital documentation system • Technical competence and timely documentation strengthen sense of autonomy • Greater safety through sensor technology, automated warning function (prompt information), shorter reaction chains • Time saving through efficient digital documentation • Reduction of times of increased workload, unplanned incidents, interruptions • Competence-focus in technology application, diversity of tasks makes work more fun • Mutual support within the team in application of technology • Support for complex decisions • Greater autonomy in terms of place and time (care planning and documentation possible from home)
Relationships	• Less time with residents due to digital documentation on the computer • Technology not accepted by relatives • Less time for communication with colleagues due to digital documentation • One-way "digital" communication with colleagues • Negative effects on working atmosphere due to high legal demands to digital documentation	• Improved cooperation and communication with care recipients, relatives, other sectors, and colleagues • More information on residents improves the relationship • Improved working atmosphere due to joint discussion of technologies

(e) Summary

Care technologies primarily exhibit a positive effect on the care staff and their job satisfaction. The growing demands from a rising number of care recipients or legal documentation requirements can be better managed in most cases. Delivery of high-quality care is also promoted in a satisfactory manner through the use of technology.

Although virtually all respondents emphasized the advantages of digital documentation, those who consistently implement digital and mobile documentation activities, have access to well-structured data, and understand the benefit of data recording for their work will derive the greater benefit. They feel that they can manage their many tasks better by having all care-relevant information available in a central location, while sensory systems relieve caregivers of routine tasks

TABLE 3 **Information provided by caregivers on the quality of work**

	TanteLouise (NL)	Lundbyescentret (DK)	Lergården (DK)	Villa Cathay (CA)	Ev. Heim-stiftung (D)	Breipohls Hof (D)	Hösseringen (D)
Job satisfaction	Highly satisfied Highly satisfied	Satisfied Highly satisfied Highly satisfied	Highly satisfied N/A	Satisfied Satisfied	Satisfied Satisfied Satisfied	Highly satisfied Satisfied/ highly satisfied	Highly satisfied Highly satisfied Highly satisfied
Energy	80% 100%	80% 85% 90%	95%[1] 95%	80% 75%	50% 65% 95%	80% 90%	90% 80% 80%
Able to work until retirement	Yes Yes	No[2] No Yes	Yes N/A	No[2] Yes	No Yes[3] Yes	Yes Yes	Yes Yes Yes

[1] When asked, the nursing specialist (PFP) emphasizes that her high energy level is also due to using technologies.
[2] When asked, this answer was not due to the working environment, but for personal reasons.
[3] When asked, the nursing specialist stated that she did not wish to have to work in her job until retirement since she was currently working at 80% after separation (previously 50%).

and support situation-focused responses. Many respondents find that use of technology has made their tasks more diverse and demanding, and that they can perform their work more independently thanks to the broader data basis. Greater process, control, and planning reliability as well as improved communication between caregivers, the team, and intersectoral actors contribute to greater job satisfaction as well.

However, there are some prerequisites for these effects of innovative care technologies on caregivers' job satisfaction. For example, several respondents note in the interviews that technology satisfaction is hinged on its design and implementation. Early involvement of care staff in selection and introduction of technology makes them more receptive to further innovations in the long term as well. It is also important that the supervisor communicate expectations and requirements of the respective technical system clearly and transparently for a common understanding of the intended effect. A particular challenge was mentioned as "taking along" less tech-savvy and, in particular, older staff members. All case studies showed that improving high-quality care is a decisive aspect for how well technologies are accepted. Caregivers must receive training and require enough time to acquire the knowledge they need for use, competent application, and evaluation of the outcomes of the technologies, as well as to integrate them appropriately into their daily work. In the absence of this, they will experience (mental) stress.

3.3 Effects on Care Recipients and Quality of Care

As mentioned before, the respondent nursing specialists see a focus on the individual as the center of their care work. They consider it an essential characteristic of "good care". Accordingly, the impact of digital technologies on care recipients directly affects their job satisfaction as well. The effects of care technologies on care recipients and quality of care were assessed in proxy-interviews with caregivers to record professional perceptions. We were unable to interview residents of the facilities within the scope of our study.

Most of the respondent nursing specialists reported a positive influence on quality of care due to improved mobility, communicative and

cognitive abilities, and social participation of care recipients. These effects either result directly from use of technology (direct effects), or as secondary effects through the actions of the care-givers who are positively influenced by the technology (indirect effects).

(a) Direct effects

Mobility of care recipients is improved in particular by the various sensor systems for movement analysis (Lundbyescentret, Breipohls Hof, tanteLouise). Knowing that caregivers can provide help promptly in an emergency makes the residents feel safer. They are more confident and move more freely. People with dementia can also use GPS and sensor-based warning or transponder systems to move more independently within the facilities or on their premises without any risk of getting lost (Lundbyescentret, Villa Cathay, Breipohls Hof). Warning systems reacting to abnormal movement can prevent falls (Breipohls Hof). Smart hip protectors that open at a fall reduce the occurrence of hip fractures (tanteLouise). The sensor technology is supplemented by the movement program of the communication robot in the tanteLouise facility to further improve residents' mobility in coordination with physiotherapy. Caregivers also report that care recipients have been more active and slept less during the day since the communication robot was introduced, which had a positive effect on their ability to sleep at night and reduced the amount of sleep medication required. Similar results are reported from use of sensor systems for fall prevention, as the introduction of sensors has eliminated routine checks by caregivers, thereby reducing disturbances to nighttime rest and giving care recipients healthier sleep (Breipohls Hof).

The cognitive and communicative abilities of care recipients, as well as social participation, are promoted, among other things, by digital activities on tablets (music, photos, videos), the Smart TV that provides an overview of the program offered by the facility and activities in the residents' vicinity, or the communication robot (quiz program) (Lergården, Lundbyescentret, Villa Cathay, Breipohls Hof, Hösseringen, TanteLouise).

Information and communication technologies (ICT) enable residents to continue participating in social and family life in particular in times of stricter contact restrictions due to the Covid-19 pandemic. Since the communication robot is able to interact with several care recipients at once, it also helps promote social interaction in a group (tanteLouise).

(b) Indirect effects

The data aggregated in the digital documentation systems help improve the quality of care and patient safety. The prerequisite for this is comprehensive and high-quality recording of information on vital data, mobility, cognitive, and communicative abilities as well as the activities and measures applied. This makes it easier for caregivers to monitor care interventions and their impact, improves continuity of care (Evangelische Heimstiftung), and provides an integrated view of the development of care recipients. Respondents also report that digital documentation helps them in better considering the applicable guidelines and standards on key quality measures while making it easier to meet care targets (Breipohls Hof, Hösseringen, Lergården, Villa Cathay). In some cases, the software also uses the data and information entered to determine information on suggested care interventions (Villa Cathay). Medication cards that provide an overview of the medication may help avoid incorrect medication as well (Lundbyescentret).

According to the respondents, use of technology contributes to the residents' satisfaction in particular when it can maintain or sustainably promote the care recipients' (health) resources for a longer period of time, thereby achieving a higher degree of self-determination (Lergården). The respondent employees at Villa Cathay concluded that the people in need of care are happy with the technology when it fits their respective individual situations. That makes monitoring of the benefits, effects, and sensible use of the technology in question, and consideration of different options if technology is found to be ineffective, important (Lergården, Breipohls Hof, Villa Cathay).

3.4 Effects on the Organization

Use of care technologies helps increase the perceived safety for a large share of respondents, in turn improving caregivers' job satisfaction along with the effectiveness and efficiency of their work due to error prevention and effective preventive measures (see table 4). The efficiency and effectiveness gains observed also primarily stem from reduced walking distances, faster documentation, and easier communication, e.g., with actors from other sectors. Central consolidation of different information and communication channels within the scope of digital documentation software renders organization of division of labor as well as the associated planning and administrative tasks more efficient while avoiding unnecessary workflow interruptions. Work processes can be implemented in a more target-oriented manner this way and block fewer time resources. However, increasing demands on documentation may render time savings invisible in some cases. When capacities are freed up, respondents tend to use them to perform other activities, in particular to improve the quality of life of care recipients. Even if the time relief is not always perceptible, nursing specialists show a greater satisfaction since person-focused care is facilitated at the same time.

Where controlling is concerned, strictly "material" savings, e.g., of paper, or reduced administration of medication (due to fall prevention, avoidance of incorrect medication, etc.) are named as well. This results in particular from use of a digital documentation system.

Even if the positive effects of digital care technologies on effectiveness and efficiency tend to become evident within the case studies, the efficiency and effectiveness gains described are either not yet reflected in a reduction in nursing specialist absence rates in the short term or are only reflected in individual cases (see below). However, such effects are imaginable on a broader basis as well in the medium to long term as new work structures are further consolidated. However, the manner in which the efficiency gains achieved are used will be vital there. If time savings are compensated in particular by consolidating tasks, or used to reduce the care staff headcount, the relieving effects for the care staff will be barely noticeable. This is why the main goal must be using the time resources made available to provide high-quality care and to relieve the burden on care staff.

TABLE 4 **Information on the impact of digital care technologies on efficiency, effectiveness, and safety**

	TanteLouise (NL)	Lundbyescentret (DK)	Lergården (DK)	Villa Cathay (CA)	Ev. Heim-stiftung (D)	Breipohls Hof (D)	Hösseringen (D)
More efficient	N/A Rather applies	Rather applies Rather applies Fully applies	Rather applies	Partly applies Rather applies	Partly applies Partly applies N/A	Partly applies Rather applies	Rather applies Fully applies
More effective	N/A Partly applies	Rather applies Rather applies Rather applies	Rather applies	Partly applies Rather applies	Rather applies Partly applies Applies	Partly applies Rather applies	Fully applies Rather applies
Safer	Applies Does not apply at all	Rather applies Applies Rather applies	Applies	N/A Partly applies	Partly applies Applies Applies	Rather applies Rather applies	Rather applies Fully applies

3.5 Overall Societal Potentials of Using Technology Based on the Example of Absence Rates

Care technologies that reduce the workload of nursing specialists can also be assumed to potentially benefit society as a whole, e.g., by helping improve the quality of work of care staff and widely reducing absence rates caused by illness and consolidation of working times as a result. Our interviews with care staff, controlling, and in the area of innovation/digitization mostly agree in showing a trend that deliberate and planned use of technology improves the quality of both work and care. However, there are some prerequisites for a technology's degree of success, including an organizational context where flexible and independent work is possible (structural capital), employees who work in a knowledge-oriented manner and are able to deal with flexible structures (human capital), and cooperation with external partners that takes place across organization boundaries (relational capital). Looking at the corporate landscape, these three capital types are particularly evident in companies with advanced digitization. They are also considered criteria of "good work". These types of capital have evolved over time, in particular in the foreign case studies. An organizational culture that promotes individual competencies and personal responsibility to permit profitable use of flexible structures that offer freedom is essential since personal responsibility would quickly turn into a burden otherwise. Finally, the potential from using technology for overall society where absence rates are concerned is to be estimated based on a model calculation resulting from the case studies at hand.

The Allgemeine Ortskrankenkasse (AOK) dataset for the year of 2017 shows that nursing specialists working in long-term care are unable to work for an average of 27.1 days ("AU days") per insurance year. In geriatric care, this rate even rises to 27.3 AU days. Extrapolated to the 353,000 employees in inpatient geriatric (day) care in Germany, this results in an average of 9,636,900 days of incapacity to work per year. Under consideration of a part-time ratio of 61.6% (2/3 employment) in geriatric care, these 353,000 employees mathematically correspond to 280,517 full-time equivalents, for whom a total of 7,658,123 days of sick leave per year would result. Based on an insurance year of 365 days, the total annual days of sick leave in Germany in inpatient (day) care then corresponds to around 20,981 full-time equivalents (FTEs) in strictly mathematical terms. Studies show that absence rates among employees can be reduced by a high quality of work and a high level of job satisfaction. The results of our case studies suggest that care technologies can improve job satisfaction, potentially also reducing the high absence rates in care, as long as use of technology is accompanied by a flexible, open, and autonomous – while also empowering – organizational culture. The sick-leave days per nursing specialist and year average only 21.70 AU days (2019) in the Breipohls Hof facility. Those in Hösseringen average 21.80 AU days (2020).

For the impact assessment, it is assumed that 25% of the inpatient care facilities in Germany have already implemented digital technologies like the ones found in the Hösseringen, Breipohls Hof, and Evangelische Heimstiftung care homes, improving the quality of work and job satisfaction of employees while reducing or having reduced the number of sick-leave days to a similar degree. In light of the general technical progress in care, this appears to be an optimistic yet realistic order of magnitude. If the remaining 75% of facilities can establish comparable processes and measures in future as well, reducing their average days of sick leave to 21.75 days per year and caregiver, this will result in only 6,101,252 days of sick leave per year, or around 16,716 full-time equivalents (currently: 20,981 FTE), for inpatient care facilities in Germany (corresponding to 280,517 total full-time equivalents). The reduction that can be achieved based on our calculation, therefore, amounts to about 20%.

4 Conclusion and Derived Actions

Use of digital technologies is associated with particular challenges in care. Activities close to and with the care recipient are central to care work. Emotional work as well as handling of unforeseeable incidents and conflicts, combined with highly intense work, time pressure, and emotional demands cause a variety of strains and stressful situations, while care technologies to support interaction work are subject to some particularly relevant prerequisites to avoid situation-specific action aligned with the needs of every individual case and interpersonal interaction falling pray to excessive standardization. The seven case studies show that digital care technologies can act as a relief in interaction work (e.g., by improving cooperation with care recipients, relatives, and other sectors or reducing unexpected incidents), knowledge work (e.g., by improving information-based care planning and reflection on care outcomes or more design options for care interventions), and planned-rational action (e.g., by facilitating complex administrative tasks) alike.

The following vital prerequisites for successfully implementing technologies in care practice and letting them unfold their effect for the benefit of both caregivers and care recipients have become evident in the course of our case studies, however:

1. The relief potential of digital technologies rarely is found in a direct effect. Successful interaction of technology, participatory involvement of caregivers in selection and implementation, adapted work structures, and the necessary know-how are needed instead to create an effective socio-technical work system. Apart from an opportunity-focused "digital mindset", this requires, first and foremost, an open error culture and high degree of adaptability in organizational and work processes. Early involvement of caregivers, and the contribution of different perspectives as a result, creates the basis on which expectations to the respective technology become clear for all users, openness towards the technologies increases, training needs are identified early on, roles can be allocated unambiguously, and innovation remains in line with the prevailing idea of good care. Cultural aspects such as language barriers need to be considered in the technology design and in training alike. Enabling caregivers to use digital technologies goes beyond learning the technical functions or operation. It includes acquiring digital sovereignty, i.e., the confident, deliberate, and autonomous use of the technologies in care in accordance with the care recipient's individual needs and the targets of the care intervention.

2. Interaction work, which forms the core of care work, is the central, meaningful component of job satisfaction. It is, therefore, vital that the effect of technologies in terms of caregiver-recipient relationships and promotion of individual resources and needs of people in need of care be monitored. Time capacities gained should be used to design interaction work and/or converted into non-working times (breaks) for the nursing specialists accordingly.

3. Work processes interlock efficiently when all relevant information is available quickly and the information flow freely crosses structural, sectoral, facility, and hierarchy boundaries.

Use of digital care documentation on mobile or decentralized terminal devices builds the technical prerequisite that makes all care-relevant information available at the respective "point of care". The documentation system is to serve as an enabling, rather than a controlling, tool in this context. Sector-comprehensive data exchange ultimately depends not only on technological and structural conditions. First and foremost, it requires an entirely "analog" interest in cooperating across professions. The IGES institute reflects plenty of untapped potential in this area in Germany: Only 36.7% of inpatient care facilities exchange data across sectors, and only 17% do so on a regular basis.

4. Successful technology deployment is based on identification, selection, and implementation processes. Networks with other actors and producers in the field are particularly suitable as a source of support, knowledge, and reflection for research, need- and goal-oriented as well as strategy-guided implementation of technologies in practice. The foreign case studies reflect a variety of networks on municipal and institutional levels for this.

5. The case studies from Denmark and the Netherlands reveal some key financing differences for digital technologies when compared to Germany. While funding is provided by the municipality in Denmark, tanteLouise has a fixed budget for acquisition and implementation of digital technologies. Additional funds are provided through subsidy projects. This financing mix achieves a planning security that Germany cannot offer due to its fragmented financing options. In addition to use of current subsidies in accordance with § 8 (8) of the Social Code (Sozialgesetzbuch; SGB) XI, funding from research and development projects as well as donations and equity capital are the main financing sources in this country. According to the facilities surveyed, sustainable investments for implementation of Care Work 4.0 are extremely difficult in light of this.

Finally, there is the superordinate question of which measures can contribute to development of supportive framework structures for effective use of technology in inpatient long-term care in Germany:

- **Promoting networks:** Integration into superordinate actor constellations and an exchange with external partners (municipal structures, science, other care facilities or producers) facilitates alignment, research, and selection as well as strategic and operative implementation of digital technologies – in particular for smaller facilities that lack dedicated innovation departments or similar structures. As a result, networks for exchange between care practice, manufacturers, and research should be created or more strongly supported on regional and supra-regional levels.

- **Creating low-threshold innovation support aligned with practical care requirements:** Inpatient long-term care facilities in Germany show very different levels of development where use of technology is concerned. Accordingly, the specific support needs (e.g., for setting up new or expanding existing infrastructure, hardware, or software) diverge considerably as well. Therefore, subsidy programs should be introduced to render the framework conditions more flexible, while funding guidelines may improve the ability to meet specific facility needs. Smaller care facilities in particular, with (very) limited resources in financial and personnel terms alike, often find it difficult to raise the investment costs needed and assign already-scarce personnel to the potentially high administrative effort required for the application procedure. Subsidy programs should also consider the organizational context more closely. As sketched above, effective use of technology in care – as in all other industries – is not limited to the technology alone but forms a triad with work organization (and culture) and qualification or competence development. If the technical systems do not fit the work processes or procedures and vice versa, or if the employees lack the know-

how required for them, quality of work and care will hardly improve. On the other hand, this means that the organizational context needs to be better considered in subsidies in order to support care facilities in rendering their existing work processes more flexible to create resources and optimize conditions for use of digital technologies with financial as well as legal measures. In the end, bringing technology into inpatient long-term care is not enough. Socio-technically innovative care settings aligned with the individual situation and needs of the facilities must be promoted as well.

- **Ensuring sustainable financing of Care 4.0:** The potential of innovative technologies for care becomes apparent based on the great number of model projects, while such projects usually cannot be maintained after funding ends since there is no way to acquire further budgets. This requires strategies for a transfer to regular structures in order to stabilize functioning technology-supported care settings through a sustainable financing perspective. Permanent rollout on a larger scale is not possible without this. The current development of technology-supported long-term care settings could hardly be foreseen at the time the current long-term care insurance system and its financing were first implemented. Accordingly, there is also no (financial) incentive for using innovative technologies. Care facilities are, instead, facing the challenge of having to operate economically on a highly regulated "market" (care rates, staffing ratios). By comparison with other sectors, care has very limited opportunities for monetizing and exploiting the digitization dividend from successful implementation, due to its billing and remuneration system. Mechanisms that shift the boundaries in the area of tension of "refinancing vs. regulation" are needed to put care facilities in a position where they can use the resources gradually gained through technology for the benefit of nursing specialists and care recipients.

However, it is also clear that technologies are only one – albeit effective – piece of the puzzle on the level of task design for improving job satisfaction, and therefore also for solving the multi-faceted challenges of care work. The remuneration of care staff, adequate staffing and time allocation, shift work, lack of separation between work and leisure time, or the issue of overtime also constitute important factors with significant influence on the satisfaction of caregivers, their health, and the time that they spend in the nursing profession. These must be addressed separately.

Notes

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