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Impact of Telemedicine Adoption on Care Professionals in Nursing Homes: A Pre- and Post-Implementation Study

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Abstract

Telemedicine has become a revolutionary solution for nursing homes that delivers better connection to care services and combines operational excellence with improved care quality. The entire telemedicine system requires substantial acceptance and practitioner adaptability to become effective. Research evaluates healthcare provider perceptions alongside their attitudes regarding telemedicine adoption along with assessment of their acceptance before and after telemedicine implementation in nursing homes. The research implements a mixed-methods approach which combines surveys with interviews to investigate four essential acceptance factors through evaluation of perceived usefulness and ease of use and evaluation of training programs and organizational support. The evaluation includes assessments of technical resistance alongside care depersonalization concerns and interruptions in workflow practices.Telemedicine implementation led to substantial changes in staff perception showing improved ability to use telemedicine and better patient results and improved teamwork among medical fields. The adoption of telemedicine faces ongoing difficulties mainly because of people's insufficient digital skills and limited technology infrastructure. Research results demonstrate why proper training sessions and changes to existing policies are essential for enhancing telemedicine integration in long-term care facilities. Research-generated recommendations direct healthcare administrators and policymakers in streamlining telemedicine implementation because they lead to better nursing home care quality and efficiency.

Keywords: ***Telemedicine, Nursing Homes, Care Professionals, Technology Acceptance, Pre- and Post-Implementation, Digital Health, Healthcare Innovation, Long-Term Care, Telehealth Adoption, Mixed-Methods Analysis.***

1.Introduction

Healthcare systems across the world face a major challenge because elder patients need better quality treatment. Rising population aging has produced an accelerated growth of older adults needing specialized healthcare thus creating extensive challenges to medical infrastructure and personnel and financial resources. The population change represents an authentic transformation which affects societies' handling of elder care through nursing homes that deal with acute medical requirements. The current healthcare system depends substantially on hospital admissions along with consultations that happen in person while these methods prove ineffective and expensive and may not be necessary. Hospital stays that might be necessary at times prove disadvantageous to elderly patients who live with multiple health problems or dementia-related cognitive disorders. The duration of emergency department waits together with exposure to novel pathogens and unfamiliar surroundings at hospitals lead to substantial health decline in elderly patients. The process of hospitalization leads to higher risks of developing complications such as delirium together with infections and decreased mobility which speeds up functional decline(1). Current healthcare systems necessitate immediate medical services which also need to avoid unnecessary hospital stays. Nursing homes can use telemedicine as a promising approach to provide remote medical care through consultations and diagnoses from healthcare professionals without requiring patient hospital transfers.

Telemedicine exists as a remote medical service delivery method that combines information and communication technology (ICT) with the purpose of overcoming geographical limitations that affect healthcare accessibility. Video conferencing enables near-face-to-face communication between patients and medical staff while electronic health records allow patients to have that information instantly available to clinicians and caregivers. The provision of remote medical care stands important in nursing homes because their physicians rarely stay onsite thus care professionals need quick guidance during critical choices. Immediate access by nursing homes to telemedical specialists enables quick diagnosis of geriatric patients displaying health crisis symptoms such as fever and sudden cognitive decline and respiratory distress which leads to better decision-making about appropriate healthcare treatment(2). The use of telemedicine leads to professional medical conclusions about when hospitalization is avoidable and provides suitable

alternative treatments that can be administered in the nursing home under supervision. By using telemedicine staff members can provide routine examination services and manage both physical and mental health needs of elderly nursing residents who can receive care from their comfort zone. Telemedicine produces two benefits: it streamlines medical care delivery and creates better residences for patients through enhanced comfort while improving their life quality.

Telemedicine implementation success in nursing homes depends mainly upon healthcare professionals showing their acceptance as well as a strong commitment to use these technological solutions in their clinical practices. Nursing homes depend on their staff to lead the integration of medical technology because these workers connect patients with consultations through telemedicine systems and maintain healthcare equipment while organizing adequate patient care afterward. Technology adoption exists as a complex procedure that does not present itself as an immediate process. Healthcare professionals decide to adopt or decline telemedicine solutions based on their opinions about product usability and usefulness as well as trust in digital healthcare systems as well as doubts regarding data security protocols. Implementing technological assistance in medical practice demands comprehensive training together with supportive organizational systems that create a new organizational perspective. Correct usage of telemedicine depends on how care professionals view it as either a useful aid or extra work because inadequate perception reduces its ability to improve patient healthcare. Scientists need to investigate nursing home workers' previous perceptions along with their resulting reactions after telemedicine deployment to discover effective ways of integrating these technologies in elder care facilities(3).

A research investigation studies how telemedicine acceptance changed for nursing home care professionals during and following the appointment of teleconsultation systems. The research derives its data from the Optimal@NRW project that implemented telemedical consultations across 24 nursing homes throughout Germany. A dual approach which combines numbers with observations helps analyze care professional assessments about telemedicine benefits and obstacles as well as its final impact on elderly patient care. The study examines influential elements affecting telemedical solution adoption to offer vital knowledge to healthcare policy makers and medical practitioners who develop digital health technologies in elder care. The research findings will enhance ongoing dialogue about efficient healthcare delivery for elderly patients by supplying information about telemedicine implementation for clinical staff.

2.Materials and Methods

Project Course and Empirical Approach

The Optimal@NRW project works to improve nursing home geriatric care quality and efficiency by adopting telemedical consultations in nursing homes. A multi-staged empirical research design formed the basis of the project for evaluating telemedicine effects within real nursing home environments regarding medical health, financial matters, and social benefits. The ongoing healthcare challenge demands innovative answers to staff shortages and elderly patient accessibility so the project established modern digital health technology ties with traditional care practices. The research team examined 24 nursing homes throughout Germany to determine how personnel working in healthcare services used telemedical solutions in their ongoing routines. The study used quantitative questionnaires and qualitative question-and-answer interviews to track the modifications in telemedicine perception between the study start and completion. The researchers designed their methodology specifically to identify all influence factors associated with telemedical application acceptance and usability while determining effectiveness(4).

The research followed a scientific approach by dividing its activities into pre-implementation followed by implementation and wrap-up with post-implementation phases. Professional care providers participated in pre-implementation surveys that assessed their viewpoints and anticipated difficulties and hopes regarding telemedicine before they started using telemedicine technology. The initial phase established fundamental information regarding what telemedical consultations would mean for practice both positively and negatively. Telemedicine equipment deployment then started together with care personnel training and finally integrating telemedical consultations into standard patient care practices. Nursing homes started implementing telemedicine services for urgent medical needs which enabled physicians to conduct live remote medical consultations during this period. The post-implementation phase included another survey of care professionals to determine their modifications in attitudes and experiences from actual telemedicine patient scenarios usage. The final assessment phase offered essential data regarding the long-term changes in nursing home professional perceptions about telemedicine implementation as well as its effectiveness in delivering improved care.

The Optimal@NRW project differentiated itself from various previous research projects by prioritizing human-centered analysis since care professional willingness and acceptance specified long-term success for such innovations. The research examined both quantitative performance results like hospitalization rate reductions and response times and it recorded the subjective feedback of telemedical systems users who are mainly caregivers. Research success

depended on this evaluation because it focused on how healthcare personnel accept and perform telemedical consultations. A comparison of findings before and after implementation enabled researchers to establish vital acceptance factors for telemedicine through the identification of usage convenience and perceived utility together with proper training and organizational backing. The research approach provides comprehensive understanding for healthcare policymakers and nurses to use findings effectively alongside nursing home administrators and technology developers when optimizing digital health solutions for elderly care(5).

Questionnaire Design

The research obtained empirical data through a structured questionnaire that allowed researchers to evaluate various dimensions of telemedicine acceptance. The research instrument followed the principles of TAM and UTAUT to create its foundation then incorporated specific questions regarding nursing home settings. Three essential areas made up the questionnaire: it gathered demographic and occupational details from participants and also investigated their perceptions about telemedicine advantages and limitations before measuring their support for using telemedicine. The first segment asked study participants to report their demographics together with job experience along with their living conditions and professional and personal experience in caregiving services. The study included these variables to determine if background traits affected nurse and healthcare worker perspectives about telemedicine.

Participants evaluated both advantages and obstacles related to telemedicine through the second section of the evaluation. The questionnaire included a six-point Likert scale (1 = strongly disagree, 6 = strongly agree) for participants to rate the given statements about efficiency, convenience, workload impact, and medical effectiveness. The purpose of this section was to understand how healthcare providers assessed telemedicine effects on patient care quality and hospital admissions and technical and ethical challenges. The field of digital health acceptance provided multiple survey instruments from which researchers adopted reliable and valid measurement items. General opinions about telemedicine along with future anticipation for telemedical consultation adoption were assessed through the third part of the survey. This section evaluated healthcare providers regarding their acceptance of telemedicine implementation and their competence using digital systems along with their training requirements. The diverse survey components generated thorough insights about telemedicine adoption which produced comprehensive statistics that connected pre-implementation data to post-implementation results(6).

Data Analysis

The researchers utilized descriptive and inferential statistics to uncover statistical relationships between important study variables from the gathered data. The reliability analysis results demonstrated that all survey sections including intention to use and perceived benefits and perceived barriers showed reliable internal consistency with Cronbach's alpha values above 0.7. The analysis of descriptive statistics included mean scores alongside standard deviations and frequency distributions for showing telemedicine acceptance changes pre- and post-implementation. A paired-sample t-test together with analysis of variance (ANOVA) established whether significant shifts occurred in attitudes and experiences during the time period under study. The statistical tests established if care professionals experienced positive or negative changes or no changes in telemedicine perception after practicing with the technology.

The predictive factors of telemedicine acceptance received analysis through regression models. The analysis used independent variables including training quality, perceived ease of use, professional experience to examine their influence on dependent variables which consisted of attitudes toward telemedicine and telemedicine usage intentions for care professionals. The analysis included controls for possible influencing factors which included age of participants and gender distribution and professional years in healthcare. The results from statistical tests yielded research-backed information helping nurse homes develop better training strategies to resolve adoption challenges so they can effectively implement telemedicine solutions.

Characteristics of the Sample

The study included 217 care professionals who responded in pre-implementation phase amounting to 130 participants along with 87 participants from the post-implementation phase. A total of 217 care professionals participated in the study where the average participant age was 37.4 years (SD = 12.0, range: 19–65) and the majority (71.9%) were female despite being representative of the nursing gender distribution. A significant number of participants (83.8 percent) resided with their partner or a member of their family while over half of them (59.7 percent) also engaged in informal caregiving before starting their nursing career. Research data showed that 53.4% worked more than five years at their nursing home while 16.8% worked one year or less and 29.8% worked between one to three years. A statistically valid comparison of results was possible because background characteristics between pre-implementation and post-implementation participants remained equivalent according to the statistical tests.

3.Results

The main goal of this research analyzed the movement of care professionals' telemedicine acceptance and attitudes during implementation phases in nursing homes. Research compared critical variables between pre-implementation and post-implementation time periods which included general acceptance evaluations and assessments of benefits and barriers and implementation requirements. The formulated hypothesis (H1) declared that care professional telemedicine acceptance would grow higher following their actual usage experience. The study results showed multiple complex elements. chấpitati on of telemedicine was positive throughout both stages according to study findings yet post-implementation evaluations did not reach statistical significance. Care professionals exhibited positive telemedicine receptiveness at the beginning and their practical experiences proved to match instead of exceeding these initial expectations. The acceptance of telemedicine remained favorable but the practical implementation failed to transcend original expectations as predicted(7).

Hypothesis H2 proved valid based on the data because care professionals assessed the perceived benefits of telemedicine with increased favorability after experiencing its practical implementation. Care professionals came into their experience with telemedical consultations already understanding multiple positive effects which included reduced hospital stays and accelerated physician availability and improved coordination for patient care. The professionals developed stronger optimistic attitudes about telemedicine following their actual practice with this technology. The practical benefits of telemedicine support were acknowledged by staff members after implementation because it streamlined real-time decisions and reduced emergency transfers and provided thank-you support for challenging medical situations. The approach helped care professionals establish easier communication with external healthcare providers because it removed the time delays from traditional in-person physician meetings. Telemedicine has demonstrated its worth as a caregiving tool for older patients within settings that lack instantaneous medical professional access.

The findings regarding Hypothesis H3 demonstrated powerful results about what professionals perceived as obstacles to using telemedicine. Many caregivers expressed multiple concerns about technical system breakdowns coupled with data protection issues along with feelings of the coldness of remote clinical examinations before telemedicine implementation began. Healthcare professionals felt that telemedicine could generate both miscommunication problems between medical and nursing staff members and lead to new administrative requirements. The actual use of telemedicine systems resulted in diminished concerns among healthcare professionals through their firsthand experiences thus proving effective in reducing their initial doubts. The usage of remote medicine solution led to substantial improvements in care professionals' perception regarding system usability and the ease of interacting with distant doctors. Healthcare workers at first expressed hesitation regarding their ability to use telemedicine equipment and the difficulty physicians experienced in diagnosis without physical examination. The interface proved easy to use and remote medical communication quality satisfied their needs for effective medical choices. Research evidence shows that direct experience with new healthcare technology destroys concerns held by healthcare providers.

The research on conditional requirements for telemedicine adoption through Hypothesis H4 produced significant findings. Before telemedicine implementation care professionals recognized that success required strong technical systems and thorough employee training and continuous technical support. The health staff rated requirements less strongly after implementation when compared to their pre-implementation ratings though technical factors still proved essential to operational success. Staff members first thought they needed comprehensive training before using telemedicine properly yet basic training proved adequate for their everyday needs. The actual encounter with technology shows that technical readiness stands as crucial but first impressions of complexity tend to be exaggerated.

Relationships Between Acceptance and Influencing Factors (H5)

The research examined both the evolution of care professionals' telemedicine attitudes over time while determining what factors most impacted their acceptance of the solution between the two evaluation periods. Registration analyses tested Hypothesis H5 based on pre-implementation while using the post-implementation data separately. The main factors that influenced telemedicine acceptance by care professionals underwent changes after they started using the system because practical experience affected their attitudes(8).

During the pre-implementation stage care professionals who held positive views toward telemedicine functions demonstrated the greatest acceptance towards this technology. Medical staff demonstrating extensive anticipated advantages of telemedicine including better patient services combined with hospital admission reductions alongside workflow optimization showed the strongest preference to implement this technology. The variables of individual demographics which included age, gender and experience level produced negligible effects on the participants' acceptance levels of telemedicine. The first reception of telemedicine among care professionals mainly stemmed from their positive perception of its worth despite their personal backgrounds or technical fluency.

The explanatory factors that influenced implementation outcomes underwent changes after implementation had been completed. Acceptance of telecare services among care professionals became dependent on both advantageous

perceptions and hinderance perceptions although advantages retained their primary influence. Professionals who started with concerns about telemedicine usability and security issues and data communication but found these factors less problematic after actual practice developed more positive attitudes toward telemedicine use. Engagement with telemedicine practice both confirmed optimistic beliefs and minimized previous concerns which together contributed to better long-term acceptance.

The regression analysis revealed an extreme connection between telemedicine attitude and users' intentions to embrace telemedicine practices. The research findings validate established technology acceptance models (TAM, UTAUT) because perceived usefulness and ease of use directly determine behavioral intent. The study results showed that organizational elements including perceived management support together with staff availability did not prove significant as acceptance predictors. User experience plays an essential role in telemedicine adoption compared to institutional factors at the beginning of system implementation.

4.Discussion

Key Insights and Interpretation

Research findings deliver fundamental details about elements affecting the acceptance of telemedicine among healthcare professionals who work in nursing homes. The examination of professional caregiver attitudes before and after telemedical consultations revealed true-life effects of these consultations on technology adoption willingness. Telemedicine acceptance rates stayed consistent from the initial phase to the subsequent phase. The studied care professionals began with positive telemedicine predispositions which maintained their similar views throughout their experience. The empirical data revealed that nursing home staff had already acknowledged telemedicine advantages prior to its implementation and their positive attitudes towards it strengthened more than evolved substantially.

Telemedicine hands-on experience resulted in substantial reductions regarding nursing home staff members' perceived obstacles to treatment. Before introducing the system staff members voiced reservations about technical problems along with concerns about data security and missing direct contact with patients and additional responsibilities. The actual use of the system resulted in diminished concerns among care professionals compared to their original thoughts in the pre-implementation stage. Research findings from technology acceptance match findings that exposing users to technological systems typically decreases their perceived understanding and enables them to develop better system proficiency. The elimination of concerns regarding technical problems and communication breakdowns proves potent because these two issues represented the biggest implementation barriers at first. The hands-on experience with telemedicine practice led healthcare professionals to discover that their expectations of usability and effectiveness about the system were wrong(9).

Telemedicine proved its practical value to nursing homes throughout the implementation follow-up period after implementation. The decision-making process improved among care professionals since they gained quick access to medical experts and noticed fewer hospital visits which are essential goals for telemedical interventions. Real-world adoption potential for telemedicine increases because care professionals use it successfully in their practice settings. The observed decrease in emergency hospital admissions supports improved care outcomes and produces healthcare expense benefits. Avoidable hospitalizations provide better care to patients through their familiar setting while simultaneously lowering the burden on emergency healthcare systems which remains crucial due to current healthcare resource distribution issues.

This research showed fundamental changes in the factors which determined telemedicine acceptance during pre-implementation compared to the post-implementation stage. During the pre-implementation period care professionals accepted telemedicine mostly because they saw the advantages of this system. The reduction of perceived barriers became the primary reason for acceptance during the post-implementation stage. The data shows that caregiver adoption of telemedicine develops through an evaluation process which first requires initial excitement but then requires hands-on technological encounter as its defining component. The importance of providing both initial encounters with digital health solutions and hands-on training emerges from these study findings. Care professionals cannot overcome their initial reservations about telemedicine until they engage with the technology directly. Theoretical education alone is not enough to change their minds about adopting this method of healthcare provision.

Organizational elements consisting of management backing and institutional procedural systems failed to demonstrate their value as predictors for acceptance. The findings demonstrate a vital aspect because they indicate that individual user experiences matter more than organizational readiness in determining telemedicine acceptance by care professionals. Technical infrastructure and administrative support tools maintain significance for healthcare facilities but do not drive decision-making when it comes to nursing home telemedicine adoption. Caregivers primarily base their decision to incorporate telemedicine at patient care sites on how they personally interact with the technology and

what advantages they perceive from using it.

Implications and Recommendations

The study provides fundamental recommendations which enable successful telemedicine adoption within nursing home facilities. Building acceptance requires nursing staff members to gain firsthand experience with telemedicine systems. Healthcare administrators must give nursing home clinicians early access to telemedicine platforms through practical seminars and operational trials rather than making theoretical lessons their only resource for exposure. Telemedicine deployment in controlled and low-risk conditions lets care professionals address potential implementation issues thus improving the overall adoption acceptance.

The implementation strategy should begin by addressing all obstacles which healthcare providers believe exist. Healthcare organizations need to focus on creating telemedical systems with high user-friendly features since technical issues and device usability problems account for most pre-implementation roadblocks. The healthcare organization should provide telemedical systems with user-friendly interfaces and straightforward troubleshooting guidance along with prompt technical support services. The reduction of doctor-patient communication doubts and data security concerns following practical training points to the advantage of including this information in training sessions. A better understanding of remote consultation security protocols in addition to proof of their effective communication capabilities would reduce the initial resistance among healthcare providers.

Healthcare providers need to deploy telemedicine through staged implementation to maximize the visibility of its advantages that developed after system deployment(10). The slow implementation of telemedical consultations enables staff members to accumulate expertise so the system might experience better acceptance down the road. Healthcare professionals need orderly feedback channels to share their practical experiences and concerns which will enhance telemedicine workflow optimization and service user satisfaction.

Organizational mandates alone do not drive telemedicine adoption because nurses adopt telemedicine based primarily on their personal experiences. Organizational enforcement strategies from above should be replaced by collaborative approaches which originate from within the healthcare system. Nursing home staff are likely to adopt telemedicine practices more successfully through programs which encourage mutual exchange of knowledge and mentoring relationships and team-based learning opportunities.

5.Conclusion and Future work

The research demonstrates telemedicine can integrate smoothly into nursing homes while most care professionals show support for its implementation. Research results demonstrate that surgical experience eliminates workplace apprehensions thus validating direct system exposure as the key factor in competing doubt. Telemedicine acceptance rates of care professionals showed no change but their confidence grew and their worries about its effectiveness and usability diminished substantially following practical implementation. Telemedicine initiatives of the future need to concentrate on direct experience rather than lengthy theoretical programs.

Real benefits emerge in geriatric care through telemedicine access because this system results in lower hospital stays as well as rapid medical expertise availability while providing better support for caregiver choices. The benefits obtained from telemedicine systems drive superior medical outcomes alongside enhanced operational health system performance and economical advantages. The persistent nursing shortage and healthcare availability problems make telemedicine emerge as an effective approach that scales up to improve elder nursing home care.

Medical practitioners along with policymakers need to guarantee that initial telemedicine implementation focuses on user-friendly interfaces and direct application training and human-oriented planning. The Optimal@NRW project demonstrates how care professionals overcome their telemedicine concerns through real projects. Research needs to study the long-term use of telemedicine in elder care through evaluation of supportive measures and healthcare policy changes as well as system advancements that sustain telemedicine adoption.

This study validates the imperative connection between healthcare technology solutions and human-based care delivery methods. The success of telemedicine in healthcare advancement requires caregivers to receive sufficient training so they can embrace and feel proficient with digital platforms. Healthcare institutions can guarantee telemedicine's continuous impact on nursing home care through active development of learning cultures that promote adaptability.

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Conflicts of interest

The authors have no conflicts of interest to declare

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