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Organisational influences on nurses' use of clinical decision support systems

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Abstract

Objective

Nurses are increasingly using computerised decision support systems (CDSS) to support their practice. Previous studies have highlighted the importance organisational factors have on the successful implementation of new technologies in healthcare. However, it is unclear how the organisations where nurses work either facilitate or inhibit the successful use of CDSS. The aim of this paper is to explore the perceptions of nurses and NHS (National Health Service) Trust managers working in NHS organisations in England on the organisational features facilitating the introduction and successful use of CDSS

Methods

A study of four case sites where nurses were using CDSS. Data included 124 observations of nurse/patient consultations, 36 patient interviews, 55 nurse interviews and 18 interviews with clinical unit or NHS Trust managers. The majority of the data were qualitative and analysed using thematic content analysis.

Findings

There were a number of drivers for the introduction of CDSS, including instigation from individual clinicians and initiatives at policy level. A key element for the successful introduction of technology such as CDSS was clinician engagement. However, also seen as important for successful implementation of an IT system are other factors such as the need for adequate resources, characteristics of the system itself and adequate training. Other key issues are a supportive environment and the desire to improve continually the quality of patient services.

Conclusions

For nurses to use CDSS successfully, engagement by clinicians in the procurement and implementation of systems is useful. However, the data collected in this study

suggest this is not necessary for successful implementation; nurses may still successfully introduce and use a CDSS if they perceive it to have benefits to their practice.

1. Introduction

Clinical decision support systems (CDSS) integrate information (ideally from high-quality research studies) with the characteristics of individual patients, to provide advice to clinicians to assist them with their decision making [1]. CDSS vary in their functionality, from 'passive' systems providing information only when requested by a clinician, through to 'active' systems automatically providing patient specific recommendations to a clinician [2]. CDSS have a long history; a systematic review of the impact of CDSS contained 5 studies published in the 1970s [3]. The review identified 100 studies, covering the areas of diagnosis, disease management and drug dosing and prescribing [3].

Nurses are increasingly using CDSS and there is a significant push in high income countries for the use of CDSS by nurses to be extended. In part, this is because recent changes in the delivery of health care in these countries have led to nurses taking on extended roles previously carried out by junior doctors. For example, in the UK a number of specialist nurses now have responsibility for the management of care of patients with heart failure and diabetes [4]. Nurses are also able to prescribe medication [5;6], and often run clinics within primary care and outpatient hospital settings [7]. The provision of CDSS has been identified as a way of supporting nurses within their extended roles, to work more autonomously and as a way of improving patient safety [8;9]. Examples of areas where nurses use decision support to help them with decision making about patient care include the management of asthma [10], diabetes [11] and angina [10], and triage of patients in first contact care [12;13].

1.1 Organisational influences on technology use

While organisational factors are generally agreed to play an important role in the successful implementation of new technologies within healthcare, a lack of studies

exploring this means there is uncertainty as to what these factors are [14]. Because of the complexity of healthcare organisations and the unpredictability of implementation, there is no simple formula for success [14;15]. However, research places emphasis on the notion of 'fit' between the technology and the organisation, achieved through mutual adaptation of the organisation and the technology. Thus, barriers to such adaptation become barriers to the successful implementation of technology. May [16] highlights the importance of an organisation's intention and capacity to effectively integrate the technology into the organisation, suggesting a lack of such will and ability results in reduced likelihood of success. However, trying to change processes through the introduction of technology is seen as a dangerous approach. What is required is flexibility in the process of implementation and in the technology [15].

Also influencing successful implementation is the culture of the organisation. Organisations where there is a history of collaboration and team work are more likely to implement technology successfully [17] especially if there is supportive leadership in place. Studies of implementation argue against treating the introduction of new technologies as a purely technical project and argue for users to be involved in order to allow ownership and the creation of systems that match current or future work practice [15]. Certainly, one systematic review of the impact of CDSS found better performance in studies in which the trial authors had developed the CDSS [3]. While possibly the result of biases in assessing outcomes, this finding could also be the result of having a local champion or having more usable and locally appropriate software. When there is not an adequate 'fit' between the technology and the organisation, and when the technology cannot be easily adapted, users often develop 'workarounds' allowing them to use the technology in a way which fits with their work practice [18;19].

Another factor which may affect the way in which new technologies are implemented and used by nurses in clinical practice is the education and training which they receive, both in general IT skills and for the specific system being implemented. A recent survey in the UK indicated the majority of nurses use computers regularly at work but more than 50% had received no training in IT within the last six months [20]. Nurses working for NHS Direct (the national telephone triage system used in England and Wales) reported increased confidence in dealing with mental health related calls and more positive attitudes towards their role in dealing with depressed patients following specific mental health training [21]. However, few studies have examined the training given to nurses on the use of specific computer systems and the effect of training on their subsequent use of technology.

1.2 Influences on the use of CDSS

Influences on the use of CDSS can be characterised as being at three levels: the computer interface level; the work process level; and the organisational level [22]. Previous research on the use of CDSS has sought to identify features associated with increased use and acceptance of advice and improved clinician performance and patient outcomes [3;23]. However, such studies have focused on the impact of features at the computer interface level and the work process level [23]. What leads an organisation to introduce CDSS and what aspects of the introduction process lead to successful CDSS use are topics that have received little attention.

A recent survey of the availability of CDSS for nurses across England found nurses who worked in Acute NHS Trusts were more likely to have access to a CDSS than nurses who worked in other types of health care environment [24]. Larger NHS Trusts employing more nurses and with a higher star rating (implying the Trust provided a higher quality of care to their patients) were also more likely to have CDSS in place and

used by nurses. This is similar to findings of other surveys examining organisational features associated with more general Health IT use; larger hospitals and teaching hospitals are more likely to use Health IT than their smaller counterparts [25]. Larger health care organisations may have the finances and technical resources to support the introduction of such new technologies [25].

Studies qualitatively examining how nurses use CDSS in practice have highlighted the influence of nurses' knowledge and experience (in general and with CDSS) on how they use the technology [26;27]. Also influencing CDSS use are factors such as the flexibility of the technology. However, what is unclear is how the organisations where nurses work either facilitate or inhibit successful CDSS use. With studies of wider IT implementation highlighting the importance of the organisation on successful technology use, and with increased use of CDSS by nurses, it is important to understand what features may facilitate the introduction of CDSS for nurses in the future.

The results presented here are part of a larger study examining how nurses use CDSS in practice, funded by the Policy Research Programme, National Institute for Health Research in England. The results relating to how nurses use CDSS in practice are reported elsewhere [26]. The aim of this paper is to explore the perceptions of nurses and NHS Trust managers working in NHS organisations on the organisational features facilitating the introduction and successful use of CDSS.

2. Methods

A multiple case study design was used (ref: Yin). Case studies are an empirical design that focus on describing phenomena within their real life context. The focus of the

research was on observing how nurses use CDSS to support different types of decisions, in different contexts.

2.1 Settings and Participants

Selection of case sites intentionally focused on case sites that could be considered to be successfully using CDSS, in terms of having integrated use of the CDSS into routine practice. Focusing on 'successful' use of CDSS was motivated by a desire to capture best practice, in order to provide guidance to healthcare organisations wishing to introduce CDSS for nursing staff.

Case sites were purposively selected according to the following criteria:

- The nursing staff within sites varied in terms of their experience and expertise using the systems
- There was variation in the types of CDSS supported decisions
- The CDSS could be compared across dimensions such as flexibility of use, type of interface
- Different contexts and implementation strategies could be compared.

Potential case sites were identified from the responses to a national survey of CDSS use in nursing [24]. Four case sites agreed to participate in the study.

Case site 1: An anticoagulation management clinic

This case site was an Anticoagulation Team based in a Primary Care Trust (PCT). It was a community based nurse led service, which managed patients' anticoagulation therapy with the assistance of a CDSS. Patients who attended the service had their blood checked for clotting times (known as INR testing). The nurse inputted the result of this test into the CDSS and the CDSS then provided the nurse with guidance on the appropriate dose for the patient's anticoagulation therapy and their next appointment

date. The CDSS used by the team is a stand-alone PC-based system, accessed by nurses through both desktop PCs and laptops whilst interacting with the patient.

Case Site 2: A spinal assessment clinic

This case site was a nurse led clinic based in the Spinal Assessment Clinic of a District General Hospital. Nurses working in the clinic carried out assessments of patients with back and referred leg pain. Before each consultation with a nurse, the patient answered a series of questions using the CDSS. The CDSS then calculated a range of quality of life scores (including pain and depression scores) for the patient, which the nurse could use to inform their overall assessment and management strategy.

Case site 3: A Walk-in centre

This case site was an NHS Walk-in Centre based within a Community Hospital. Nurse practitioners manage the centre, diagnosing and treating a wide range of minor injuries and minor illnesses. Where necessary the nurse practitioners could refer patients to other health and social care providers. Patients did not need an appointment to attend the Walk-in Centre. Algorithms that are logically structured, ordered, symptom-based questions, leading to an endpoint (disposition) which advises the appropriate level of care required, form the basis for the CDSS used by the nurses.

Case Site 4: A respiratory centre

This case site was a Respiratory Centre of a District General Hospital, which provides respiratory medical services to adults. Nurses in the Centre treat patients within the hospital, at health clinics and in patients' homes. Seven nurses in the Respiratory Centre used a CDSS to monitor patients with chronic obstructive pulmonary disease (COPD) who are living at home, with the aim of preventing their readmission to hospital. Patients used a Data Collection and Interaction (DCI) unit twice daily to

answer a series of questions displayed on the screen, providing information about their own health and well being, such as their weight, level of breathlessness, characteristics of sputum and medication used. The system sent the collected data to a secure database via the patient's telephone line in the early hours of the following morning. Nurses in the Respiratory Centre could access the database via an internet web browser, allowing the nurses to monitor trends in patient responses over time. The system displayed warning alerts when patient responses exceed thresholds previously determined by the nurses in the Respiratory Centre.

2.2 Data collection

In order to capture both the decision making at practitioner/patient level, and the characteristics of the environment that may support or inhibit the use of new technologies in decision making, data were collected at three levels within each case site. In order to compliment the qualitative data collected at each level, contextual data was collected where available (e.g. description of the case site, staffing levels, experience of staff, length of time new technology has been in use, audit trail of introduction of technology, records of education and training). Data were collected between June 2006 and March 2007.

2.2.1 Practitioner/patient level

The purpose of this level of data collection was to gain insight into how new technologies inform nurse decision making in practice, together with nurse and patient views of the usefulness of new technologies in clinical care. A sample of nurse/patient consultations (up to 40) in each case site area was observed, using non-participant observation. Before the consultation, both the nurse and patient consented to being observed. The consultation was digitally recorded, and the researcher made notes of non-verbal behaviours during the consultation related to the study questions, guided by

an observation protocol (e.g. when the nurse looked at the computer, the positioning of the nurse and patient in relation to the computer screen).

In case site 4, nurses interacted with the CDSS independently of the patient. Researchers observed the nurse using the system, either digitally recording how they used the system, or making field notes. For 3 of the interactions the nurse was asked to explain what they were doing, as they were looking through the patient data.

Following ten of the consultations, nurses were asked to answer very brief questions regarding how they perceived the decision task, how adequate the information sources were that they used and if there was anything that could have helped them during the consultation that was not available to them. This interview normally took place immediately after the consultation, in the room where the consultation was held, and lasted approximately five minutes. Up to ten patients were also interviewed following their consultation and again these interviews lasted approximately five minutes. Patients were asked for their perceptions of the use of technology to inform decision making. In particular, if the nurse used a computer or looked up any information during the consultation, they were asked if they thought it helped or hindered the decision making and how. They were also asked about their general satisfaction with the consultation and their understanding of any decisions that were made.

In case site 4, all of the patients who consented to take part in the study were observed using the CDSS in their own homes and the researchers made field notes during the observation. The patients were then interviewed about their experiences of using the system.

In-depth semi-structured interviews were also carried out with all nurses within a case site who consented to be interviewed. These interviews typically lasted 30 minutes to one hour. The interviews focused on the nurses' experiences of using new technologies to inform their decision making, including their perceptions of its usefulness and how they thought it affected their interactions. They were also asked to reflect on what helped/hindered them in the use of the technology, any education or training they had received, and their perceptions of what education or training they required to use the technology more effectively.

Overall 124 consultations or nurse/patient interactions with the CDSS were observed, 38 patients and 36 nurses were interviewed after their consultation/interaction, and in-depth interviews with 19 nurses working with the CDSS in the case sites were carried out. A breakdown of the data by case site is provided in Table 1. In case site 2, observations of consultations took place in both hospital and community clinics (22 in hospital and 8 in community clinics) with post observation interviews also taking place in both areas (7 in hospital and 3 in community clinics). In case site 4 observations were carried out both on nurses reviewing patient data in the Respiratory Centre and patients using the CDSS in their own homes. In three of the nurse observations, the nurse commented on what they were doing and thinking, as well as answering short questions about the process asked by the researcher.

2.2.2 Clinical unit level

The purpose of this level of data collection was to gain insight into how technologies are introduced at unit level and education and training issues regarding the use of technology. Semi-structured interviews were carried out with individuals who had responsibility for implementing new technologies within the clinical unit, together with

other main stakeholders (such as the clinical manager, education provider). These interviews typically lasted approximately one hour.

We carried out a total of 9 Unit Level interviews. A breakdown of those individuals interviewed can be seen in Table 2.

2.2.3 Trust level

The purpose of this level of data collection was to gain insight into the policies for the introduction of new technologies at Trust level. Semi-structured interviews were carried out with individuals within the Trust who had responsibility for IT or practice development (e.g. Director of Nursing, Director of IT, Director of IM&T). They were asked to provide insight into the Trust implementation strategy, including any educational or training issues. These interviews typically lasted approximately one hour.

We carried out 8 Trust level interviews. A breakdown of those individuals interviewed can be seen in Table 2.

All interviews were digitally recorded and transcribed.

Case Site	Observations	Post observation interviews with patients	Post observation interviews with nurses	In-depth interviews with nurses
1. Anticoagulation clinic				
Routine clinic	25	6	7	
Initiation clinic	15	4	5	
Total	40	10	13	6
2. Spinal Assessment clinic				
Assessment consultation	14	5	6	
Review consultation	16	5	4	
Total	30	10	10	3

3. Walk-in centre Total	40	11	11	5
4. Remote COPD monitoring Nurse Patient Total	5 7 12	7	3	4
Total	124	38	36	19

Table 2: Details of data collected by case site

Case Site	Unit Level	Trust Level
1. Anticoagulation clinic	Team Leader GP Advisor	Director of IT Head of Professional Development
2. Spinal assessment clinic	Consultant	Director of Nursing Director of IT Senior Nurse for IT
3. Walk-in centre	Advisor Team Leader CAS Trainer Nurse Consultant	Director of Nursing
4. Remote COPD monitoring	Respiratory Centre Manager Community Respiratory Specialist Nurse	Specialist & Clinical Equipment Services Manager (PCT) Director of IM&T (AT)

Table 2: Unit and Trust level interviews carried out by case site

2.3 Analysis

The data was managed with the computer package Atlas-ti. The majority of the data collected in the case study were qualitative and analysed using thematic content analysis (ref: Miles & Huberman). Data were coded and classified according to themes that arose out of the observation and interview data. The codes for indexing the observation data were developed inductively and were distinct for each case site, because of the differing nature of the consultations. In contrast, the codes used for

indexing the nurse interviews were derived from the research questions that the case study sought to answer (e.g. index codes relating to how nurses used the CDSS) together with the results of earlier components of the wider project (e.g. index codes relating to the role of experience in how the CDSS was used). However, for each case site, these codes were adapted to reflect the differences in the settings and new codes were created as significant themes emerged.

3. Findings

The findings presented in this paper draw on the interviews with nursing staff and with unit and Trust level staff, focusing on organisational features facilitating the introduction and successful use of CDSS. The findings relating to how nurses use CDSS in practice are reported elsewhere [26].

Apparent in the data were a number of general issues at organisational level related to the introduction of IT across the NHS Trusts who participated in the study, as well as specific issues related to the individual CDSS used within the case sites. Therefore, the more general NHS Trust issues are reported first, before relating these to the specifics of the CDSS examined.

3.1 Trust processes for technology introduction

3.1.1 Technology introduction: drivers and decision processes

Trust level staff mentioned a range of drivers for the introduction of new technologies. These included the clinicians themselves:

“It was the team that pushed [...] came to me and said, ‘look, we’ve got this scheme, we could pilot it, what do you think?’” (CS1 Trust Int1)

Initiatives at policy level were mentioned:

"I think our main influences are the White Papers [Government policy documents], and the targets that we've got [...] to reach." (CS1 Trust Int2)

Also mentioned were financial drivers:

"Periodically around November and December time [...] we [...] find ourselves [...] with a million pound [that needs to be spent] [...] [T]he only thing you can do with it sensibly [...] is kit, so we bought in an awful lot of mobile equipment and the network infrastructure to support it." (CS2 Trust Int2)

Although respondents in all of the case sites could identify elements of the process they used to make a decision about technology implementation, such as the need for piloting a technology, or needing to have a decision approved by the Trust Board of Directors, only one case site appeared to have a clearly defined strategy for choosing between systems:

"We work with the staff, the clinical staff to identify what they want to get out of this, what new working practices, what new skills, what new patient care processes are they trying to implement [...] [R]ather than specifying what the system will do, we will specify what we want the system to deliver. We then go through a procurement. We do it through a formal evaluation [...] what we do is score systems. [...] generally we'll go for the system with the highest score." (CS2 Trust Int2)

Two of the case sites acknowledged the process the Trust used for decision making about the introduction of health IT was problematic. In these sites, the Trust level staff highlighted there were probably IT systems in use within the Trust unknown to them. In fact in two of the case sites Trust level staff were unaware of the CDSS being studied:

“I should imagine there is still a couple [of systems] left out there that we don’t know about...” (CS2 Trust Int2)

Interviewees also highlighted a number of challenges to introducing technology in the NHS. This included financial limitations and difficulties in recruiting and retaining technical staff:

“[W]e’ve just lost our [...] integration engine expert. [...] we’re trying to train people up but [...] what’s been offered in the private sector [...] is phenomenal compared to what NHS can pay.” (CS2 Trust Int2)

Also mentioned was the bureaucracy associated with introducing innovations:

“I think there is this time lag behind what organisations do and what actually practitioners need, the incredible hoops you have to go through to get something different.” (CS4 Trust Int1)

3.1.2 Implementation processes

When discussing what is necessary for successful introduction of IT into the NHS, the most commonly mentioned factor was clinician engagement. This ranged from an emphasis on communication to actually having clinicians drive the introduction of new technology. The system also needs to provide an obvious benefit to the user.

“[I]f they can see something that’s going to benefit them or benefit the patients that they’re dealing with then they’re happy to use it. Problems are when you try and force things on people that actually don’t improve their working life.” (CS4 Trust Int2)

Other factors mentioned by staff across all four Trusts were: the need for integration of new systems into existing systems; the need for robust and usable systems; the need for adequately resourced IT projects and training. Two Trust level staff emphasised it is not just the IT system itself but the systems and processes around the IT system that can affect whether or not the implementation of a system is successful:

“A software can’t be implemented without a framework for a service. [...] there must be a supporting mechanism, and it’s got to be supported from the highest level, [...] and I think that’s the key success factor.” (CS1 Trust Int2)

Trust level staff in two of the case sites (both acute Trusts) talked of practical strategies for getting the best out of an implementation. For one Trust, that meant ensuring that money was put aside for ‘implementation support’, such as training and adaptations to the system, while the other Trust focused on web based systems, so as to reduce the burden of installing software on machines.

3.1.3 Evaluation of technology

Trust level staff acknowledged the importance of evaluating technology, although they were able to give few examples of having evaluated a system within their Trust. Case site 2 appeared to have the most comprehensive strategy, carrying out what they referred to as ‘post-implementation reviews’:

“6 to 9 months afterwards we go back and do a post-implementation review when we do the survey, the questionnaires, look at the costs, look at the efficiency ...and then we produce a report out of that which has a number of recommendations [for improvements to the system]...” (CS2 Trust Int2)

There appeared to be increasing pressure to go back and evaluate a technology after its implementation, although limited capacity hampered the ability to do this:

“We just don’t have the time to keep going back, you know, we implement things and then we often do something else.” (CS4 Trust Int2)

3.1.4 Education and training needs

Two of the case sites identified IT training as a specific issue needing addressing. One of the case sites focused on providing basic IT skills training, in the form of optional courses staff could attend if they wanted to. Trust level staff recognised providing training to nurses was problematic because it was difficult to release nurses from the wards to attend training sessions:

“[T]hey sign up for the training with all the intention of attending and then that particular shift they might be two or three people missing for some reason, they just can’t leave the ward, it’s just not clinically safe.” (CS2 Trust Int2)

One Trust had attempted to provide training on the wards but felt that this was still less than ideal:

“[Y]ou’ll have somebody peering over your shoulder for a minute and then they’re off to deal with a patient and then they come back and peer for another minute and then they’re off again.” (CS2 Trust Int2)

A consequence of the difficulties associated with releasing clinical staff for training is often technology is introduced into areas where individuals do not know how to use a system effectively. One respondent highlighted that this can actually lead to problems with how the technology is subsequently used:

“[T]he worst practices come into play and they get consolidated and passed on to colleagues...” (CS2 Trust Int2)

3.2 The Introduction and Implementation of CDSS

3.2.1 Decisions to introduce CDSS

Decisions to introduce the CDSS were either predominantly clinician led or as a reaction to external influences. In case site 1 (anticoagulation clinic) and case site 2 (spinal assessment clinic) decisions appeared to be clinician led. Nurses in case site 1 had used CDSS since 2001, when the anticoagulation service was established. In 2005, due to limitations with the software they had been using, senior nurses took the decision to move to a different software package, as they felt the new software package could accommodate the team’s requirements more appropriately. The CDSS used in case site 2 (spinal assessment) developed from a paper-based questionnaire in use when the clinics began. A desire to record information about patients before and after patients started treatment, to see if there was an improvement, motivated the questionnaire. For a number of years, IT students from the local university have done placements in the clinic, creating and subsequently developing the CDSS in liaison with clinical staff.

In contrast, the decision to implement the CDSS in case sites 3 and 4 appeared to be because of a reaction to external drivers. The introduction of CDSS into case site 3 (Walk-In Centre) was part of a national drive from the Department of Health in England; Trust level staff considered the introduction of the CDSS to be motivated by a desire to support recording of activity. Thus, the introduction of the CDSS involved no process of procurement and choosing between different systems. The CDSS was originally designed as a triage system for use by nurses providing a telephone based information and advice service to patients. In case site 4 the CDSS was introduced as the result of a partnership between the local city council and the primary care trust, who applied for European funding (in collaboration with partners from other EU countries) for the implementation of new technologies to manage an ageing population. Once the PCT had received funding for the study, the PCT approached the Respiratory Centre, who agreed to use the CDSS.

3.2.2 Training

There were variations across case sites in the training provided to nurses to use the CDSS, with nurses who were using commercially developed packages more likely to have received some form of formal education or training. The formal training consisted of 'off-site' training days delivered by either the system provider or an outside company. Only nurses who were working in the case sites at the time of the CDSS introduction were trained in this way; these case sites now used a system of induction periods, on screen training, booklets and learning from other nurses 'on the job' to teach new members of the team how to use the CDSS. Most of the nurses reported only really learning how to use the CDSS once they had used it in practice. One of the nurses involved in training at the Walk-in Centre mentioned lack of time for update training

leading to nurses using the system in different ways and not always getting the most out of the system.

In case site 2 (spinal assessment), where the nurses used a locally developed system, none of the nurses had received any training on the use of the CDSS. However, the nurses found the system easy to use and did not feel training was necessary.

In discussing education and training needs, unit level staff seemed less concerned with training in how to use the software and more concerned with more general training and support to develop the nurses' decision making skills. In case sites 1 and 3, the nurses have an 'advisor' they could contact with queries, while in case site 2, the consultant was able to support the nurses. However, unit level staff acknowledged this need for support decreased over time:

"These days it's just two or three calls a week [from the nurses] and it's usually [a patient] who is just very very difficult to anticoagulate, to stabilise." (CS1 Unit Int3)

In case sites 3 and 4, there was less perceived need for such support, possibly because the nurses had been working confidently in these roles prior to the introduction of the CDSS.

3.3 Additional organisation level features

3.3.1 A supportive environment

In two of the case sites the supportive nature of the team within which the nurse worked was identified by the nurses as an important factor for both using the CDSS and for making decisions more generally. In case site 1, although the nurses worked

across different locations, there was a sense there was always someone at the end of the phone:

'I feel (...) that I'm getting really confident with it but I think that's part of working with a good team as well, 'cos if there's any problems with it, I just ring up somebody and they'll advise me and help.' (CS1 Nurse3 Int)

Similarly, in case site 3 a number of nurses commented on the supportive nature of the nursing team working in the Walk-in Centre. Nurses reported being happy to ask for, or to give, a second opinion or advice in cases when there was uncertainty as to the best decision to make. In 4 of the 40 observed consultations in this study the nurse involved asked a colleague to give a second opinion.

"A very strong team here....Which is so supportive.....That makes the difference."
(CS3 Nurse2 Int)

3.3.2 A concern for process improvement

While not something identified by staff themselves, what did stand out in three of the settings was the desire of unit level staff to continuously improve the nature of the service provided to patients. For example, in case site 1, the unit level staff were looking to do 'in reach' work with the local hospital so as to improve communication and provide guidance, while in case site 2 the unit level staff were keen to audit their work so as to identify areas for improvement.

Similarly, Trust level staff described a range of future plans for technology implementation; case site 1 was particularly interested in telecare and making use of remote monitoring technologies, case site 3 felt the way forward was more integrated

technology, and case site 4 were concerned with other uses of the remote monitoring technology.

4. Discussion

4.1 Organisational features associated with CDSS use

The aim of this paper was to explore the organisational features that appear to influence successful CDSS use in nursing. Although nurses were observed (and reported) using the CDSS in ways probably not envisaged by the original designers of the system [26], all of the nurses who participated in this study considered the technology they used to be useful. Nurses had 'normalized' the CDSS into their working practices [16], developing strategies to deal with perceived inflexibility in the systems they used. In this way, the CDSS examined in this study can be considered as successful implementations.

A number of organisational features appearing to facilitate the successful use of CDSS across the four case sites were identified, including the role of clinical involvement, general organisational strategies for the procurement, implementation and evaluation of IT and organisational culture. Most studies examining the successful implementation of health information technology highlight the importance of engaging clinicians in the process [17]. Other studies have discussed the problems arising when clinicians are not engaged fully in the process of decision making and implementation of health IT systems [15]. The results of the study reflect the key role that clinicians play in the successful use of CDSS; the majority of NHS Trust managers highlighted the importance attached to involving clinicians in the process of decision making and implementation around the introduction of new technology.

However, the engagement of the nurses with the process of introducing CDSS in each of the case sites varied. In two of the case sites the nurses themselves had been the drivers for developing the CDSS or had taken the decision about the system to use. In the other two sites nurses (and other Trust staff) had had very little input into either the procurement decisions about which CDSS to use, or involvement in the ensuing implementation process. However, in both case sites, the perceived benefits the nurses could identify to their practice of using the CDSS appear to have offset this lack of involvement in selecting and implementing the system. Thus, while engaging nurses in decision making around the introduction of CDSS can facilitate successful use of the system, successful integration of a CDSS into practice may occur even in situations where such engagement does not take place.

Research examining the successful implementation of technology in health care has also highlighted the importance of 'fit' between the technology and the organisation, ensuring the technology chosen can be adapted to the needs of the working environment, and that it is recognised that implementation is not just a 'technical' project [14;18]. The results highlighted recognition by most trust level staff of the importance of choosing the 'right' technology for a task and ensuring effective planning of a technology implementation. However, only one trust appeared to have formal mechanisms in place for IT procurement, in a case site where the CDSS used was actually chosen by clinical (rather than Trust level) staff. In all of the case sites, there was an awareness of the complexity of technology implementation, with associated strategies to manage that implementation. Although it was not clear how use of those strategies related to the specific CDSS examined in this study, an awareness of the issues around implementation appears to be part of the organisational culture where nurses used CDSS successfully.

It is unclear what role education and training may have in the successful implementation and use of technology such as CDSS. It was apparent from the data that at an organisational level trying to organise training for nurses is problematic; nurses have difficulty being released from clinical areas and taking the training to clinical areas is equally challenging. In terms of training on specific CDSS, nurses were more likely to have had some form of 'one off' training. However, ongoing training and support was more 'ad hoc', and dependent upon learning from other nurses. It remains unclear whether or not this is a satisfactory approach to training for the use of CDSS or other types of IT, as such an approach could lead to nurses not using technology as effectively as they could.

Organisational culture is an important factor in the successful implementation of technology [17]. Although not formally measured in this study, it was apparent from the data the importance staff attached to working in a collaborative, team environment. Many of the nurses mentioned the supportive nature of environment where they worked and valued the encouragement given to them by NHS managers to innovate and improve their practice. The nurses in this study valued the CDSS they used as a tool to help them with improvements in their practice, and the benefits the CDSS had brought were highly valued.

4.2 Limitations of the research

The study was carried out in four case sites identified as being innovative in their introduction of CDSS used by nurses to assist with clinical practice. Although case sites using different types of CDSS, in different contexts, to support a range of nurses' clinical decisions were selected, generalisation of the findings to other organisations where nurses use CDSS or other forms of technology is limited. Contextual details of

the four case sites used in the study have been provided to enable the reader to make judgements about the findings and their transferability to other clinical contexts.

This study examined the use of CDSS in organisations where the implementation could be considered 'successful', and the CDSS was in use. The data is relevant in terms of examining nurses' use of such technology once use of the technology is established, but cannot provide insights into the processes of implementation initially used to introduce the technology into the organisations in the first place.

The focus on successful use of CDSS could also be considered a limitation of this study, as it is not possible to determine to what extent absence of the organisational features identified in the study results in failure to use CDSS successfully.

4.3 Conclusion

This paper has provided a description of some of the characteristics of NHS Trusts where nurses were successfully using CDSS in their clinical practice. Through this description, the intention is not to suggest a simple formula for the successful introduction or use of new technologies such as CDSS. Even the NHS Trusts who participated in this study indicated they experience challenges when attempting to adopt technology such as CDSS, particularly in relation to training and technology evaluation. However, the analysis does suggest certain organisational characteristics, such as those described above, are associated with the successful introduction of new technologies for supporting nurse decision making and possibly the successful introduction of new technologies more generally. When taken as a whole, those characteristics represent a socio-technical approach to the introduction of technology [28].

Authors' Contributions

RR collected part of the data and made a substantial contribution to the analysis and interpretation of the data and drafting of the article. DD contributed to the conception and design of the study, data analysis, data interpretation and drafting of the article. Both authors have approved the final version for submission.

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Statement of Conflicts of Interest

The authors have no conflicts of interest to declare.

Summary Table

What was already known on the topic

- Organisational features influence how successfully Health Information Technology is implemented in practice
- Clinician engagement is an important feature in successful health information technology implementation

What this study adds to our knowledge

- Lack of involvement of clinicians in health information technology implementation can be offset the perceived benefits of the system to clinical practice.
- Awareness of the issues around implementation of technology integrated into the organisational culture appears to lead to successful technology use.
- A supportive and collaborative team environment appears to contribute to successful technology use.

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