

Can Artificial Intelligence (AI) Support the Personnel Absence Management of Nursing Staff in Hospitals in Germany?

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ABSTRACT

Introduction: The integration of artificial intelligence (AI) in healthcare, particularly to support personnel absence management for nurses in hospitals, offers significant potential and challenges. Technological advances have already improved the quality of patient care through precise diagnostics and efficient monitoring. However, the shortage of qualified medical personnel remains a critical challenge.

Objectives: AI can analyze staff schedules, illness statistics, and employee profiles to proactively identify potential bottlenecks and absences. This enables preventive measures to minimize staff shortages and improve staffing efficiency, ensuring the continuity of patient care.

Methodology: Research shows that AI-based approaches in other industries have been successfully used to predict absences and optimize management strategies. For example, predictive algorithms have been developed to reduce financial losses and inefficient workflows.

Results: The application of such technologies in the hospital environment shows promising approaches, such as the development of apps that simplify the process of short-term staff replacements.

Conclusions: However, challenges remain, particularly regarding the legal and organizational implementation of such systems in hospital operations. Labor law provisions and the need for human intervention in short-term absences present significant hurdles. In summary, AI can support personnel absence management in hospitals and increase efficiency. However, careful planning and adaptation to legal frameworks are required to fully realize its potential.

Keywords: Artificial Intelligence, Healthcare, Personnel Absence Management, Nurses, Hospitals, Efficiency, Legal Frameworks

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INTRODUCTION

The German healthcare system offers a wide range of innovative medical services. Over the past decades, technology has significantly propelled healthcare into the future. Faster and technology-based diagnostic procedures have improved patient treatment outcomes with the aid of ultrasound, magnetic resonance imaging (MRI), X-rays, and computed tomography (CT), more accurate

diagnoses can be made. This advantage allows treatment plans to be precisely tailored to patients, medications can be finely adjusted through blood value analysis, and patient recovery can be optimized accordingly¹. In a hospital setting, technologies also support doctors and nurses, for instance, in collecting vital parameters². Due to demographic changes³ patient care is becoming more critical than ever, as the number of patients with multiple chronic conditions is steadily increasing. Unfortunately,

¹Cf. <https://link.springer.com/article/10.1007/s00103-023-03823-z>

²Cf. Kubek, V. et. al. (2020). Digitalisierung in der Pflege Zur Unterstützung einer besseren Arbeitsorganisation (Springer-Verlag) 2020 S.3

³Cf. https://www.destatis.de/DE/Themen/Querschnitt/Demografischer-Wandel/_inhalt.html

the healthcare system also faces significant challenges. A major issue is the shortage of personnel, impacting patient care capacity. The legal framework of the Nursing Staff Lower Limits Regulation (PpUGV) stipulates that only a certain number of patients can be assigned to a certain number of trained nursing professionals⁴ If hospitals do not have enough staff, it can lead to performance losses.⁵ Therefore, efficient absence management is crucial to prevent severe staffing shortages. Since hospitals collect many metrics and data to improve and make hospital management more transparent, artificial intelligence could develop an absence algorithm based on these metrics and data, allowing for early compensation of absences. This algorithm would consider duty rosters, illness rates, and predictable absences such as during flu seasons. This step would ensure the quality of patient care, enable automated processes, relieve employees, and save costs.

CURRENT STATE OF RESEARCH

To define the conceptual framework, I would like to discuss some definitions and legal foundations. In the bachelor’s thesis by Ms. Kristin Steinlein on the „Evaluation of Absence Management Models in Hospital,“ two terms, „jumping in from free time“ and „minimum staffing,“ are examined.⁶

Jumping in From Free Time

Table 1. Table on Nursing Staff Lower Limits from the Federal Ministry of Health.

Department	Number of patients in day shift	Number of patients in night shift	Number of staff
Intensive care medicine	2,5	3,5	1
Intensive care and pediatric intensive care medicine	2	3	1
Geriatrics	10	20	1
General surgery, trauma surgery and orthopedics	10	20	1
Internal medicine and cardiology	10	22	1
Cardiac surgery	7	15	1
Neurology	10	20	1
Neurological stroke unit	3	5	1
Neurological early rehabilitation	5	12	1
General pediatrics	6	10	1
Specialized pediatrics	6	14	1
Neonatal pediatrics	3,5	5	1
Gynecology and Obstetrics	7,5	15	1
Otolaryngology (ENT)	10	22	1
Urology	10	22	1
Rheumatology	13	30	1

⁴Cf. https://www.gesetze-im-internet.de/ppugv_2021/BJNR235700020.html

⁵Cf. <https://kidoks.bsz-bw.de/frontdoor/deliver/index/docId/1499/file/BASteinleinK.pdf>

⁶Ibid.

⁷Ibid.

⁸Ibid. ⁹Cf. <https://www.bundesgesundheitsministerium.de/themen/pflege/pflegepersonaluntergrenzen>

For acute absences, which occur immediately before an understaffed shift, the shift supervisor or the responsible manager must act directly and try to recruit staff. In such cases, teams often contact off-duty employees by phone to ask if they can jump in. According to § 12 Abs 2. of the Part-Time and Fixed-Term Employment Act (TzBfG), the employee is not obliged to take on this shift. „Der Arbeitnehmer ist nur zur Arbeitsleistung verpflichtet, wenn der Arbeitgeber ihm die Lage seiner Arbeitszeit jeweils mindestens vier Tage im Voraus mitteilt“ (BMJV (d), 12.12.2018) means: The employee is only obliged to perform work if the employer informs them of the timing of their working hours at least four days in advance.

Minimum Staffing

To focus on the definition of minimum staffing, it is essential to look at the legal framework of the Regulation for the Determination of Nursing Staff Lower Limits in Sensitive Hospital Areas (Nursing Staff Lower Limits Regulation – PpUGV). Before this legal basis, there was no minimum staffing in hospital wards, leading to the possibility that not all necessary nursing measures were performed, which could have resulted in supply problems or legally relevant consequences. This law provides clear specifications for the definition of minimum staffing.

Artificial Intelligence

In the academic literature, there is currently no uniform definition of the term “Artificial Intelligence”. Instead, a multitude of different explanatory approaches can be found (cf. Wirtz et al., 2019, p. 597)¹⁰. This diversity can be attributed, in particular, to the interdisciplinary nature of the field of Artificial Intelligence research from the beginning, as well as to the various stages of development that this field has gone through, and the associated technological advances. At the beginning of the research, classic Microsoft „Excel“-based „If“ rules were created. Gradually, some rules evolved into a rough construct of automated knowledge representation. It is important to note that there must always be a basic data source to which this system can access. Through the primary data source of the internet, the systems of automated knowledge representation could be fed. Furthermore, a learning function was then integrated into the system, allowing it to create new knowledge approaches and build upon them. This creates a dynamic that shows that knowledge continuously expands, provided that the old knowledge is stored.

Employee Pool Variants

Absence management offers opportunities for employees with special life circumstances or particular requirements for work-life balance. At the same time, it positively contributes to the working conditions of all employees and could, in the long term, counteract the necessity of using temporary staffing.¹¹

A proven method for dealing with long-term absences is the establishment of an employee pool. Such absences can arise due to various circumstances such as pregnancy, serious illness, or the unexpected loss of employees which can be difficult to compensate for in the medium term.

Unlike fixed teams, the employee pool does not offer a fixed assignment and routine like in a „permanent“ ward but enables flexible shift planning and potentially changing workplaces. Pool employees also report that they are relieved from discussions about internal team problems and structural political matters, which is perceived as relieving. For the sense of belonging, there can be pool team meetings, creating a sense of community.¹²

If the employee pool is the only solution for personnel absences, a crucial problem remains unresolved: short-term sick leave. These events are unpredictable and often require spontaneous employee cover, leading to dissatisfaction and an increase in overtime. Flex pool employees indicate in advance which days and times they are available. Daily, ward or shift leaders report the expected workload and short-term absences to the central coordination office. Half an hour before the start of work, the Flex pool employees are informed of which ward and center they will be assigned to on that day. The goal is to provide all employees with an opportunity to work, which in a conventional shift system would not be possible. Therefore, the Flex pool is particularly suitable for employees with a work commitment of less than 50%.¹³

METHOD (SYSTEMATIC LITERATURE REVIEW)

To determine whether artificial intelligence can support personnel absence management in hospitals, various literature databases were searched for academic literature. The selected search engines for this review were: PubMed, Cochrane, Springer Link, Google Scholar, Elsevier (Scopus). The search terms used for the literature search were: KI; Künstliche Intelligenz, Ausfallmanagement, Krankenhaus, AI, Artificial Intelligence, personal absence management, employee absence management, hospital.

Table 2. Database Hits with Respective Search Terms

	PubMed	Cochrane	Springer Link	Google Scholar	Elsevier (Scopus)
KI	11.391	218	856.947	5.290.000	19
Künstliche Intelligenz	192	0	28.151	121.000	1
Ausfallmanagement	1	0	77	159	0
Krankenhaus	22.483	320	144.620	734.000	1
AI	1.104.724	32	1.319.611	7.830.000	4
Artificial intelligence	228.217	6	1.016.202	6.110.000	1
Personal absence management	40.914	80	292.794	4.660.000	0
Employee absence management	7.136	13	127.279	3.170.000	0
hospital	7.009.673	2059	2.414.858	6.610.000	2

¹¹Cf. <https://link.springer.com/article/10.1007/s41906-019-0655-5>

¹²Ibid.

¹³Ibid.

When conducting a literature search, it is important to filter out high-quality search results to better investigate the relevance to one's own research question. Due to the

large number of professional articles, the search terms were combined, and the following number of hits were determined:

Table 3. Combined Database Hits with Respective Search Terms

	PubMed	Cochrane	Springer Link	Google Scholar	Elsevier (Scopus)
Künstliche Intelligenz Ausfallmanagement Krankenhaus	0	0	8	10	0
Artificial intelligence absence management hospital	492	6	23.800	245.000	0

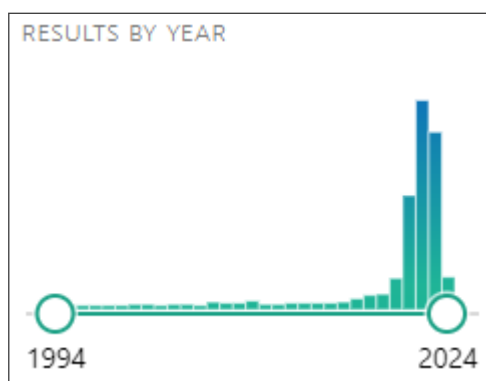


Figure 1. Publication Years of the Search Term „Artificial Intelligence Absence Management Hospital“ on PubMed¹⁴

In Figure 1, it can be seen that the number of scientific articles published on PubMed regarding the search term “Artificial Intelligence Absence Management Hospital” has significantly increased since 2016. The reason for this seems to be the integration of artificial intelligence into daily life, as well as the growing number of AI system providers.

The literature search revealed that the topic of absence management holds great importance, with various systems already addressing employee turnover and illness rates. The illness rate (short-term and long-term absences) is the core aspect of absence management. If there were no personnel absences, the absence management would not need to be activated to fill the respective shifts. Nevertheless, the application of artificial intelligence in hospital absence management has not yet become evident.

In the first study from 2022, artificial intelligence was used to create an absence pattern in a web-based decision tool to help managers revise policies or make new agreements to reduce workplace absences, financial losses, and the likelihood of economic insolvency. Nath G. et al. conducted predictive analyses and developed algorithms

to reduce costs and increase efficiency. They obtained the data to categorize absence classes from a Brazilian courier company.¹⁵

Araujo et al. addressed predictable absences of a Brazilian company in their 2019 study „A hybrid approach of intelligent systems to help predict absenteeism at work in companies“¹⁶ to reduce financial losses due to employee absences. They created a „fuzzy-neural network model“ that enables the calculation of regressions and defines the estimation of an employee's missing hours. The experimental results demonstrated that the intelligent model can help create a specialized system that aids in predicting absences.

Another study from 2019 concluded that AI plays a crucial role in improving various functions in human resources and paves the way for robotics companies to take over tasks such as recruitment, data analysis, data collection, workload reduction, and overall efficiency increase in the workplace. Vivek V. Yawalkar et al. believes that organizations that adopt AI-driven solutions harness their transformative potential and thus gain a competitive edge in the dynamic business world.¹⁷

¹⁴Cf. <https://pubmed.ncbi.nlm.nih.gov/?term=Artificial+intelligence+absence+management+hospital>

¹⁵Cf. <https://doi.org/10.3390/info13070320>

¹⁶Cf. <https://doi.org/10.1007/s42452-019-0536-y>

¹⁷Cf. www.researchgate.net/profile/Vivek-Yawalkar/publication/331596981_A_Study_of_Artificial_Intelligence_and_its_role_in_Human_Resource_Management/links/5c82a7e2458515831f92beea/A-Study-of-Artificial-Intelligence-and-its-role-in-Human-Resource-Management.pdf

More specifically, an article from the trade journal Thieme Online in 2023 on the topic „How a Potsdam Start-up Envisions Future Shift Planning“ introduced a Potsdam (Brandenburg) company that ventured into an app solution for absence management. Traditionally, managers or nursing shift leaders had to seek alternatives within the team by phone to quickly fill the absent shifts. Minutes of phone calls and requests or even orders were the daily business of absence management. Crewlinq created an app where the demand was communicated with one click to the other team members. Employees could conveniently accept or decline the respective shift with another click. This significantly reduces the time required and the associated stress for everyone involved.¹⁸

RESULTS

There are always approaches to how artificial intelligence (AI) is implemented in processes to create added value and ease human work. In healthcare, AI is often tied to examinations and rarely to processes. Nevertheless, it is possible to filter out illness rates among individual employees based on collected metrics, create an algorithm, and then provisionally hold personnel ready should the predicted absences occur. However, it must be noted that even if a short-term absence is reported, it must somehow/somewhere be recorded by a human, even if it occurs in a service company.

DISCUSSION

In a short review, it is difficult to scrutinize all sources for such an open question. Even the filtered sources deal with companies from other countries or with theories or even already functioning applications.

Furthermore, in some companies, it is not possible to implement such a concept without the consent of the works council due to labor law. This requires precise planning of information technology and possibly also adjustments in various processes such as automatic work recording, automatic system feedback if employees do not arrive on time, an AI algorithm, and much more.

CONCLUSION

The topic of absence management is not only encountered in healthcare but also in all other professions. Managers hope that a well-optimized absence management system will lead to better efficiency, reduced costs, or even the avoidance of additional costs if trained or experienced personnel are absent. In healthcare, specifically in the hospital sector, absence management is necessarily

required to ensure patient care. If the legal ratio according to PpUGV between the number of caregivers and the number of patients is not met, penalties for the clinics will follow. The approach of using artificial intelligence to make more accurate predictions of when acute personnel absences will occur is possible. However, the interface from sick leave notification to the specialist stepping in still has hurdles that cannot be fully replaced by artificial intelligence. Furthermore, labor law does not permit the evaluation of personal sickness rates.

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¹⁸Cf. <https://www.kma-online.de/aktuelles/it-digital-health/detail/ausfallmanagement-so-stellt-sich-das-start-up-crewlinq-die-dienstplanung-der-zukunft-vor-49332>

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