Transition from Paper to Electronic Nursing Documentation in Residential Aged Care: an Actor Network Theory Analysis

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Abstract

Objectives: To examine the role of technology when introduced into the specific setting of residential aged care and then analyse the associated changes to this complex socio-technical network of human and technology actors on the introduction of this technology using the rich lens of Actor Network Theory. Methods: An exploratory qualitative single case study was conducted. The specific focus being the implementation of a nursing information system in an aged care context, i.e. the transition from paper-based nursing documentation to electronic nursing documentation. A series of 19 semi structured interviews with facility managers, nursing coordinators, and the nursing and care staff were conducted. The collected data were analysed using standard qualitative techniques such as thematic analysis and a priori themes were developed from the application of Actor Network Theory. Results: A priori themes coupled with emergent themes served to highlight the impact of a disruptive technology solution into a complex context. Conclusion: An Actor Network Theory analysis enables a rich theoretical lens to be used to examine the introduction of a disruptive technology into a complex context. On such examination critical success factors were identified as well as key barriers. Moreover, people issues were found to be central to the success of such a solution.

Keywords: Electronic nursing documentation; Technology implementation; Actor Network Theory

1 Introduction

As the aging population increases, it is essential that already strained aged care facilities try to incorporate technology solutions to make them more effective and efficient as well as offer high quality care to their residents. Documenting and accessing residents' health information, care delivery and assessment, and care plans are important in residential aged care (RAC) provision. The exchange of residents health information between staff is vital to ensure resident quality, safety and continuity of care [1]. Previous studies revealed that information processing is a major care staff activity and that information input and exchange were time consuming, especially for nurses and personal assistant care (PCA) staff through the hand over and care delivery process [2-4]. The analysis of nursing errors in clinical management highlighted that clinical handover also plays a pivotal role in resident safety [5]. In addition, literature reviewed highlights that inaccurate or inade-

quate communication of residents' health information can result in adverse outcomes, including unnecessary delays in the diagnosis, treatment or communication of results and incorrect treatment as well as considerable waste of limited resources [6, 7].

Information technology (IT) has a great capacity to support efficient and effective information processing in aged care [2, 8, 9]. Electronic nursing documentation is increasingly adopted in residential aged care organisations [10]. However, still there are some issues related to IT based electronic nursing documentation [8, 11]. This is because aged care is a multidisciplinary and multiagency area [12], which involves a complex interaction of physical, social, environmental, and economic factors that affect the lives of older people and those who provide services for them [13, 14]. It is complicated further by the need for decision-making, communications and information sharing across multiple actors and providers [15].

The ability of electronic systems to facilitate the documentation and exchange of information in most industries such as healthcare is proved [16, 17]. Hence, adapting IT technology solutions to facilitate residential aged care might be an effective and efficient solution to improve care delivery and reduce nursing costs, particularly in residential aged care, due to their long-term treatment and care delivery process [3, 18-22]. Also, electronic nursing documentation systems could potentially increase efficiency as the nursing and PCA staff would not have to search for information from different locations as is currently performed [1].

Although transition from paper to electronic nursing documentation in residential aged care is progressive, further studies are needed to address some other important issues. For example, Lyhne et al. [1] identified four main issues through residential aged care (RAC) facilities handover process included in information access, information duplication, multiple information gathering mechanisms and lack of standardization [1]. Most of these issues are socio-technical concerns, due to relation and communication errors between different actors as well as barriers to consistent and effective communication practices between actors through the information exchange process [23-27].

Therefore, to examine a transition from paper based to electronic nursing documentation in residential aged care, this study is designed to identify a socio-technical network of actors and their interactions in the contexts of residential aged care, and to explore benefits, barriers and complexities of technology-user relationships. The socio-technical approach has previously been found to be useful to explore complexities of actors' relationships and to address issues around interactions across

transition process from paper to electronic documentation in other industry as well as in healthcare [28-31]. Several scholars [32-39] have argued that Actor Network Theory (ANT) should be used together with a socio-technical perspective, as a robust lens to capture all the complexities, nuances and richness of healthcare operations, accurately.

Thus, this paper reflects on the use of Actor-Network Theory to gain an understanding of the role of people and technology during the transition from paper to electronic nursing documentation in the specific setting of residential aged care. In this research, a qualitative approach is used to examine an exemplar data site as a single case study and thereby identify in-depth the complex and dynamic networks of actors and their interactions during the transition.

2   ANT background

Actor-Network Theory (ANT) is a sociological theory developed by French sociologist Bruno Latour and Michel Callon and British sociologist John Law [40-44]. The essence of this theory is that world is constructed of hybrid entities [41] consist of both human and non-human elements e.g people, objects and organisations know as actors or sometime actants, and these elements cannot be studied in isolation and separation [42].

ANT tries to bridge the gap between socio-technical divide by denying the existence of purely social or technical relations. In doing, so it takes a very radical stand and assumes that things (such as Technologies) are actors therefore have the potential to transform and mediate social relationships [37]. It also put emphasis on the concept of heterogeneous networks because of the non-similar nature of elements and their relationship in network. This makes them open and evolving systems [45]. Therefor Actor- networks are highly dynamic and inherently unstable in their nature; and a better understanding of how alignment between people, technology, their roles, routines, values, training and incentives as well as understanding of the role of technology that how it can facilitate or negatively impact the work process and tasks in an organisation can stabilise these network to some extent [32, 36, 46]. Therefore, ANT can be a material-semiotic approach and can provide lens to study the ordering of scientific, technological, social, and organisational processes and events [32]. To realise the importance of the application of ANT into the evaluation of electronic nursing documentation system, it is important to understand the key concepts of ANT and map them to the critical issues in electronic nursing documentation system.

An initial assessment of these key concepts and their mapping is provided in Table 1.

3   Methods

This study is exploratory in nature. Central to the study is to explore and examine the complexities of interactions between key actors such as nurses or care givers and residents or patients as they transition from paper to electronic nursing documentation in a residential aged care context. Within the field of information systems (IS) and more especially in health informatics, a qualitative interpretive case study approach has been accepted as a mature method to investigate contemporary phenomena in their context [50]. Hence, this study uses a qualitative interpretive single case study [51-53] to study the socio-technical phenomenon under consideration; namely, the transition from paper to electronic nursing documentation in a residential aged care context.

Specifically, in this study, the single case is a large not for profit aged care organisation, in Melbourne, Australia. This host organisation provides a range of services including residential aged care services (RAC), community services, disability services (DS), and education services including early childhood and specialist education at over 40 sites around Melbourne and Victoria. The organisation adopted a new electronic nursing documentation system in two areas of residential services: RAC and DS as part of a large Enterprise Resource Planning (ERP) implementation programme. Prior to that, the nursing documentation was paper based and there was limited software support in RAC and DS facilities. There are 4 RAC facilities with 305 beds providing both high and low care. This paper focuses on the transitional from paper based to electronic nursing documentation in RAC one year after the introduction of a nursing information system (NIS). The NIS project had good management and user buy-in and involvement from inception. The goals of the project were to increase visibility and access to information, improve standards of care and provide a more efficient and available documentation system.

Data collection took place in end of 2011 and start of 2012 – one year after the initial introduction of the system and during phase 2 of the implementation project. A series of 19 semi-structured interviews were conducted with facility managers, clinical care managers, and the registered nurses (RN), enrolled nurses (EN), personal care assistants (PCAs). The interviews were transcribed. The transcripts and the observations made by two of the researchers during the systems implementation formed the primary source of qualitative data. Other documents
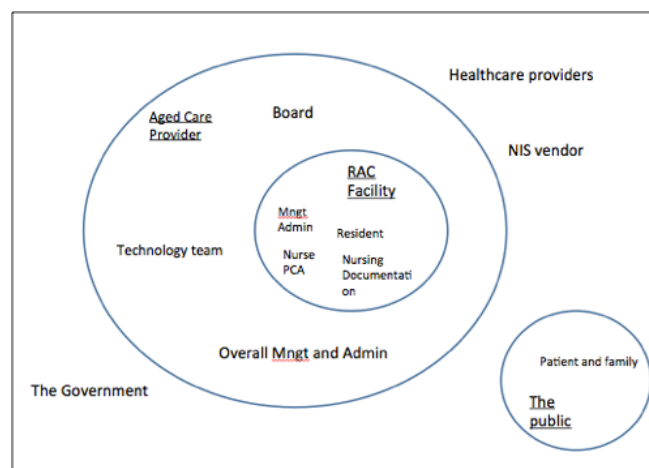

Figure 1: An overview of the involved actors

about the organisation goals, structure and service provision, and system's documentation were also included as additional qualitative data. The project received ethics approval from Deakin University and the ethics committee of the involved aged care organisation. A priori themes and thematic coding through the lens of ANT [51] was applied as the data analysis method in this research. The analysis took place through iterative cycles of independent coding/recoding and synthesis discussions to draw and refine the emerging themes.

4   Results

4.1   An overview of the key actors and interactions

Actors involved in the transition to electronic nursing documentation of the NIS were identified to include: the Residents, Nursing staff (including Registered Nurses (RN) and Enrolled Nurse (EN)), Personal Care Assistants (PCA), RAC administrative and management staff, senior management and overall administrative staff. In addition, the paper based documentation system, nursing documentation (in the transition from paper based to the new Nursing Information System (NIS)), other existing Information Systems (such as ACFI, finance, risk management), the Information Technology (IT) team, and external parties such as General Practitioners (GPs), allied health professionals, hospitals, pharmacists, the IT vendor (who provides the nursing information system (NIS)), the public and Government were also central actors. The punctualisation structure can be denoted in Fig 1 with sub-networks of actors. Each of the sub-networks can be presented as a black-box to the actors external to it and should be stable and strong to support the function of the whole network.

The network of the key actors and interactions be-

Key Constructs of ANT	Initial Mapping of electronic nursing documentation in RAC with ANT
Actor/Actant: Actors are the web of participants in the network including all human and non-human entities. Because of the strong biased interpretation of the word actor towards human; a word actant is commonly used to refer both human and non-human actors. Examples are human, information systems, technical artefacts, work process and graphical representation [32].	Residents, Nursing staff, PCA staff, RAC admin and management staff, general practitioners (GP), allied health, hospitals, pharmacists, vendor, Chief Information Officer (CIO), Chief Financial Officer (CFO), System, paper documentation system, existing Information Systems (human resource management, finance management etc.).
Heterogeneous Network: is a network of aligned interests formed by the actors. This is a network of materially heterogeneous actors that is achieved by a great deal of work that both shapes those various social and non-social elements, and "disciplines" them so that they work together, instead of "making off on their own" [40, 41, 47]	The electronic nursing documentation system here is clearly a network of different applications in this context, but it is important to understand that heterogeneous network in ANT requires to conceptualise the network as aligned interest including people, organisations, standards and protocols and their interaction with technology. The key here is a better alignment and representation of interests so the healthcare delivery can be improved.
Tokens/Quasi Objects: are created through the successful interaction of actors/actants in a network and are passed between actors within the network. As the token is increasingly transmitted or passed through the network, it becomes increasingly punctualised and also increasingly reified. When the token is decreasingly transmitted, or when an actor fails to transmit the token (e.g., disconnection from Server), punctualisation and reification are decreased as well [47].	In electronic nursing documentation system. Context this translate to successful cost effective and efficient healthcare delivery, such as for nurses and PCAs to provide care for residents by having a capability of sharing health information with other service providers and for the RAC admin staff to have access to all resident records available at their desk just one-click away can improve services with in the facility. It is important to understand here that to maintain the integrity of the network all the time is very important because if wrong information passed through the network, the errors would be devastating because they can propagate quickly and will multiply. Residents' details, progress notes, assessment charts, assessment forms, care plans, GP diagnosis, prescriptions, medicines, assistance in activities of daily living, management instructions and internal/external reports etc. Social interactions between Nursing/PCA staff and Residents/Families are the examples of quasi objects.

Table 1: Mapping of key ANT concepts to a general RAC setting. Continued on next page.

Key Constructs of ANT	Initial Mapping of electronic nursing documentation in RAC with ANT
Punctualisation: The concept of ANT is pretty much based of punctualisation. Within the domain of ANT every actor in the web of relations is connected to others and as a whole it will be considered as a single object or concept same as the concept of abstraction is treated in Object Oriented Programming. These sub-actors are sometime hidden from the normal view and only can be viewed in case of the network break-down; this concept is often referred as a depunctulisation. Because ANT require all actors or sections of network to perform required tasks and therefor maintain the web of relations. In case of any actor cease to operate or maintain link the entire Actor-Network would break down resulting in ending the punctualisation. Punctualisation is a process and cannot be achieved indefinitely rather is a relational effect and is recursive that can reproduce itself [48].	For example, a computer on which admin staff or nurse is working would be treated as a single block or unit. Only when it breaks down and need help with spear parts can reveal the hidden chain of network consist of different actors made up of (People, Computer parts and organisations). Similarly, in a NIS context uploading record of a patient is in reality a consequence of the interaction and coordination of many sub-tasks. This only be revealed if some kind of breakdown at this point occurs and depunctualisation of the network happens and all sub-task would be carefully examined then this will reveal different subsets of systems and actors involved e.g (RAC management and admin staff. Care givers (care staff) include Nurses (RN/EN), PCA and life style and leisure support staff), Healthcare providers include GPs and Allied Health, Specialists, and Hospitals. Community include the Residents' families and friends.
Obligatory Passage Point (OOP): broadly refers to a situation that has to occur in order for all the actors to satisfy the interests that have been attributed to them by the focal actor. The focal actor defines the OPP through which the other actors must pass through and by which the focal actor becomes indispensable [49]	Focal actors: Nurses and PCA. Having access to residents' clinical information to deliver RAC service to residents is key to satisfy interests of the focal actors.
Irreversibility: Callon [49, p. 159] states that the degree of irreversibility depends on (i) the extent to which it is subsequently impossible to go back to a point where that translation was only one amongst others and (ii) the extent to which it shapes and determines subsequent translations.	In the context of a very complex nature of healthcare operations irreversibility is very less likely to occur and would be more dependent on social networks and the nature of interaction between human and non-human actors in the network. Here it is important to remember that the chain of events needs to be monitored carefully so the future events can be addressed in best possible manners. Once the system is in, no turning back. Data are critical and hence a backup and business continuity plan is required.

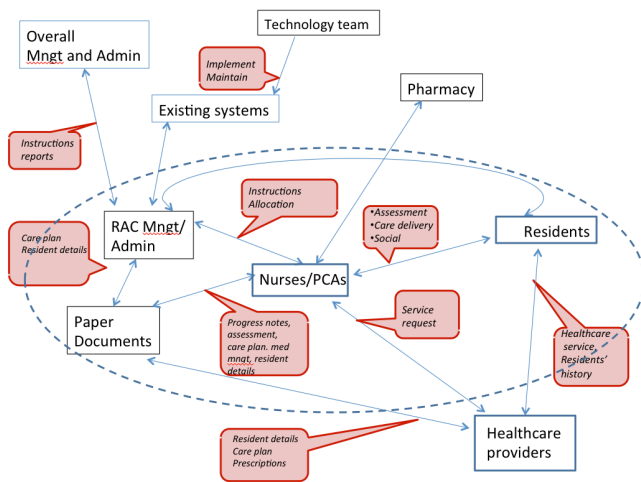*Table 1: Mapping of key ANT concepts to a general RAC setting.*

Figure 2: Key actors in paper based nursing documentation practice

Figure 3: NIS-based documentation practice

tween them as established and exercised in paper based nursing documentation practice can be shown in Fig 2. Key actors of interest include the RAC sub-network Quasi objects (tokens) passed between them include: Residents' details, progress notes, assessment charts, assessment forms, care plans, GP diagnoses, prescriptions, medicines and other healthcare, social support, and assistance in Activities of Daily Living (ADLs) etc. There are also administrative information between the management, administrative and care staff, and social support and interactions between the Nursing/PCA staff, residents, and their families. Prior to the NIS implementation, the paper documentation actant (non-human actor) played a central role in accessing and documenting RAC service. Such information includes residents' details, progress notes, assessment charts and forms, and care plans – necessary in RAC service provision.

Generally in residential aged care provision, the focal actors include the residents (care recipients) and care givers (care staff) i.e. the nursing and PCA staff. In implementing the new NIS, the focal actors include Nurses and PCAs as they were direct end users of the system. The key interests of these focal actors are to ensure their abilities to deliver quality and safe care for the residents. Obligatory Passage Point (OOP) which is defined as a situation that has to occur in order for all the actors to satisfy the interests can be understood as a stable sub-network of each RAC Facility which can provide the focal actors with real time access to information and documentation functionality critical to delivering safe care to the resident as well as providing required reports, communication and information with external actors and/or networks. Not all external interactions are shown in Fig 2 for simplicity.
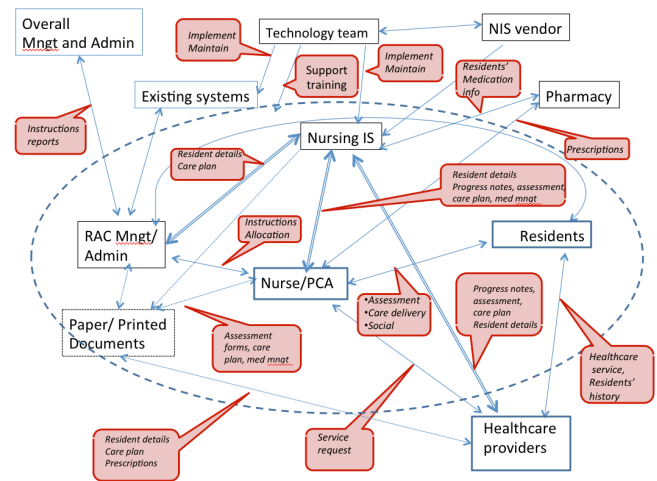
4.2 Findings

4.2.1 Actors adjust their practice and interactions

The NIS actor entered the network and formed its association relationships and started interacting with existing actors. Overall, a moderate-positive level of NIS acceptance was found. Care staff, management and admin staff learned to and interact with the NIS actor. A hybrid complex network is formed as the new NIS system is establishing its role with the other actors including the paper documentation actor (see Fig 3). The system and paper documentation actors co-exist. Roles of human and non-human actors were readjusted and redefined as the implementation took place. The interactions denoted in dotted lines still exist, but in a new form due as discussed below.

4.2.2 Transition of the NIS to the network and changes to documentation practice

The network was complex, dynamic and went through many changes including those that were pre-planned as well as those learned as needed during the transition to electronic documentation. The nursing and care staff learned to use the NIS to access, view and document progress notes, assessment charts and forms. All staff use progress notes in the NIS. The nursing and PCA staff use progress notes to check "*for the last 24 hours . . . and use that as a bit of a handover*" [Facility Manager 2]. Real time documentation has not been accepted as an emerging practice. Although laptops are available, and it is common that the nurses and PCAs write their notes and later transfer them into the NIS: "*keep a notebook in our pockets. . . jot down in summary form*" [PCA 9] then enter progress notes into NIS for a bunch of four or five residents at a time in between breaks. A care staff member shared her view: "*I'm just with our*

aged residents, computers are not something that they would be very familiar with." [Life style and leisure – PCA15]

The care staff adjusted their documentation practices. Some shared with us: "*I go straight away after I finish my observation and everything what I need to do, I go and that's what I like to do to record straight away.*" [Clinical Care Manager 8]. Others described: "*It depends on how busy you are, if you are not busy just document straight away, if you are busy you have to wait and document when we have time.* [RN] They find the NIS to be useful. "*you can go back in, you can select your date ranges and you can actually read through the whole thing rather than having to flick through manually and find handwritten notes which are sometimes illegible..*" [PAC]. The administrative staff interacted with the NIS by using the resident records administration and account management functions. They add and enter the residents' details and photo into the NIS, archive their files when they leave or transfer to another facility. The administrative staff also sets and manages user accounts and assist other actors for example the nurses, PCA, and external GPs and allied health professionals in accessing, logging in and using the system. Although the families and residents do not directly use the NIS, the RAC staff interacts with them and document details about the residents.

The process of documenting assessment charts, assessment forms, and care plans was reviewed and adjusted as staff learning about the NIS took place. There are two reasons for the co-existence of paper documentation and NIS actors. First, assessment charts and forms were gradually introduced to the RAC facilities (rather than in a big bang approach); therefore not all forms were available in the NIS. For example, at one facility: "*we just do charts, we don't do forms at all. So we have the bowel chart and urinary chart...*" [FM2]. Second, not everyone from the care staff documents these data into the NIS yet, often the RN (Division 1) and Clinical Care Manager and Facility Manager do so. However, all nurses and PCAs access and view these documents to enable care delivery. Some of the RN's and Clinical Care Managers use more advanced components and acted as clinical champions to demonstrate the NIS and provide training for the PCA staff: "*We have trained, but we're slowly going to the PCA's to show them to do, because there are many assessment they can do, personal hygiene for example, toileting, continence, what they're doing every day, they can record this, but not many people know (how to do it)*" [Clinical Care Manager 8]. As the nursing and care staff learn to interact with the NIS and adjust their documentation practice, a common agreement is found among them that there is

no going back to paper and that all functions should be available and accessible in future.

In addition, the medication management has been introduced to only one facility. It picks up admitted medications and there is evidence of mixed paper-based and NIS practices: "*the doctors got to handwrite the medication chart, you've got to fax the medication chart to the pharmacy, the pharmacy's got to upload it on to the NIS then you've got to come back and then you've got to double check the medication chart that the pharmacist has made matches the one that the doctors hand-written*" [Facility Manager 2]. This facility manager finds the NIS medication management to be "*great for getting PRN reports to review the amount of PRN's that a resident be getting*" and "*It picks up if an RN's missed a medication.*"

4.2.3 Staff experiences with and perceptions about the NIS actor

The interviewed staff shared a mix of experiences. Most of them felt satisfied, comfortable and confident in interacting with the NIS, especially the resident details and progress note functions. For example a PCA expressed: "*I think iCare is important. I think it's fun to use and it's easy and it's good to have everything documented.*" Some care staff were rather neutral about the NIS but still found it to be "*very important because it's much easier to access information.*" Data quality was found to be easy to read and "*reliable generally. Once in a blue moon I notice a Pension number might be wrong or something like when I'm transferring information.*" [Admin Staff 3]. Staff experienced some usability issues with the NIS, such as the lack of a spell checking making it difficult for some staff from non-English speaking backgrounds.

A majority of the interviewed staff found the NIS to be useful for getting and documenting information. "*So we have all that information there now at our disposal. And I think it's given staff a degree of confidence now, the ones who have really mastered the art of documentation.*" [RAC General Manager]. According to the general manager, RAC has become more informed: "*..the information is well documented and it provides a continuous record of the care needs that we've met for the residents...*" [RAC General Manager]

The NIS was found to be an efficient tool for documenting and retrieving nursing information. "*It's time saving, it's user-friendly and reliable. It saves a lot of time*" [RN5]. She further described: "*the benefits is it saves time, like when you are transferring a resident to hospital you just have to document in [0:13:22.7] rather than filling all the paperwork, the transfer form.*

When you are transferring someone to hospital it is easy." (RN5). A similar observation is found among the administrative and management staff: "*it's an efficient way of accessing information.*" [Admin Staff 3]. However, in the nursing and care staff's view the NIS needs improvements to enable them to be efficient in reviewing and approving residents' care plans.

According to the management and administrative staff, timely and efficient information access dramatically improved management and administrative reporting. The NIS was found to offer "*greater efficiency overall because all our documentation is now centralised into one point. And it's given people a degree of confidence about the continuity of that information*" [RAC General Manager].

On-going training and support is required and important due to a number of reasons including staff turn over, changes to the documentation practice as well as the NIS during the long period of implementation, staff writing and English skills need to be improved to ensure the quality of progress notes. To address this, A training program was provided to improve staff literacy skills and documentation quality. This was acknowledged: "*it's enabled a lot more scope with the extra training that we're putting in place*" [RAC General Manager]. Some staff found it harder to type data such as blood pressure data into computers than in paper. Peer support and role of champions were found to be important. Having stressed the importance of training, several staff acknowledged time and human factors as important in assimilating the NIS with their existing care delivery and documentation practice. The staff with strong keyboard skills found the NIS to be easy to use while those with weak computer skills found it slow to enter data into the system. According to them, it takes time for people to learn and become familiar with the system: "*I think it was a learning curve for everybody*" [Facility Manager 2].

The shortcomings of NIS as voiced through human actors include the slow Internet access and number of laptops at some RAC facilities during the first stage of the implementation. Due to the slow network access, the NIS was often perceived to be slow by the users, especially when they tried to upload or view the residents' photos. While new additional computers were provided to sites the location of some of these did not encourage use and needed to be relocated to more optional areas where higher staff traffic occurred. The paper based documentation actor was also discussed by the staff through their description of mixed practice: for example some assessment forms and charts are still in hard copies during the early implementation stage; a new form of summative progress notes that would be later transferred into the NIS; and signed forms that need to be kept in hard copies for various legal requirements. Still, the nursing and care staff believed that paper-based nursing documents would phase out down the track and electronic documentation would stay.

Concerns by the GPs and allied health professionals were voiced through the interviewed participants. For example, a facility manager shared with us that at her site all the doctors accepted and use the NIS. However, she also noted that some of the doctors at another site refuse to do the progress notes on the computer: "*they're older and they don't want to learn*" [Facility Manager 2].

Senior and new staff also noted that having an NIS would attract new employees to Villa Maria. With increasing frequency staff are asking which NIS if any is present at a facility when considering applying for a role.

Overall, the technology and paper actors co-exist and adjust their roles in the new emerging network. The network of actors involved in electronic documentation is spreading as they become more familiar with the system as more of its functions become available to them. Not only the nursing champions trained other actors, but also the administrative staff were active in training and providing assistance to other actors in interacting with the system.

5 Discussion and Conclusion

In summary, a hybrid complex network is formed with the introduction of the new actor (system) and as the new actor forms its interactions with other actors. The system and paper documentation actors co-exist. Roles of actors are redefined. In addition, following observations were made:

- NIS customisation to fit in RAC in the specific context, staff engagement and on-going training and support contributed to success.

- Mixed reactions require strong leadership and good engagement at all levels for change management.

- There is a need for maturing the process of use to simplify the new documentation practice and increase flexibility.

- Implementation and change management is resource intensive.

By enlarge the success of the implementation of the NIS was largely underpinned by the significant involvement of all levels of RAC staff in decision making

ANT Translation moments	Mapping
Problematisation: At this stage Problem is Identified as well as actors/actants and their interests are identified and framed. Then a primary actor is chosen who act as a OPP between other	The RAC organisation had no or limited resident management systems software in Residential, Disability and Education Services businesses, and ERP was underway and nursing documentation should be integrated with the new ERP to facilitate care provision and reporting processes.
Interessement: Primary actor/actant convince other allies to join network and lock them into problematisation.	IT team and management liaise with nursing and administrative staff champions to convince other actors into problematisation and provided assistance in transferring to NIS.
Enrolment: The successful outcome of previous stages and acceptance of roles led more allies to attach	The RAC was in the middle of enrolment with ongoing training and support. Successful implementation of Progress Notes enrolled more and more focal actors (care staff) to use NIS. Assimilation took place with other documentation components of assessment and care plans.
Mobilisation: Maintaining the network by persuading the actants that the interests of translates and actants are same so the enrolment can become active support.	The network is spreading as more actors used NIS and more components were introduced to RAC facilities hence benefits such as informed care and process efficiency were more evident.

Table 2: Mapping the ANT translation stages to the transition from paper based to NIS documentation

around the NIS project. From product selection through to training design staff where empowered to guide and support the project team. This was so successful that parts of the implementation and configuration managed directly by a RAC working party to implement.

The project highlighted that a generic implementation model could not be found that was a perfect fit for every facility. Factors such as lay out, staff numbers, specific actor characteristics, training needs and demographic all played a part in tailoring the implementation. While an overarching project, methodology and general direction was adopted tailoring the role out for each facility, even in small ways, proved successful. This did create a higher workload for project implementation staff but proved beneficial in the longer term.

The participants did report an improved access to information that facilitated both care delivery but also management reporting and visibility of RAC facility activities. Staff that were both on and off site were able to support each other accessing the NIS to obtain information. Removing paper record templates also improved take up of the NIS removing the option for staff to revert back to these documents. Easier access to information highlighted knowledge gaps that needed filling. Some staff required some support with English being their second language that impacted documentation quality. Training programs were tailored for these groups.

A system was carefully selected that had a simple to use user interface. Respondents indicated that this was a critical success factor. The staff that were less computer literate were assisted in their transition to the NIS. Computer literacy programs were put in place to support all staff as a parallel to the core implementation training.

Implementation of the medication management system was of particular interest. A barrier was that the staff were initially very reluctant to move away from paper for this critical process. The training program was coupled with a buddy/mentoring model of delivery to support the transition to online medication management. Staff quickly adopted the online medication management portal due to ease of use, less incidents and time efficiencies. Having an ability to order and interact with pharmacies via the system was also considered of value.

The major limitations of the study is concerned with the fact that only focal actors were included and a subsequent evaluation is needed when the system has been fully implemented that also examines other actors as well.

The study also has contributions to theory. In particular, it has been shown that ANT provides a unique and rich lens that enables a full and deep understanding to ensue regarding the implementation of large-scale technology solutions into complex care contexts. However when applied to such large complex healthcare contexts that typically have many actors ANT also needs to differentiate between and within types of actors for an even more useful analysis of respective interactions to ensue.

This is an important and necessary extension of ANT when applied to healthcare contexts and requires future studies to fully identify how this might occur.

In closing, it is noted that the use of ANT as a theoretical lens is most helpful to understanding critical issues regarding health informatics and serves to extend and enhance the health informatics implementation studies. Moreover, such an in depth understanding should also enable a successful outcome to ensue which given the poor success rate to date of many technology implementations into healthcare contexts is a key consideration especially given the increasing aging population coupled with the increase in technology applications into healthcare contexts.

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Conflicts of Interest

The authors report no conflicts of interest.

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