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Measuring the impact of digitisation on NHS nurses' time and morale: A time and motion study

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Abstract

Objective: Despite the benefits of digital transformation, many healthcare organisations still rely on manual, traditional processes to transfer clinical images and videos to electronic patient records (EPRs), consuming valuable nurse–patient-facing time. Our study aimed to outline tasks performed by nurses to traditionally transfer clinical images and videos to EPRs, assess the impact on nurses' time and efficiency cost, and report on nurse experiences when transitioning to a digitised process.

Methods: Observations spanned two one-week periods in the ENT outpatient department of Royal Devon University Healthcare NHS Foundation Trust, using direct observational time and predetermined motion time system analysis to map nurses' tasks pre-and post-implementation of a Medical Video Recorder and Centralised Medical Content Management. Two staff experience surveys were conducted, and data was aggregated to evaluate the impact of digitisation.

Results: Nurses traditionally followed two processes to transfer clinical images and video to EPRs. Digitisation saved 43 seconds per endoscopy (a 10% efficiency gain) compared to Process 1, in which nurses print, attach, scan, and digitise images off-site to EPRs, and 3 minutes and 8 seconds (a 33% efficiency gain) compared to Process 2, where urgent content is recorded on an iPad and transferred to EPRs. Digitising could save nurses 26 working days annually by reducing non-patient-facing tasks in the ENT department, leading to an annual time efficiency cost-saving of £6780. Furthermore, 75% of nurses reported significantly improved morale, 63% strongly agreed that digitisation improved confidence in the accuracy of patient details, and all paper processes were eliminated.

Conclusion: Our findings highlight the inefficiency of traditional methods in transferring images and videos to EPRs. Digital transformation could enhance nursing efficiency and morale, improving care quality. Future studies should evaluate the effectiveness of Medical Video Recorders and Centralised Medical Content Management in other departments.

Keywords

Digital, digital health, health, technology, imaging, connected care

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Introduction

The National Health Service (NHS) is in a state of transition. The healthcare system faces difficult challenges such as economic pressures, declining staff morale, and a growing nursing shortage. A supply–demand gap of 140,600 nurses is projected for the NHS in England by 2030/2031.[1,2] These shortages heighten the pressure on

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current staff, leading to overwork, burnout, and potentially compromise care quality.[3]

Nursing care is required to be more patient-centred, efficient, and effective, in addition to producing high-quality patient outcomes.[4] However, the NHS annual staff survey continues to show downward trends in staff morale, which has a direct influence on productivity, quality of care, patient safety, staff retention, and healthcare costs.[5–8] This highlights the need for the NHS to increase nursing efficiency to deliver high-quality care despite limited resources.

Digital transformation: Nurse care delivery and morale

Digital solutions are an integral part of health and social care practice, as it has the potential to significantly improve patient care.[9] The NHS has made digitising, connecting, and transforming technology a core priority because it will increase the long-term viability of healthcare.[10] The NHS Long Term Plan outlines the need for all NHS providers to achieve a core level of digitisation, including health records, by 2024, with the key milestones of 90% of NHS Trusts adopting electronic patient records (EPRs) by December 2023, and full implementation by March 2025.[11]

Digital solutions have the potential to boost nurses' productivity by decreasing the amount of time they spend on documentation. Nursing productivity has been measured in terms of the amount of time nurses spend providing 'value-added' care, which includes direct patient care, interprofessional communication, and other tasks that benefit the patient directly.

The quality of patient care and nurse morale is strongly tied to the direct time nurses spend with patients.[12] Direct care not only improves patient outcomes but also enhances patient satisfaction.[13–16] However, studies indicate that nurses only dedicate 37% of their time, or roughly 3.1 hours of an 8.5-hour shift, to patient interaction.[12] Documentation alone accounts for 35% of their day, while actual patient care tasks comprise just 19% of their time.[17] Moreover, a 2016 study revealed that healthcare professionals (HCPs) spend only 27% of their day with patients, with almost half their time consumed by EPRs and desk work.[12]

The emphasis should therefore be on implementing digital solutions that enable nurses to dedicate more time to direct patient care, as this has been shown to positively impact health outcomes and satisfaction levels for both patients and HCPs.[12]

The importance of procedure recording and medical content management

Nurses increasingly rely on digital tools like EPRs to manage health data, moving away from paper records.[18–21] Digital transformation in the NHS also includes the storage of endoscopic clinical images and videos, which are vital for tracking patient conditions, and supporting referrals. In 2020, 1.3 million endoscopic procedures were performed in the UK's JAG (Joint Advisory Group on Gastrointestinal Endoscopy) registered services, an 89% rise since 2010, highlighting the demand for endoscopic imaging systems and effective image documentation.[22]

Quality documentation is vital for recording accurate findings,[23] prompting hospital departments to invest in camera systems, which typically consist of a processor, light source, monitor, and camera head to provide digital imaging.

Healthcare organisations require an automated digital system to transfer clinical images and videos to EPRs from the camera system. The current traditional process often lacks this direct interface, making automatic digital transfer impossible. Swift access to notes, images, videos, and test results leads to fewer errors and quicker decisions, ultimately enhancing patient care and outcomes.[24,25]

Despite the clear benefits of digital transformation, many NHS Trusts still continue to rely on paper records and portable devices to transfer clinical images and videos from camera systems to EPRs, which takes up valuable time for nurses and poses risks like data loss, challenges in retrieving damaged or degraded information, and dependence on mass storage devices.[26] Nursing time represents one of the highest costs for health services.[27] Digital solutions in healthcare settings can potentially streamline existing processes and improve workflow, allowing nurses to make better use of their time.[28]

The traditional process of transferring clinical images and videos from the camera system to EPRs is inefficient and time-consuming. Due to its paper-heavy nature, limited data exists regarding its impact on nurses' time and morale. Implementing digital solutions for medical content management and procedure recording and capture of clinical images could potentially save time and costs, but currently, little data is available.

The objective of this observational study was to examine traditional tasks performed and quantify the time nurses spend manually transferring clinical images and videos from the camera system to EPRs in an ear, nose, and throat (ENT) department in the United Kingdom (UK); and to assess the impact on nurses' time and efficiency costs, and document staff experiences during the transition from traditional to digitised processes.

Methods

Design and setting

This was a single-centre, direct observational time (DOTS) and predetermined motion time system (PMTS) analysis conducted over two separate one-week periods in the

ENT outpatient department of Royal Devon University Healthcare NHS Foundation Trust, in Devon, UK. The Trust was selected as the study centre, having recently digitised its process, facilitating comparative analysis of processes before and after digitisation.

Sample and recruitment

During the study period, nurses on duty in the ENT outpatient department, responsible for transferring clinical images and videos from camera systems to EPRs, were observed. A total of 11 nurses participated, including 2 Band 5, 1 Band 4, and 8 Band 3 nurses.

Observations took place in various areas of the ENT outpatient department, such as the outpatient room, corridors, and administrative rooms, on weekdays between 9 am and 5 pm, coinciding with most flexible nasal endoscopy procedures (hereafter referred to as 'endoscopy'). Nurses were included in the study if they regularly participated in transferring clinical images and videos. Observers did not observe nurses during endoscopy procedures per the agreement with the Trust, and patient consent was not required.

Data collection and analysis

We used DOTS as the data collection tool to consistently record the time and work rate for specific tasks. This enabled us to analyse the time required to perform a task at a specific performance level. However, we did not include tasks conducted during the endoscopy procedure in our analysis, as their timings vary depending on the patient.

We found that certain tasks were performed outside the ENT outpatient department, in an off-site facility managed by dedicated office staff. To capture tasks performed in the off-site facility, we conducted PMTS, a method that examines basic human motions for specific manual tasks. To establish PMTS, an observer records a task according to specifications and subsequently breaks the recording down step by step.

All observations were carried out by a single observer, an industrial engineer certified in work quantification and pace rating. Additionally, the observer holds a PSL3 certification in the Predetermined Standard Library.

Phase 1: Defining the traditional process to transfer clinical images and videos from the camera system to EPRs

During Week 1 of this study, from 24 to 28 April 2023, the observer conducted daily observations over five days using DOTS and PMTS to document the traditional process followed by nurses when transferring clinical images and videos from a camera system to EPRs.

Phase 2: Training and adaptation to digitised process

Between May and September 2023, the Medical Video Recorder (nCare™), manufactured by Gyrus ACMI, Inc., Brooklyn, USA with Olympus Europa SE & Co. KG, Hamburg, Germany as the EU Authorised Representative and the Centralised Medical Content Management (VaultStream™), also manufactured by Gyrus ACMI, Inc., Brooklyn, USA with Olympus Europa SE & Co. KG as the EU Authorised Representative, were installed in the ENT outpatient department.

Nurses received in-person training on the Medical Video Recorder and Centralised Medical Content Management in early September. From that point, the digitised process became part of their routine, allowing them to integrate and familiarise themselves with it until the end of October 2023, when Week 2 of this study began. The training covered system login, patient search, recording and previewing clinical images and videos, reviewing content during procedures, uploading to the server, troubleshooting, and ensuring patient privacy.

Phase 3: Defining the digitised process to transfer clinical images and videos from the camera system to EPRs

In Week 2 of this study, from 30 October to 3 November 2023, the observer conducted daily observations over five days using DOTS and PMTS to document the new process nurses followed when transferring clinical images and videos from the camera system to EPRs. This followed the installation of the Medical Video Recorder and Centralised Medical Content Management in the ENT outpatient department, which replaced the traditional process, fully digitising it.

The Medical Video Recorder is connected to the camera system and captures full high-definition (HD) clinical images and videos recorded by HCPs during endoscopy procedures. These images and videos are automatically transferrred, at the end of the procedure, to Centralised Medical Content Management, VaultStream™, where they are securely stored. HCPs can then access and view clinical images and videos for reference, review, and consultations through EPRs on any device connected to the hospital's network.

Furthermore, the Medical Video Recorder automatically retrieves patient data through the Digital Imaging and Communications in Medicine (DICOM) worklist, enabling the automatic retrieval of patient data before an endoscopy procedure, streamlining nurse workflows by pre-populating patient information, minimising manual data entry errors, and ensuring accurate patient data is associated with the corresponding clinical images and videos.

DOTS and PMTS were repeated following the installation of the Medical Video Recorder and Centralised Medical Content Management to compare the new digitised process to the traditional process when nurses transferred clinical images and videos to EPRs from the camera system.

> 'Medical Video Recorder and Centralised Medical Content Management' will hereafter be referred to as the 'digitised process'.

The analysis and visualisation of task durations across processes were conducted using Microsoft Excel. The dataset was structured within Excel, and conditional formatting was applied to generate a heatmap. This heatmap used a colour gradient to depict variations in task durations, with darker shades denoting longer times and lighter shades indicating shorter durations.

Standard minute values

Standard Minute Values (SMVs) were used to measure and compare the efficiency of traditional and digitised processes. SMVs represent the total time required to complete a task under standard performance conditions, accounting for basic task time as well as allowances for relaxation, fatigue and contingencies. This metric ensures that the reported times reflect what can be realistically achieved under normal working conditions.

SMVs provide an objective and consistent benchmark for comparing the two processes. Unlike mean time, which can be influenced by individual variations in performance or external factors, SMVs represent an idealised yet achievable timeframe. This allows for a fair evaluation of whether the digitised process delivers genuine efficiency improvements over the traditional method.

During data collection, the Basic Time for each task performed in both the traditional and digitised processes was recorded. The Basic Time was then adjusted using standard allowances to calculate the SMVs for each task. By using SMVs as our primary metric, we ensured that our analysis is based on consistent, comparable data, enabling us to accurately assess the impact of the digitised process on overall workflow efficiency.

Basic Time and SMVs are reported in seconds for consistency and ease of comparison.

Measuring nurse experience

Two surveys were conducted: one before the digitisation of the process and one after. The surveys aimed to understand the perceived impact of both traditional and digitised processes on nurses in terms of their confidence in the accuracy of entering patient details, the frequency of issues, delays, or downtime they experienced, and the resulting impact on their morale.

Resource cost analysis

After all data was gathered from DOTS and PMTS, a resource cost analysis was conducted to estimate the time efficiency, time efficiency cost-saving per endoscopy procedure,and the projected cost savings for the ENT outpatient department.

A model was first created to outline each potential task and determine the amount of staff time required for each task.. Next, we calculated the probability of each task occurring. Finally, we calculated the cost of staff time consumed by each task.

We estimated the cost of resources by calculating an average hourly rate for all nurses using data from the Unit Costs of Health and Social Care.[29] We based this on pay bands used by the NHS for the nurses observed during the study. These costs were then applied to the model.

Ethics approval and consent

We completed the NHS Research Ethics Committee (REC) review tool available at https://www.hra-decisiontools.org.uk/ethics which indicated that an NHS REC review was not required. This study did not include the recording of any patients, patient-related data, or the personal data of any nurses. As a result, informed consent for information published in this manuscript was not obtained (from patients). The research team met with all nurses before data collection to address any questions they had. Written informed consent to conduct and publish the study and conduct observations in the ENT outpatient department and associated hospital areas, was provided by the Trust's senior leadership team on behalf of all nurse participants.

Results

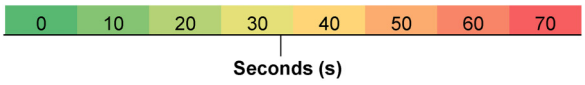
Traditional process: Transfer of clinical images and video to EPRs

DOTS identified two traditional processes ('**Process 1**' and '**Process 2**') followed by nurses to transfer clinical images and videos from the camera system to EPRs.

Basic Time and SMVs, presented in this section, are reported in seconds for consistency and ease of comparison.

Process 1. In Process 1, DOTS identified that if a clinical image was captured and saved to the camera system, nurses would print the image onto paper and attach it to a printed version of the patient's notes using glue. Later, the image was digitised at an off-site facility using a scanner and then transferred to EPRs. This process was only used to transfer and digitise clinical images from the camera system to EPRs, not videos.

As shown in Figure 1, the heatmap compares the SMVs (in seconds) of tasks for Process 1, Process 2, and the



		Process 1			Process 2			Digitised Process		
Task Number	Task Description	Total Basic Time (s)	Observations (n)	Standard Minute Values (s)	Total Basic Time (s)	Observations (n)	Standard Minute Values (s)	Total Basic Time (s)	Observations (n)	Standard Minute Values (s)
1	Retrieve endoscope	366	32	13	366	32	13	466	32	17
2	Unpack the endoscope and plugin	1231	39	37	1231	39	37	716	28	30
3	Input patient details into the camera system	1488	41	42	1488	41	42			
4	Wash ticket to paperwork	732	42	20	732	42	20	76	5	17
5	A Chaperon sticker was applied and filled	2328	43	62	2328	43	62	747	17	50
6	Track and trace stickers to paperwork	938	41	26	938	41	26	123	5	28
7	The endoscope was unplugged and a side-to-tray	407	14	34	407	14	34	302	12	29
8	Red cover to crate and details added	1218	37	38	1218	37	38	295	15	22
9	Print photograph(s)	302	12	29						
10	Collect paperwork and walk to the cabinet	338	42	9	338	42	9	127	14	10
11	File paperwork in the cabinet	320	42	9	320	42	9	63	13	6
12	Used endoscope tray returned	687	43	18	687	43	18	494	33	17
13	Save photograph/ video to camera system (USB)	905	28	37	905	28	37			
14	Retrieve iPad				11	1	13			
15	Log into iPad and select the patient.				30	1	34			
16	Take photograph				189	4	54			
17	Record video				48	1	55			
18	Log out of iPad				10	2	6			
19	Aside iPad				21	2	12			
20	Get endoscopy paperwork	3	1	3	3	1	3	3	1	3

Figure 1. Heatmap comparing task durations across Process 1, Process 2, and the Digitised Process. (continued)

21	Mark patient details	5	1	6	5	1	6	5	1	6
22	Input the patient number and confirm	10	1	11	10	1	11	10	1	11
23	Select Procedure	3	1	3	3	1	3	3	1	3
24	Input procedure description and document type	6	1	6	6	1	6	6	1	6
25	Scan document(s)	7	1	8	7	1	8	7	1	6
26	Quality control check of scan	3	1	3	3	1	3	3	1	3
27	Sign off and aside paperwork	13	1	15	13	1	15	13	1	15
28	Select patient							274	28	11
29	iProc							71	29	3
30	Order scope							333	30	13
31	Search and select patient on nCare.							553	34	19
32	Save images to EPIC.							539	32	19
33	Endoscope not used note.							36	1	41
	Total	**11308**	**464**	**428**	**11316**	**463**	**573**	**5263**	**336**	**385**

Note: *Totals represent the sum of the values for each column: Total Basic Time (seconds), Total Observations (n), and Total SMVs (seconds). Blank cells indicate that the respective tasks did not occur in the process. Observations (n) refers to the number of times each task was observed during the study.*

Figure 1. Continued.

Digitised Process. Additionally, it displays the number of Observations (n) and the Total Basic Time (in seconds) for each process. The colour intensity in each cell reflects the time taken for each task, with red shades indicating longer durations and green shades representing shorter ones.

In total, 21 tasks were performed per endoscopy (see task numbers 1–13 and 20–27 in Figure 1). This process had a Total SMVs of 428 seconds (equivalent to 7 minutes and 8 seconds), representing the time it took nurses per endoscopy.

The most time-intensive tasks identified were Task 3 and Task 5 (see Figure 1), which involved the creation and placement of a chaperone sticker on the patient's physical notes. This sticker lists the patient's identifying information, appointment details, and the name of the hospital. Tasks 3 and 5 required 42 seconds and 62 seconds, respectively, constituting 10% and 14% of the overall time spent by nurses on tasks.

In process 1, out of the 21 tasks, only 2 (Task 9, and 13, as shown in Figure 1) were specifically dedicated to the transfer of clinical images from the camera system to EPRs. The other 19 tasks would have happened irrespective of whether a clinical image was taken or not. Tasks dedicated to transferring clinical images to EPRs accounted for 15% of nursing time per endoscopy. Tasks 9 (29 seconds) and 13 (37 seconds) took a combined total of 66 seconds (equivalent to 1 minute and 6 seconds).

As shown in Figure 1, a total of 464 observations were recorded across 21 tasks. The number of observations per task varied considerably. Most tasks had a substantial number of observations, ranging from 12 to 43. However, a small group of tasks (Tasks 20–27) had only a single observation each. The most frequently observed tasks were Task 5 and Task 12, with 43 observations each, while Task 9 was the least frequently observed among the tasks with multiple entries, with only 12 observations.

Process 2. In Process 2, if a clinical image or video required an urgent review at the suggestion of the clinical specialist, nurses would use an iPad camera to record the content displayed on the camera system's monitor. The recorded content was then transferred to EPRs via the iPad. This

process was required when a video was captured for digitisation but could also be used to transfer clinical images.

In total, 26 tasks were performed per endoscopy (see task numbers 1–8 and 10–27 in Figure 1). This process had a Total SMVs of 573 seconds (equivalent to 9 minutes and 33 seconds), representing the time it took nurses per endoscopy.

In Process 2, 7 tasks (numbers 13–20, as shown in Figure 1) were specifically dedicated to the transfer of clinical images or videos from the camera system to EPRs, while the other 19 tasks occurred regardless of whether a clinical image or video was captured. These specific tasks (13–20) took a combined total of 210 seconds (equivalent to 3 minutes and 30 seconds) accounting for 37% of the nursing time per endoscopy dedicated to transferring clinical images and videos to EPRs from the camera system.

As shown in Figure 1, a total of 463 observations were recorded across 26 different tasks. The distribution of observations varied significantly, with Task 5 and Task 12 being the most frequently observed, each with 43 observations. Tasks 3, 4, 6, 10, and 11 also had high observation counts, ranging from 41 to 42. In contrast, several tasks, including Tasks 14, 15, and 17, were observed only once, while Task 16 had very low counts, with only 4 observations.

Nurses' experience with traditional processes. As part of the survey (see Table 1), all nurses who actively participated in the traditional processes were invited to take part. Of the 11 nurses employed in the department at the time of the study, 9 completed the survey, resulting in an 82% response rate.

Nurses had been using the traditional process for an average of 4 years and 3 months.

Digitised process: Transfer of clinical images and video to EPRs

The Digitised Process, enabled by the Medical Video Recorder and Centralised Medical Content Management, required nurses to perform 24 tasks per endoscopy (tasks 1–2, 4–8, 10–11, and 20–33 as shown in Figure 1), with a Total SMVs of 385 seconds (equivalent to 6 minutes and 25 seconds per endoscopy). Of these 24 tasks, four tasks (tasks 28–31) were specifically dedicated to transferring clinical images or videos from the camera system to EPRs. The remaining 20 tasks occurred regardless of whether images or videos were captured.

Nurses spent 45 seconds transferring images and videos (tasks 28–31), which accounted for 12% of their time using the Digitised Process.

Overall, the implementation of the Digitised Process resulted in a 10% time-efficiency gain over Process 1, saving 43 seconds per endoscopy (6 minutes and 25 seconds vs. 7 minutes and 8 seconds). Compared to Process 2, the Digitised Process achieved a 33% time-efficiency gain, saving 3 minutes and 8 seconds per endoscopy (6 minutes and 25 seconds vs. 9 minutes and 33 seconds).

When comparing the time dedicated to tasks specific to the transfer of clinical images and videos from the camera system to EPRs, the Digitised Process was 32% faster than Process 1, saving 21 seconds per endoscopy (45 seconds vs. 1 minute and 6 seconds).

Compared to Process 2, the Digitised Process was 78% faster, saving 2 minutes and 45 seconds per endoscopy (45 seconds vs. 3 minutes and 30 seconds).

After the digitisation of the process, nurses spent 12% of their time on tasks that involved transferring clinical images and videos from the camera system to EPRs. This represents a 20% decrease in non-patient-facing tasks compared to Process 1, where nurses spent 15% of their time per endoscopy, and a 68% reduction compared to Process 2, where 37% of their time per endoscopy was dedicated to these tasks.

A total of 336 observations were recorded across 24 different tasks. The distribution of observations varied significantly, with Task 31 being the most frequently observed with 34 instances, followed closely by Task 12 with 33 observations. Tasks 1 and 32 were also observed frequently, with 32 observations each. However, a substantial number of tasks, particularly Tasks 20 to 27 and Task 33, were observed only once. This suggests a wide variation in the frequency with which different tasks are performed, with some tasks being central to the workflow and others being less common.

Nurses' experience with the digitised process. Eight out of the 11 nurses (see Table 2) working in the ENT outpatient department responded to the study, resulting in a response rate of 73%. On average, nurses had been using the Digitised Process for six months.

Additional time efficiency savings

DOTS identified that additional time efficiency savings were achieved by lowering consumable usage and, as a result, lowering the time spent placing orders for consumables such as printer paper, and printer ink. Both consumables were used in Process 1 when transferring and digitising images to EPRs from the camera system.

Nurses spent 21 minutes and 22 seconds (refer to tasks 25 and 36 in Appendix 2 of the Supplemental material.) each week ordering and obtaining consumables before the implementation of the Digitised Process. Following the digitisation of the process, nurses spent 10 minutes and 41 seconds per week ordering consumables and obtaining them, saving 50% of that time.

Resource cost analysis

We developed a resource cost model to understand the cost of performing the identified tasks. Costs were assigned to

Table 1. The impact of traditional processes on the experiences of nurses.

Survey question	Response	Number of respondents (count and %)
I rarely encounter difficulties using the traditional processes.	Strongly agree	0/9 (0)
	Agree	1/9 (11)
	Neutral	2/9 (22)
	Disagree	6/9 (67)
	Strongly disagree	0/9 (0)
I am confident in the accuracy of patient details when I enter them into the traditional processes.	Strongly agree	1/9 (11)
	Agreed	4/9 (45)
	Neutral	3/9 (33)
	Disagree	1/9 (11)
	Strongly disagree	0/9 (0)
How often do you experience issues, delays, or downtime whilst using the traditional processes?	Daily	2/9 (22)
	Weekly	4/9 (45)
	Monthly	2/9 (22)
	Less frequently than monthly	1/9 (11)
How much clinical impact do these issues, delays, or downtime have?	No clinical impact	0/9 (0)
	Some clinical impact	7/9 (78)
	Significant clinical impact	2/9 (22)
When issues, delays, or downtime occur, how much does this affect your morale?	No negative impact	1/9 (11)
	Some negative Impact	8/9 (89)
	Substantial negative impact	0/9 (0)
On average, how much time is wasted whenever there is an issue, delay, or downtime?	0–10 minutes	2/9 (22)
	10–20 minutes	4/9 (45)
	Over 20 minutes	3/9 (33)

each nurse using data from the Unit Costs of Health and Social Care data.[29]

We used the model to calculate cost savings per endoscopy procedure and projected cost savings in the ENT Outpatient Department. The data was extrapolated based on the total number of procedures performed over one year provided by the NHS Trust.

Cost savings per endoscopy procedure. Digitising the process resulted in a time-efficiency cost saving of £0.38 per endoscopy compared to Process 1 (see Supplemental Appendices 1 and 3) (£3.43 vs. £3.81 per endoscopy) and £1.68 compared to Process 2 (see Supplemental Appendices 2 and 3) (£3.43 vs. £5.11 per endoscopy).

Table 2. The impact of the Digitised Process on the experience of nurses.

Survey question	Response	Number of respondents (count and %)
The Digitised Process has reduced the occurrence of issues, delays, or downtime I have experienced.	Strongly agree	5/8 (63)
	Agree	3/8 (37)
	Neutral	0/8 (0)
	Disagree	0/8 (0)
	Strongly disagree	0/8 (0)
How often do you experience issues, delays or downtime whilst using the Digitised Process?	Never	0/8 (0)
	Less frequently than monthly	5/8 (63)
	Monthly	3/8 (37)
	Weekly	0/8 (0)
	Daily	0/8 (0)
The Digitised Process reduces the time you spend on tasks.	Strongly agree	6/8 (75)
	Agree	2/8 (25)
	Neutral	0/8 (0)
	Disagree	0/8 (0)
	Strongly disagree	0/8 (0)
The Digitised Process makes your tasks more efficient.	Strongly agree	8/8 (100)
	Agree	0/8 (0)
	Neutral	0/8 (0)
	Disagree	0/8 (0)
	Strongly disagree	0/8 (0)
The Digitised Process has improved your confidence in the accuracy of patient details.	Strongly agree	5/8 (63)
	Agree	2/8 (25)
	Neutral	1/8 (12)
	Disagree	0/8 (0)
	Strongly disagree	0/8 (0)
How has the Digitised Process impacted your morale?	Significantly improved	6/8 (75)
	Slightly improved	2/8 (25)
	No impact	0/8 (0)
	Slightly decreased	0/8 (0)
	Significantly decreased	0/8 (0)
Given the choice, would you go back to the traditional processes?	No	8/8 (100)
	Unsure	0/8 (0)
	Yes	0/8 (0)

Specifically, for tasks related to the transfer of clinical images and video to EPRs from the camera system, the time-efficiency cost for Process 1 was £0.59 per endoscopy, and for Process 2, it was £1.88 per endoscopy. By digitising the process, a £0.19 saving (£0.40 vs. £0.59) was achieved over Process 1 and a £1.48 saving (£0.40 vs. £1.48) over Process 2.

Projected time efficiency and cost savings in the ENT outpatient department. Annually, the ENT outpatient department performs approximately 9,600 endoscopy procedures. Based on the advice of the NHS Trust, the model assumes that 75% of these procedures used Process 1 and 25% use Process 2 for transferring clinical images and videos from the camera system to EPRs. The model also assumes that one working day equals an 8-hour shift.

By implementing the Digitised Process, nurses reduce the time spent on non-patient-facing tasks by 211 hours and 21 minutes annually, resulting in a time-efficiency cost-saving of £6,780 per year.

This is equivalent to nurses spending 26 fewer working days per year on non-patient-facing tasks.

Additional time efficiency cost savings. After implementing the Digitised Process nurses spent 50% less time ordering consumables, equivalent to £5.71 in time-efficiency costs per week.

In addition, the implementation of the Digitised Process eliminated the need for printers in the department. As a result, there have been yearly cost savings of £6252 to £9531 (see Appendix 4 of the Supplemental material) due to a decrease in the consumption of printer paper and ink.

Discussion

The Medical Video Recorder and Centralised Medical Content Management reduced the time required to transfer clinical images and video from the camera system to EPRs, during each endoscopy. This reduction saved 43 seconds (6 minutes and 25 seconds vs. 7 minutes and 8 seconds), representing a 10% time-efficiency saving compared to Process 1, where nurses print, attach, scan, and digitise images off-site to EPRs. Compared to Process 2, where urgent content is recorded on an iPad and then transferred to EPRs, the time savings were 3 minutes and 8 seconds per endoscopy (6 minutes and 25 seconds vs. 9 minutes and 33 seconds), representing a 33% time-efficiency saving. As a result, nurses in the ENT outpatient department can now spend 26 fewer working days per year on non-patient-facing tasks.

Despite the body of literature on the implementation of EPRs in healthcare settings,[30–36] there is an absence of research focusing on the tasks performed by nurses to manually transfer clinical images and videos from the camera system to EPRs, and the subsequent impact of digitising the process. Diagnostic images in the UK are frequently repeated due to the current limitations on sharing diagnostic images. The implementation of procedure recording, and medical content management could reduce repeated diagnostic imaging, saving the NHS and patients money and time.[37] EPRs enable this data to be stored and disseminated efficiently and securely.[38]

The findings of previous studies highlight that there should be an emphasis on digital solutions in healthcare that allow nurses to focus more on direct patient care, as this has been shown to positively impact health outcomes and satisfaction levels for HCPs.[12] One study reported that nurses spent more time talking to family (indirect care). Increased time spent providing direct care to patients may improve job satisfaction and morale since nurses feel valued and rewarded.[39,40]

Although our study did not measure patient health outcomes, it did show a decrease in the proportion of time nurses spend on tasks dedicated to the transfer of clinical images and video to EPRs from the camera system per endoscopy. This indicates that digitising the process provides nurses with the opportunity to allocate more time, per endoscopy, away from non-patient-facing tasks. After digitisation of the process, nurses spent 12% of their time per endoscopy on these tasks, a 20% reduction compared to Process 1 (15% of nurses' time per endoscopy) and a 68% reduction compared to Process 2 (37% of nurses' time per endoscopy).

The survey (as shown in Table 2) indicated that, on average, nurses had been utilising the Digitised Process for six months. According to McCarthy (2010), hospital staff vary significantly in their life stages, comfort with technology, adaptability to change, and overall job satisfaction.[41] This diversity may contribute to the finding that 37% of nurses encounter issues, delays, or downtime with the Digitised Process every month, whereas 63% face these problems less frequently than once a month. Although the Medical Video Recorder has been designed to improve efficiency and reduce the learning curve associated with using it, this highlights the need to incorporate digital healthcare into the medical training and education of both current and future NHS nurses.

Moreover, 75% of nurses reported a significant improvement in morale following the digitisation of the process. This finding aligns with an earlier study that showed digital technologies also contribute to improving healthcare performance and staff morale if effectively designed and implemented.[42] It is crucial to acknowledge that continuous education and training in the efficient use of digital processes are essential to sustain the observed improvements in morale. Evidence from other research suggests that insufficient training and knowledge about new systems can complicate the transition period, potentially leading to decreased motivation and morale among staff.[43]

Our findings show that the confidence level of nurses in the accuracy of patient details improved following digitisation, with 63% strongly agreeing, 25% agreeing, and 12% remaining neutral. This is likely because the traditional processes involved manually entering the patient information into the camera system, a method prone to human error. However, with digitisation, the process has become more efficient. Now, the nurses only need to input the first three letters of the patient's surname, execute a search, and select the relevant patient for the procedure. This has significantly reduced the chances of errors. Our findings are in line with other qualitative studies that have shown that the adoption of digital technologies can mitigate errors and increase efficiency.[44,45]

Studies show that digital initiatives that are effective in allowing clinicians to shift more of their time to direct patient-facing time are likely to produce improvements in health outcomes, and patient and health professionals' satisfaction, which may also impact improved staff retention.[16,46]

Digitising the process led to additional improvements not initially targeted by the study. The introduction of the Medical Video Recorder and Centralised Medical Content Management provided clinicians with timely access to

clear endoscopic images and videos, reducing the time it took for clinicians to obtain information, which enhanced their clinical decision-making. Specifically, clinicians could review all the endoscopy imaging during multidisciplinary team (MDT) meetings.

An unintended benefit of digitisation was that clinicians could review images or videos of patients captured during previous endoscopy procedures before performing subsequent or follow-up procedures. This allowed clinicians to track a condition's progression between the current and previous endoscopy procedures, adding confidence to clinical decision making.

Previously, clinicians in the ENT outpatient department used printed images or videos for patient feedback or to explain complex anatomy. Access issues and image degradation made it difficult to provide these resources to all patients consistently. With digitisation, clinicians can now present bright, clear images and videos as standard, improving patient education, engagement in their treatment, and communication between clinicians and patients.

Furthermore, clinicians can access these digital resources remotely or from anywhere in the hospital, a significant improvement from prior limitations. Digitisation also streamlined processes, particularly in cases where the clinician conducting the initial endoscopy was not the one performing subsequent treatments. Previously, this might have necessitated another hospital visit for the patient to be re-scoped by the treating clinician. However, all imaging could be shared and reviewed during MDT meetings, eliminating the need for repeat procedures, and reducing patient visits to the hospital.

The health service accounts for approximately 4% to 5% of total UK carbon emissions, with the NHS in England alone accounting for 40% of all public sector emissions.[47] Digitising the process improved the ENT outpatient department from an environmental perspective by decreasing the consumption of printer paper and ink. This also led to a yearly cost saving of £6252 to £9531 for the department. This aligns with the 'delivering a "Net Zero" NHS by 2040' commitment to reduce reliance on paper across secondary care through increased digitisation and aligns with findings from other qualitative studies that show that the use of EPRs can reduce costs associated with paper-based records.[48,49]

Our study identified two traditional methods for transferring clinical images and videos from the camera system to EPRs. The first method is scanning and digitising physical images, which can sometimes cause image quality loss or inaccurate colour reproduction. The second method involves recording content shown on a monitor with an iPad camera. However, this method is subject to the iPad's quality and the person's ability to hold the device steadily. Digitalising the process enables high-quality transfer to EPRs without any degradation. Future studies should explore the impact of image degradation on clinical decision-making and patient outcomes.

Potential long-term impacts of digitised processes

By adopting digital processes, hospitals can increase process efficiency, quality and consistency by integrating EPRs with digital solutions, thereby improving accessibility and knowledge sharing for time-sensitive tasks, improving response time to patient treatment, reducing expenses and promoting staff flexibility in the long term.[50–53]

Enhanced collaboration between MDTs, reduced errors, cost-effectiveness, and better time management are among the many advantages of digital solutions and digitised processes.[54–57] There is also potential to decrease storage, administration, and access costs. If traditional processes that rely on printing paper records are eliminated following digitisation, storage costs can be reduced from the moment digitisation is implemented.[58]

Moreover, digital images and videos can be efficiently shared across networks, allowing for simultaneous viewing, dissemination, access, and utilisation by different members of the MDT.[58] The implementation of digitised processes in hospitals has the potential to enhance knowledge transfer and reuse of information, therefore enabling nurses to optimise their time management.[58]

The costs associated with establishing and maintaining a digitised process will vary based on the scope and goals of improving the operational efficiency of the hospital units. Standard costs encompass the expenses related to software and equipment purchases for digitisation and subsequent upgrades.[58] Costs may also include cybersecurity measures, as well as training and change management strategies for nurses who will use the digital system.[59–62] These strategies may include specific training opportunities that are offered through contractual agreements with software and medical equipment suppliers.

In addition to this, an allocation of nurse time for tasks such as quality control checks, monitoring and evaluation may be required. The provision of information technology infrastructure, storage capacity for maintaining new digital copies, acquisition of software for viewing digital images on tablets or computers, and continual maintenance and updating of systems should all be factored into the costs of implementing digital processes.

Despite the benefits of digital processes, research has shown that the impact of digitalisation on nurses is usually twofold: it enables certain objectives but may also introduce complexities or hinder the progress of other tasks.[60] If not adequately addressed throughout the implementation of new digital processes and systems, challenges such as heightened workload, work slowdown, new digital skill demands, and inadequate time to adapt to new digital processes may arise.[60]

The transition to a digitised process is a strategic decision that can improve hospitals' operational efficiency and decision-making.[63] However, due to limited evidence on the effectiveness of digital technologies in nursing

care,[64] it will be imperative to conduct economic evaluations on implemented digitised processes to determine the long-term benefits on patient outcomes and workflow efficiency in hospitals. Outcomes of such studies would enable hospital decision-makers to address identified challenges and allow nursing educational departments to offer targeted digital literacy and information and communication technology training to upskill nurses so that they are satisfactorily prepared for the digitalised workforce.[65]

Implementing a digitised process as a pilot in a single department may allow decision-makers to evaluate its efficacy, and subsequently expand. Regular evaluations and monitoring of the digitised process can ensure that outcomes and nurse user experience are in accordance with the established objectives.[60] Finally, establishing a feedback mechanism to actively solicit feedback from nurses and unit managers regarding the digitised process is essential for identifying and making required modifications.[60]

Strengths and limitations

To the best of our knowledge, this is the first study to show that digitising the traditional process nurses follow to transfer clinical images and videos from the camera system to EPRs allows nurses to spend less time on non-patient-facing tasks, improves staff confidence in the accuracy of patient details, and significantly improves staff morale.

A major limitation is that our research was descriptive, and we were unable to determine a cause-and-effect relationship. Another limitation of the current study is that we used the cost of nurse time saved which is a time-efficiency cost saving, and not a cash-releasing saving. The study was conducted at a single centre to ensure continuity and consistency of nurses throughout the study period and to achieve a high response rate. This may limit the generalisability of the findings to other healthcare settings in different geographic locations and varying levels of digital maturity within their settings.

The survey of the nurses following the digitisation of the process was conducted after six months. However, the digital competence of nurses was not evaluated as part of this study. Therefore, it is recommended that further research with a longer follow-up period, including an economic evaluation and an assessment of nurses' digital competence, be conducted to provide a more comprehensive understanding of the long-term impact of digitising the process on patient outcomes, nurse staff efficiency and morale.

Future research should explore the impact of digitised processes on the speed of treatment, as clinicians can access clinical images more quickly than through traditional, paper-based methods. The results of this study, despite its limitations, serve as a pilot to validate the necessity for additional hospital-wide research. Finally, although the current study offers useful insights into the use of digitised processes and their effect on the operational efficiency of nurses, there are many opportunities for future research to enhance and broaden our knowledge of this dynamic and developing area.

Conclusions

Our findings highlight the inefficiency of the current traditional process of transferring clinical images and video from the camera system to EPRs. Digital transformation in the procedures and technology for medical content documentation may improve nursing care efficiency, boost staff morale and subsequently improve the quality of care delivered. More research and pilot studies are required to investigate the efficiency and cost-effectiveness of the digitised process for image and video transfer across different hospital departments.

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