ARTIFICIAL INTELLIGENCE SOFTWARE SUPPORTING PHYSICIANS IN COLONOSCOPY DIAGNOSTIC TASKS (ID9)

1 Introduction

Automating tasks through technological advancements has been an ongoing process in many industries. This development can also significantly impact occupational safety and health (OSH) in a work environment. It enables the removal of workers from hazardous situations and can improve the quality of work. This can be accomplished by automating cognitively strenuous tasks using an artificial intelligence (AI)-based system or by 'delegating' repetitive tasks to accurate and tireless machines like intelligent robotic systems. Some tasks might not be fully automated, but workers can still receive support through, for example, collaborative robots (cobots) operating in a shared space with workers. An increasing number of companies employ AI or advanced robotics. Although still in their infancy in terms of deployment, AI-based systems for the automation of both cognitive and physical tasks, as well as intelligent cobots, show promise in a variety of sectors. However, more information is needed on how they are implemented and managed in the workplace to help ensure workers' safety and health in present as well as in future applications.

EU-OSHA has developed a number of case studies with the aim of investigating the practical implementation of AI-based systems for the automation of physical and cognitive tasks and of intelligent cobots in the workplace, their impact on workers, how OSH is managed in relation to such systems, and to gain a better understanding of the drivers, barriers and success factors for the safe and effective implementation of these systems.

To develop these case studies, several key informants at the EU and international levels, such as workers' representatives and industry associations representing the targeted sectors, were consulted Initially, 16 cases were identified and preliminary information was collected through a questionnaire. Hereafter, 11 of them were further developed into cases studies, including higher levels of information collected at the workplace level.

2 Methodology

The primary data source for the case studies was interviews held with different stakeholders within companies. For each case study, up to five interviews were conducted with workers of the company from different work areas. The participants included operators, data protection officers, health and safety engineers, managers work-councillors and technology officers.

The interviews had a duration of 1-1.5 hours each and were performed in the participants' native language, if possible, or alternatively in English. The interviews were conducted using an interview guide, while the results of the interviews were anonymised.

3 General company description

The **oncological centre** is part of a hospital in central Germany. It is an academic teaching hospital for the medical faculties of bordering universities. It was founded in the 1600s as a municipal hospital and is now a non-profit limited company. The hospital hosts a total of 21 specialist clinics and institutes with a staff of around 3,000. The oncological centre at the heart of this case study treated over 1,000 cancer patients in 2021 alone.

The oncological centre was founded in 2010 and was successfully certified according to the guidelines of the German Society for Haematology and Oncology. The centre is subdivided into seven specialities, namely a visceral oncological, urological, breast cancer, gynaecological cancer, skin cancer, leukaemia, and head and throat tumour centre. They aim to provide a multidisciplinary and holistic approach to diagnostics and therapy for cancer patients.

As part of the larger municipal hospital, they follow its core values to provide the highest level of care, meet external structural and quality requirements, and work based on reliable scientific knowledge. To achieve these goals and stay innovative in the field of medicine, they invest in their workers and infrastructure. Their interdisciplinary team allows them to approach patient care and cancer treatment with individualised diagnostics and therapy based on reliable scientific knowledge. They perform annual quality controls and have their expertise certified by the experts of the German Cancer Society.

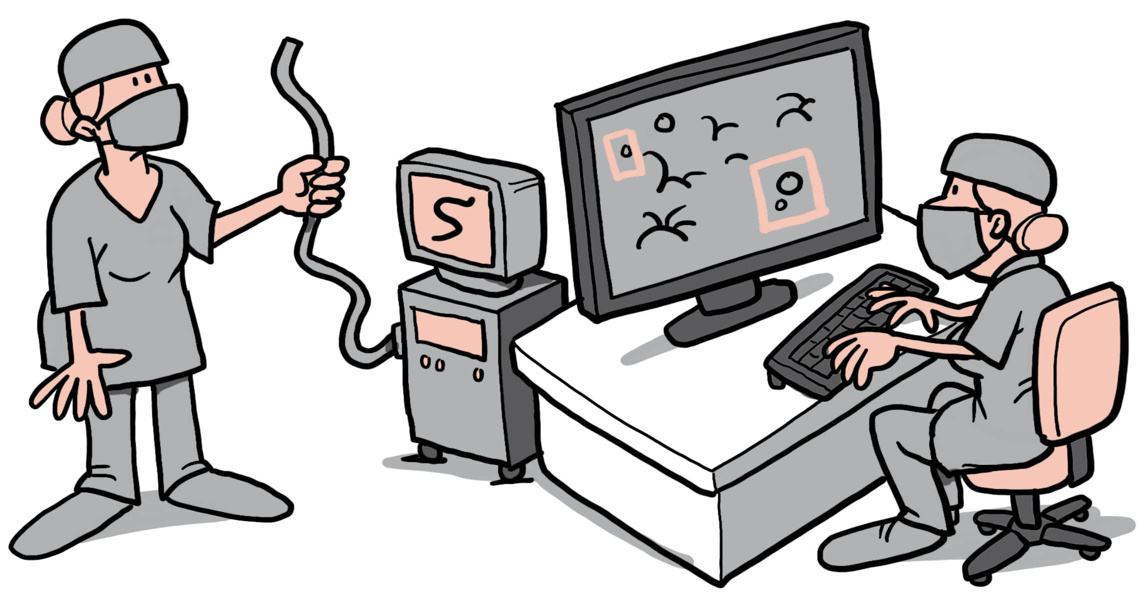
They have a strong focus on supporting their workers by expanding their individual skills through a comprehensive range of internal and external training and further education options as well as their own academy.

3.1 Description of the system

A colonoscopy is one of the most frequently performed forms of cancer preventive care in Germany. It is considered a routine procedure performed with a specialised tool, called a colonoscope. A doctor introduces a **colonoscope (a specialised endoscope), a tube with a built-in camera, into a person's large intestine**. The system then releases air into the intestine to widen it and have the mucous membrane unfold. The camera transmits images of the intestinal mucosa to a connected monitor. Here, the **practitioner inspects the images for intestinal polyps, adenomas and early stages of cancer**. Even when using state-of-the-art endoscopy systems, which can display the mucous membrane in high resolution, residual contamination or mucus remains can obscure vision of the tissue, making the initial signs of colon cancer harder to identify by eye. The identification in the oncological centre now gets supported by AI. It is a real-time video image analysis program, trained to identify polyps and adenomas at an early stage of development. It processes the colonoscope's video data during the medical check-up and displays visual indicators (green squares) on the screen where it sees a change in tissue with a high probability of being early-stage cancer. The AI has an increased detection rate, particularly for small, flat or difficult to detect adenomas smaller than 5 mm. The AI can operate without delay and display suspicious areas live to the practitioner.

A cartoon-style representation of the system, performed tasks and interaction with workers, including some of the challenges and opportunities for OSH is presented in Figure 1.

Figure 1. AI software supporting physicians in colonoscopy diagnostic tasks



3.2 Taxonomy-based categorisation

To categorise different types of technology, a taxonomy specific for different important criteria of AI-based systems and advanced robotics was developed by EU-OSHA.[1] This taxonomy includes, among others, the type of backend and frontend being used and the type of task performed, as well as which category it falls under (information-related, person-related or object-related). It distinguishes between routine and non-routine task characteristics as well as the degree of automation in the form of assistance or substitution. Finally, the taxonomy takes into account different OSH dimensions (physical, psychosocial and/or organisational) that are impacted by the technology.

Figure 2. Taxonomy for AI-based systems and advanced robotics for the automation of tasks

The system performs **cognitive tasks** based on an **AI-backend software**. It assists the clinicians in their task of performing a colonoscopy for cancer screening. It also assists in an **information-related** task that requires **continuous concentration** from the medical practitioner.

The medical practitioner still performs the colonoscopy and has to guide the endoscope through the intestines. While doing so, they also still perform the diagnostic task of searching for adenomas or abnormalities in the patient's large intestines. The AI performs the same task simultaneously and thereby **assists** them. This is a

[1] EU-OSHA – European Agency for Safety and Health at Work, *Advanced robotics, artificial intelligence and the automation of tasks: definitions, uses, policies and strategies and Occupational Safety and Health*, 2022. Available at: https://osha.europa.eu/en/publications/advanced-robotics-artificial-intelligence-and-automation-tasks-definitions-uses-policies-and-strategies-and-occupational-safety-and-health

routine task for most oncological practitioners. The **AI-based** software analyses the visual input in real time and flags any small nodes. Final confirmation of the analysis or the decision for further diagnostic processes is still done by the medical practitioner.

The doctor's job routine has not significantly changed with the AI's implementation. There are physical limitations to the speed of a colonoscopy for the patient's wellbeing, hence the process can only be sped up a little. Furthermore, there is no wish to increase speed, as the doctor also still manually analyses the video feed.

A similar picture emerges when one looks at the impact the system has on the doctor's job content. They still perform the same task as before. That includes the physical aspect of a colonoscopy, as well as the cognitive part of reviewing the camera footage and detecting any abnormalities. The major change is that they now have to take the AI's analysis into consideration when making their diagnosis.

It is especially important to highlight that the AI is limited and thereby cannot and will not replace doctors at this point. Firstly, neither the AI nor the doctor are considered to have a 100% detection rate of abnormalities. Hence, **having both analyse the footage increases the potential to spot any polyps**. Secondly, the AI-based system is trained to detect a specific type of abnormality in the intestines. This utilises the strengths of the AI-based system, by focusing on a very narrow field of application, by training the system to be highly discriminatory between what falls in this field and what does not. However, the human body is a highly complex environment with a variety of possible ailments. **Incidental medical findings** are not the objective of the cancer-focused diagnostics process, however, a skilled clinician is able to spot abnormalities during routine check-ups, even if they are not the initial objective.

In addition, care-related tasks following the colonoscopy are also unchanged. It is still the duty of the clinician to present the diagnosis to the patient and create a suitable treatment plan. Given the AI's area of application, cancer diagnostics, presenting a potentially positive diagnosis has to be done with the patient's mental state in mind. **Patients receiving a cancer diagnosis are likely to experience negative emotions, including depressive symptoms,**[2] **anxiety and post-traumatic stress.**[3] At the same time, there is sufficient research to indicate that cancer 'patients' quality of life and satisfaction … [are] most clearly predicted by the affective quality of the consultation.'[4] The importance of the doctor–patient relationship is well established and cannot be replace by an AI. So, while the AI can play an important part in the cancer diagnostics process, a skilled, human professional is still needed.

Another important unchanged factor is the concept of **responsibility**. While the AI provides diagnostic assistance to the clinician, it is ultimately the latter's responsibility to interpret and act on the AI's results. So, the final responsibility for providing a diagnosis lies with the doctor.

4 Implementation process

A key factor for the successful integration of technology into a new work environment is the implementation process. Several factors, such as the identification of objectives and goals prior to implementing the technology, design decisions and participation, worker involvement and training, as well as the inclusion of guidelines or legislation, can influence it. In addition, some of the most important steps are the assessment of whether the intended goals have been reached, documentation of what challenges were faced, and finally consideration of how these lessons influence future company plans regarding the implementation of either new systems or more of those already implemented.

4.1 Motivators and goals

Setting **goals** prior to implementing a technology can help quantify the success of the implementation and also inform what kind of technology is needed to reach them. The interviewees expressed a number of objectives and goals for the introduction of the AI.

The primary goal of the oncological centre is the **improvement of care for their patients**. Providing care to the highest level of standards is one of the hospital's core values. As the AI is capable of improving diagnostics and thereby helps detect cancer in the earliest stages, it contributes to this goal.

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[2] Hollingshaus, M. S., & Utz, R. L. (2013). Depressive symptoms following the diagnosis of major chronic illness. *Society and Mental Health, 3*(1), 22-39. https://doi.org/10.1177/2156869312464788

[3] Fortin, J., Leblanc, M., Elgbeili, G., Cordova, M. J., Marin, M.-F., & Brunet, A. (2021). The mental health impacts of receiving a breast cancer diagnosis: A meta-analysis. *British Journal of Cancer, 125*, 1582-1592. https://doi.org/10.1038/s41416-021-01542-3

[4] Ong, L. M. L., Visser, M. R. M., Lammes, F. B., & de Haes, J. C. J. M. (2000). Doctor–patient communication and cancer patients' quality of life and satisfaction. *Patient Education and Counseling, 41*(2), 145-156. https://doi.org/10.1016/S0738-3991(99)00108-1

The diagnostic process through video stream is **mentally demanding**. While a singular procedure only takes minutes, these minutes can be pivotal for a patient's medical future. Doctors have to be attentive and concentrate on the video stream for the entirety of the procedure. Done repeatedly, this can be tiring and draining on cognitive resources. Having technology that does not experience fatigue assist in this process can provide the medical staff with a feeling of support.

Lastly, the oncological centre, as well as the hospital at large, wants to use this type of technology to catch cancer early and often. The earlier cancer is detected, the easier and more successful its treatment can be. This would result in fewer resources needed for late-stage cancer care (a highly resource-intense medical procedure), which would in turn reduce stress in the hospital staff and the healthcare system as a whole.

4.2 Implementation

Before a new technology can be introduced into a workplace, there are a variety of factors to consider, and often several stakeholders to involve. The implementation process can differ from company to company. With AI-based systems and advanced robotics being so customisable in their application, the general implementation differs for each case study. Nonetheless, there can be common implementation steps taken, with regard to who is involved in the process. The standards considered to implement a technology are equally important, both with regard to which are widely used and which are relevant to a specific case study. Furthermore, the individual difficulties and challenges are as vital to understanding the success of a case study as the ones more broadly shared among several case studies.

4.2.1 Implementation steps

The implementation of this AI-based system is considered quick and comparatively low-effort. The initiative to buy the system came from the head of the oncological centre, after they had assessed the technology to be both fit for the task and to add value to the care process. The decision to fund the project had to be made by management, which approved the suggestion. As it is standard procedure when new medical technology is introduced, the data security evaluation was performed. Then the system was installed in the clinic and the company that developed the system held a briefing for the staff on how to use it. From there on, activating the system is simply done by push of a button. The system has been operating for around three months by the time of writing this report, without any incidents.

4.2.2 Standards and regulations

There were no specific standards and regulations that needed to be considered during the implementation process, beyond common considerations and norms for medical technology. However, as the hospital bought the system, it falls under the responsibility of the developer to provide a product that adheres to the norms.

4.2.3 Difficulties and challenges during implementation

There were no technology-related difficulties or challenges during the implementation process. As the technology is integrated into an already existing set-up, no major changes needed to be made to the examination office. The AI-based system is described as easy to use and very comprehensive and is received positively by the medical staff working with it. What was considered a 'difficulty' to some degree was the price of the AI-based system. The AI-based system used is described as the current 'gold standard', which is why the price is so high. While the price for this type of technology has come down slightly over the years, it is still considered an expensive product. The price is considered a possibly prohibiting hurdle for smaller hospitals or individual medical practitioners' offices to invest in the technology.

4.3 Worker involvement

Worker involvement during the implementation process can contribute to the success of a technology's implementation. Depending on the circumstances, this involvement can start at the design stage, or once training to use the technology starts. While there are external factors that can limit the extent to which workers can be involved, companies seeking to introduce AI-based systems should consider at what stage worker input can be included.

As this technology was bought from a third-party company, the workers of the oncological centre did not contribute to the design or creation of the system. The impulse to implement the technology, however, came from someone who would actively use the system in their daily routine.

4.3.1 Training and worker qualifications

Worker training and education is a major element for the success of technology implementation.[5,6] The doctors did not have to undergo additional extensive training to use the AI. It is built into the system they were already using before, and therefore it integrated easily into the workplace. While there is certified instruction by the developer, its output is described as understandable for trained medical personnel without the need for additional training.

One of the concerns, when it comes to the automation of tasks through AI-based and robotic systems, is the process of deskilling. Automation like this is generally seen as a starting point for one of three skill developments: **deskilling, reskilling or upskilling**.

The level of skill required in this case study does not change. While the AI is capable of improving cancer detection rates, the clinic is aware that it is not at a 100% rate. This is the reason why experienced doctors are still needed to work in tandem with the technology. **They need to maintain the same level of skill as before to provide quality care for their patients.**

4.3.2 Feedback system and report handling

Overall, the feedback on the system has been positive. It has improved the level of care the medical personnel can provide to their patients. It has been integrated into the workflow seamlessly and is easy to use. So far, there have been no reports of any incidences relating to OSH. Should there be any relevant changes made to the system itself, the company that developed the AI-based system would have to give the relevant staff new instructional seminars. This is standard procedure with medical equipment. Should there be any concerns or incidents related to the AI-based system, workers can speak to their supervisors to address them.

4.3.3 Level of trust and control

An adequate level of human trust towards the interacting system promotes appropriate system use,[7,8] while extreme forms of trust can lead to adverse effects. Excessive trust can lead to automation complacency,[9] whereas insufficient trust may lead to neglect of the technology.[7]

As the technology is only used by skilled and trained medical professionals, they are aware of the limitations of the technology. The AI-based system was trained for high sensitivity but low specificity. This means that it has a tendency to produce false positive results. The doctor then has to determine if the indicated area is a false positive or not. However, as the procedure is meant to spot early stages of cancer, investing the time needed to differentiate between a false positive and a positive is preferred to risking a false negative, which could result in undetected cancer for the patient. Doctors using the system are aware of this bias. Hence, they trust the system to perform its task within the limits of its programming.

In addition to trusting the system, a worker's **level of control** can have significant influence on a number of factors. The level of control doctors have over the system is more complex to determine. They can theoretically decide not to use the system. In rare cases, the additional time needed to perform the procedure with the AI-based system is not available or the intestines are not clean enough. Once the system is activated, however, doctors can only decide how to deal with the system's output. They have the final decision on how to interpret the system's indication; that is, if an abnormality is cancerous or not. So, while technological control over the system is limited, **the doctor remains in control of the medical procedure itself**.

4.3.4 Company culture and structure

There has been no impact on the company culture and structure by the AI-based system. As mentioned before, the system has only limited impact on a worker's routine and job content. Prior to the AI-based system being introduced, the procedure was performed by a team: a medical doctor and a trained nurse. Both roles are still needed to perform the procedure even with the addition of the AI-based system. It did not make either party's

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5 Waldeck, N. E. (2000). *Advanced manufacturing technologies and workforce development*. Garland Press.

6 Fraser, K., Harris, K., & Luong, L. (2007). Improving the implementation effectiveness of cellular manufacturing: A comprehensive framework for practitioners. *International Journal of Production Research, 45*(24), 5835-5856. https://doi.org/10.1080/00207540601159516

7 Parasuraman, R., & Riley, V. (1997). Humans and automation: Use, misuse, disuse, abuse. *Human Factors, 39*(2), 230-253. https://doi.org/10.1518/001872097778543886

8 Hancock, P. A., Kessler, T. T., Kaplan, A. D., Brill, J. C., & Szalma, J. L. (2020). Evolving trust in robots: Specification through sequential and comparative meta-analyses. *Human Factors, 63*(7), 1196-1229. https://doi.org/10.1177/0018720820922080

9 Parasuraman, R., & Manzey, D. H. (2010). Complacency and bias in human use of automation: An attentional integration. *Human Factors, 52*(3), 381-410. https://doi.org/10.1177/0018720810376055

contribution redundant, especially regarding the ‘four-eye’ principles in which the colonoscopy was already being performed. The AI-based system rather introduced an additional ‘set of eyes’ to the procedure.

Implementing the AI has impacted the quality of care for colon cancer patients, but not the overall hospital structure. It is considered a minor automation, not far reaching enough for larger structural changes on its own. While the procedures now take slightly longer, this did not spark the need for major scheduling changes. Neither were the teams performing the procedure reduced or increased in numbers, hence a reduction of social interaction at the workplace, or social isolation, did not occur. Whether the technology has long-term effects on the oncological centre’s workload remains to be seen. In theory, it should decrease workload in the long run, as it reduces the number of cancer patients needing intensive care, however, the true extent again will only become apparent in the long run.

The overall **automation is likely to impact the hospital and healthcare structure**. In the interviews, several possible developments are described: **it starts at the option for remote doctor consultations, surgical robots, long-distance care and other systems, like autonomous guided vehicles, to deliver medicine**. While their individual impact is often localised, with increased presence in a hospital, healthcare workplaces are predicted to continuously change, with impacts on the company culture and social structure being possible.

4.4 Future developments

The oncological centre itself as well as the hospital is looking into more innovative technologies to further improve care for the patients and to reduce the strain, stress and workload of their medical staff. While there currently are numerous systems being created and considered for introduction, no specific one was singled out. When it comes to the AI-based system that supports colonoscopies, the medical staff predicts it to become common practice in every hospital and practitioner’s office within the next 10 years. A major factor for this development is how the price of the system develops. Should it come down, they predict this process will be even faster.

Furthermore, next to more AI-based medical systems, the oncological centre sees tremendous value in improved, possibly AI-based reminders and invitation systems. These systems are supposed to help remind patients of their appointments and support them in scheduling new ones. More people attending these preventive care appointments is an important step in reducing the number of cancer patients in the long term.

5 OSH impact

The introduction of advanced robotics or AI-based systems can have a wide impact on OSH. It can pose a number of challenges as well as opportunities unique to each case study. Therefore, it is important to identify possible barriers and drivers to consider them in future projects. These new forms of task automation can even lead to changes in the overall OSH management of a company. Through the interviews, a number of these factors for this specific case study have been identified and discussed.

5.1 Challenges

As some AI-based systems and advanced robotics allow highly individualised solutions for a company, they can also present challenges specific to their case study. In addition, a company might also face more universal challenges during or after implementation of the technology. The interviews contained a number of OSH challenges the company had to face, both during the implementation phase as well as in ongoing production.

As this AI-based system was expected to have minimal impact on OSH, the challenges that arose in this context reflect that. Besides an increased cognitive load, no other challenges for OSH were reported.

5.1.1 Cognitive load

While AI is commonly associated with being used to decrease cognitive load, this specific system has the risk of having the opposite effect. As described above, **it prioritises sensitivity over specificity**. This means that more areas are indicated than technically need to be. For every single indication, the doctor needs to make a decision. This is in addition to all indications the doctor and nurse identify without the AI’s assistance. Hence, a single procedure now contains more decisions to be made than before. There is a risk of decision fatigue or increased cognitive load. However, a single procedure takes around 10 to 12 minutes, in between which breaks can be taken to counterbalance the effect.

5.2 Opportunities

The introduction of an AI-based system to the oncological centre also has the potential for numerous OSH benefits and opportunities. However, this case is unique in the way that the major OSH pay-offs are expected to occur in the future, rather than imminently with the introduction of the system.

5.2.1 Long-term workload

While the system initially increases the duration of an individual check-up procedure by minutes, the long-term benefits this increase can have might be significant.

Identifying critical polyps before they develop into cancer can reduce the extent of follow-up medical treatment significantly. It can possibly avoid the patient developing later stages of cancer altogether. While the doctor and medical staff performing the colonoscopy have a slightly increased workload during the procedure, they possibly decrease their future workload significantly with this initial investment. However, the practitioners highlight that there are no long-term studies on this effect available at the moment. The actual impact AI-based systems like this can have on the overall workload of oncological centres and hospitals still needs to be determined. Nevertheless, based on how other innovative technologies have improved care, it is reasonable to assume that this type of diagnostic support system will mirror their impact to a degree.

5.2.2 Emotional wellbeing

The oncological centre was already using what they call a ‘four-eye’ principle when it came to colonoscopies. This means both a doctor and a trained nurse monitored the colonoscope’s video output for abnormalities. This system is still kept in place, however, the AI now functions as an additional pair of eyes. Despite that, interval carcinoma still developed in some patients. This happens due to unavoidable human error and circumstantial factors beyond the medical staff’s responsibilities (for example, unforeseen interruptions, uncooperative patients and so on). Nevertheless, having a patient return with a carcinoma despite the check-up can be a negative emotional experience for the staff. The AI provides the medical staff with another layer of safety and assurance that the likelihood of having missed something is decreased.

5.3 Barriers and drivers

Many companies go through the process of integrating an advanced robotics or AI-based system in their workspace for the first time. The present case study encountered a variety of barriers and drivers throughout this process. Identifying these can help this company as well as others avoid barriers and promote drivers for their process automation.

5.3.1 Barriers

The financial side of the introduction process reveals itself to be a barrier in two ways. Firstly, the AI-based system is described as being **expensive medical equipment**. This might deter smaller hospitals or individual practitioners to invest in the technology. In this case, the system was approved for purchase to improve the standard of care, however it is not mandatory for a hospital to invest in this type of technology. Especially given the recent stress on the healthcare system in Germany and internationally, funds might be allocated to different departments to increase staff size or invest in protective gear for the workers, rather than in diagnostic tools. The price of the system also makes it harder for individual practitioners to buy it. They are further de-incentivised as the technology makes a single procedure take longer. In theory, this can result in lost revenue, as fewer procedures can be performed each day. Insurance currently does not prioritise or include AI-based diagnosis to give financial incentive to use the technology.

5.3.2 Drivers

There is an international push for developing AI-based systems to support doctors and healthcare workers in the diagnostics process. Worldwide research efforts have taken place in countries like China and Japan to develop systems with increased efficiency and reliability. This technology is now becoming commercially available.

Another driver is increased **awareness of the public of the technology**. As the technology is becoming more available, more people hear about it, show interest and possibly research it. This contributes to gathering long-term data that, in turn, can be used to improve the technology. Additionally, as the topic of preventive medical intervention through AI-based systems becomes more prevalent in the media and people’s minds, more people are likely to go get the procedure. This, in turn, can reduce the strain on the healthcare system in the long term and attract funding towards the technology.

The cooperation with an adjacent university is also highlighted as a driver for innovation in the hospital. This allows them to do their own research on medical technology and treatments and stay up to date on developments in the medical sector.

5.4 OSH management

New technologies can lead to a change in work procedure. This includes expectations for the technology and subsequent OSH management.

5.4.1 Expectations for OSH

The oncological centre expected the AI to affect OSH only in minor or indirect ways. In theory, the introduction of the system has increased the time needed to perform a single procedure by around 50%. However, the average procedure still only takes around 10 to 12 minutes. During this time, the medical staff is in a standing position. The increase in standing time of a single procedure, however, is not considered significant in the larger context of the healthcare staff's workday. Their risk assessment also came to the conclusion that the AI-based system does not cause any additional visual or acoustic risks to the medical staff.

5.4.2 Emerging OSH risks and monitoring

There is no formal OSH monitoring system in place for this specific technology. Should any changes be made to it, the company that developed the AI-based system sends someone to perform any required additional training for the staff. As the system is considered low-risk in general, the primary way to identify any emerging OSH risks would be through the doctors and nurses using the system.

5.4.3 Communication strategies

Communicating any changes about the technology follows the same channels as other technological changes in the oncological centre.

5.4.4 Integration of OSH management

The AI-based system did not spark the need for any adjustments to the hospital's or oncological centre's OSH management. Should advanced robotics and AI-based systems become more widespread at workplaces, this might change, however, in what way and to what extent will depend on the specific technologies.

5.4.5 Need for action

The oncological centre sees a need for action from both the medical and research communities and from the government. They express the potential for vast improvement in the medical field through advanced robotics and AI-based systems, which is currently not used due to a lack of official funding for research. They also see potential in creating a position for a **centralised coordinator** who helps identify common needs and potential for automation in several hospitals to unite their efforts and resources. This could help in prioritising the development and research of technology, which is expected to benefit a large number of hospitals, medical practitioners and patients.

5.4.6 Cybersecurity

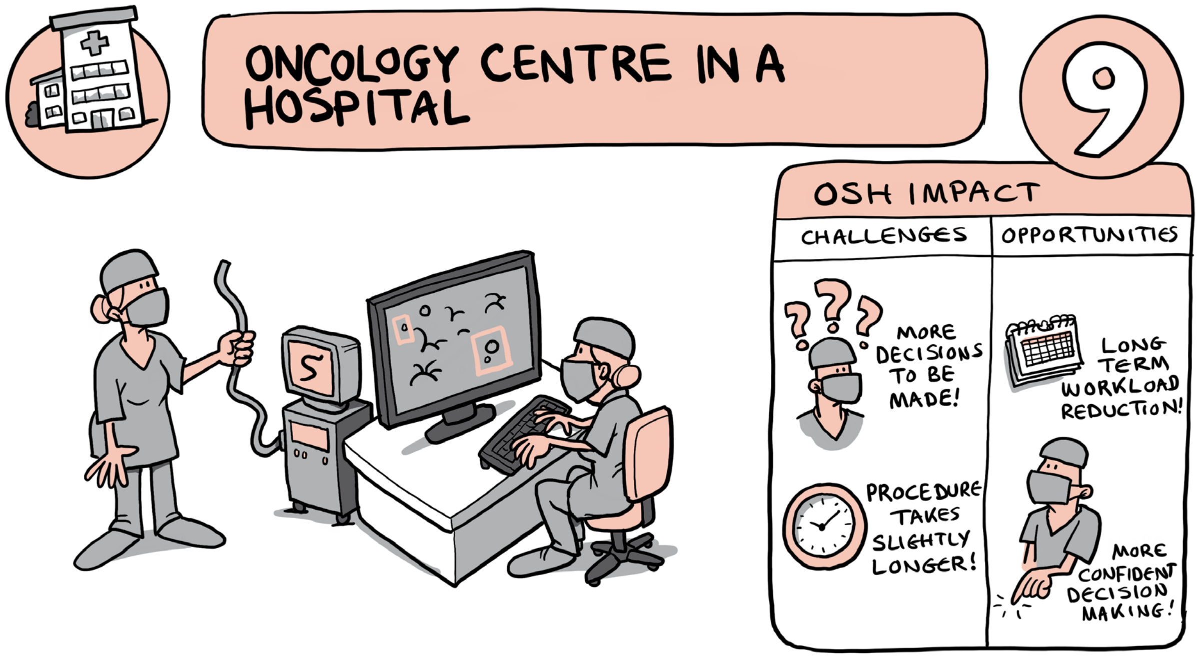
With technology becoming increasingly interconnected and data itself being a resource needed by some AI-based systems to improve their functionality, the topic of cybersecurity becomes prevalent in companies employing these technologies. The way that cybersecurity is handled at a company level is a key factor in securing the data when it comes to AI-based systems. Some systems require additional safety measures, depending on their use.

This AI-based system does handle person-related data, which need to be connectable to the person in question. However, this is not for the doctor using the system, but the patient. This is done with their consent and is a vital basis for their medical treatment. Furthermore, **the data are handled with the same level of confidentiality as any other medical information**. A data security evaluation came to the conclusion that the system was not 'critical' and that the medical staff's right to privacy is not infringed by the AI.

The system handles sensitive medical data. To ensure the patient's rights, **the hospital has extensive data protection in place**. This data protection, however, has not changed with the introduction of the AI-based system. The system does not inherently pose a threat to cybersecurity, nor does it provide a reasonable entry point into the hospital's network to be considered a target for a cyberattack. Hence, the measures for cybersecurity have not changed.

A cartoon-style representation of the system, including some of the challenges and opportunities for OSH is presented in Figure 3.

Figure 3. AI software supporting physicians in colonoscopy diagnostic tasks, posing challenges and opportunities for OSH



6 Key takeaways

This case study highlights the vast potential of using AI-based automation of tasks in the field of medicine. Decision support systems and diagnostic support tools are becoming more and more prevalent, not only improving the level of care provided to the patients but also supporting medical staff in their daily work.

The presented AI-based systems show that AI can be very effective in automating a specific task in a limited knowledge domain. Image analysis is an area where AI especially excels. And in combination with a trained doctor, the AI can contribute to better patient care.

While the system overall is considered to have limited immediate impact on OSH (there are some possible cognitive benefits, however, compared to other case studies, they are less prevalent), it holds the potential to have significant long-term effects. The implication of more early-stage cancer diagnoses is far reaching. Starting intervention in the early stages of cancer increases a patient's likelihood to survive. From a workload perspective, this can imply a decrease in needed medical treatment, medication and, possibly, a lower mortality rate. These effects will have to be tracked over time. **So, while the system itself automates a singular task, and does not change the job content or structure of the clinicians significantly in relation to that task, the use of the AI can potentially have far-reaching benefits, such as a reduction in the workload of medical professionals.**

One factor that remains unchanged is the **importance of having a human present in the diagnostics process**. Not only because neither the AI nor the human are currently infallible at detecting early stages of cancer, but more so for the doctor–patient relationship. It has significant impact on long-term care, and the mental state of patients. While the AI might be able to identify the early stages of cancer, communicating this news and consequences of the diagnosis in a comprehensive and compassionate way is a task that needs a human dimension.

Another key point of this case study is the topic of the **responsibility of the AI**. While the AI can detect and analyse information relevant to a diagnosis, it is still the trained doctor confirming or dismissing these results. This AI is a prime example of assisting in a task, not substituting it. The final decision and the responsibility lies with the medical professional, not the AI-based system. Keeping decision control with the human worker is not only an issue of trust in the technology but also **a matter of liability and ethics**.

In total, the field of medicine is seeing significant changes caused by advanced robotics and AI-based systems. There are numerous small systems automating singular tasks, like this AI, reducing the workload of medical personnel in the moment. However, where diagnostic support tools will likely show significant impact is in the long-term workload. **Early diagnosis in almost all medical conditions, especially cancer, improves the chances of successful intervention and survival.**[10] Fewer terminally ill patients reduces the workload of the entire hospital staff, all the way from care providers, like nurses, to administrative staff. In addition, this potentially decreases their exposure to patient death, which is a highly distressing part of the job at a hospital. While medical personnel are trained to handle these situations, reducing their occurrences can potentially lessen the mental and emotional strain they experience over their professional lifetime.

We are likely to see more automation faster in the hospital context than in most other workplaces. Recent events have highlighted the difficulty of handling a surge of patients without risking the medical personnel's safety and health. Automation, be it telepresence systems, delivery robots or online examination AI software, holds the potential to decrease workload, while keeping medical staff safer. In addition, it can decrease unskilled but time-consuming tasks (like delivering items through the hospital) and **allow care providers to spend more time with their patients**.

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[10] Hiom, S. C. (2015). Diagnosing cancer earlier: Reviewing the evidence for improving cancer survival. *British Journal of Cancer, 112*, S1-S5. https://doi.org/10.1038/bjc.2015.23