Identifying key success factors for the adoption and implementation of a chemotherapy ordering system: A case study from the Australian private healthcare sector

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Abstract
This paper is designed to systematically assess the benefits of a chemotherapy ordering system (COS) for the private healthcare sector in Australia. By taking a rational economic perspective and modeling the principle-agent relationships using an actor network framework, it is possible to evaluate various scenarios and thereby assess the benefits, barriers and facilitators, possible COS can have. In this study, four hypotheses are tested using a mixed methodology which will serve to facilitate the decision making processes regarding the choice and implementation of the appropriate COS for Epworth.

Keywords: Chemotherapy Ordering System (COS), Actor-Network Theory (ANT), Agency Theory, Computerized Physician Order Entry (CPOE) system, Private Healthcare Sector.
Introduction

Cancer is one of the most common diseases in today's modern society and cancer treatment regimens are complex, have high risks associated with them and often have unwanted variances. One area within cancer treatment today that exemplifies these issues is in the prescription and administration of complex chemotherapy protocols. Although part of drug prescribing generally, chemotherapy is much more complex than most other drug prescribing in terms of the intrinsic toxicity of the drugs, the complexity of the schedules of administration and the necessity for close monitoring. Additional differences from other prescribing are the role of specially trained chemotherapy nurses who actually administer most of the drugs and a very high level of pharmacy engagement.

In the Australian private hospital setting, private physicians usually order the drugs in their consulting rooms, a privately contracted pharmacy manufactures the drugs and chemotherapy nurses employed by the hospital administer the drugs in hospital facilities. These multifaceted employment arrangements in the private sector and the intrinsic complexity of the prescription process combine to create a heterogeneous network of operations that exhibits a unique set of problems and agency dilemmas due to misaligned and/or divergent goals. From a rational economic perspective this means there are multiple or nested principle-agent relationships in a heterogeneous network in contrast to the Australian public hospital setting where the physician, nurse and pharmacist are all employed by the public hospital so the principle/agency arrangements are more straightforward. However, a Chemotherapy Ordering System (COS) for the ordering, make up and administration of cytotoxic drugs is likely to improve the quality, safety and efficiency of this process. A major consideration is the effectiveness of the implementation of such a system, the facilitators and barriers to this process as well as how to address them, form the central focus of this paper. Hence, the objectives of this study is to answer the research questions:

- “How can a group of non-employee clinicians’ goals be aligned to use a single IS system? What are the barriers, facilitators and critical success factors that must be addressed?”

This is reviewed in the context of the Australian private healthcare sector at one of the private hospitals, referred to as the ABC Hospital throughout the paper, located in Victoria, Australia. The ABC Hospital is Victoria’s largest not for profit private health care group, renowned for excellence in diagnosis, treatment, care and rehabilitation. The ABC Hospital considers itself to be an innovator in Australia’s health system, embracing the latest in evidence-based medicine to pioneer treatments and services for its patients.

To better understand the underlying critical dynamics in this context and thereby design and develop appropriate ICT (information communication technology) systems and solutions to facilitate the delivery of superior care, it is useful to model the scenario (figure 1) in terms of Actor Network Theory (Aarts and Koppel 2009) and describe the relationships in terms of agency theory in the case of a knowledge worker (Aarts et al. 2007). The study involves 3 key phases as follows: Phase 1: an assessment of the existing technology applications at all ABC Hospital facilities and private physicians rooms with regard to the ordering of chemotherapy interventions as well as a mapping of all existing processes used in the ordering of chemotherapy interventions using the rich lens of Actor-Network Theory (ANT). In addition, this phase will require an in depth analysis and synthesis of the relevant literature. Phase 2: an assessment of the specific benefits of the proposed ICT solution for this specific context as well as an assessment of the need for any process changes. Prior ICT experience of all professional staff will be assessed and their attitudes to ICT evaluated. Phase 3: recommendations and directives will be provided regarding the best way to move forward in trying to assimilate the system into the ABC Hospital context in order to realize maximum benefits and reduce any possible risks and potential barriers.
Background

Australian healthcare contains two different sectors - private and public, with a different funding structure between these sectors. Recent developments have blurred this distinction a little with private hospitals contracting to do public work and public hospitals accessing private health funds and the Medicare funding for fee for service clinics. Nonetheless for the purposes of analysis the distinction is mostly valid. Private healthcare consists of, not-for-profit and for-profit hospitals (Bloom 2002). The for-profit hospitals’ primary goal is to generate profits for its shareholders. The not-for-profit hospitals, owned by religious, charity and community organizations, are not primarily driven by profit but by committed agreements or values (Bloom 2002). This unique funding combination plus the mission to generate profit and achieve an acceptable return on investment determine private hospitals must carefully plan and employ revenue as a strategic tool. Thus they have to put their major focus on revenue that best suit their commercial and corporate objectives. This sometimes leads to less or no funding for IS/IT investments (Leggat and Dwyer 2002).

However, research shows that using computerized systems can bring many benefits to hospitals and clinics as indicated by many researchers (Kaushal et al. 2003; Lin et al. 2014; Nolen and Rodes 2008; Redley and Botti 2013; Wickramasinghe 2013). However, new technology can contribute to system complexity and create unanticipated or new problems and opportunities for medication error (Aarts et al. 2007; Balkrishnan et al. 2009; Campbell et al. 2006; Kohn et al. 2000; Koppel 2005a; Koppel 2005b; Redley and Botti 2013). For example, human-machine interface errors and work flow problems. Further, as technology grows rapidly, system design and development at the time may have not included the new technology, features and functions which results in system/technology problems. The Y2K problem is a good example. System integration at the implementation is another concern to healthcare organizations. Hospitals usually have many existing local/unit applications that are used for different purposes in diagnosis and treatments (Kaplan and Harris-Salamone 2009; Poon et al. 2004). Integration of the new system/solution with the existing application without affecting the workflow and creating too much extra burden to the existing operation is very important. Some system implementations went half way and were aborted because of integration failure and workflow problems (Bloom 2002). A good system should be
customized to fit clinician’s workflow and simplify and support their workflow, as recorded by Kaplan and Harris-Salamone (2009). Moreover, software applications may have not been fully tested and contain hidden bugs. It is reported that U.S. Food and Drug Administration “data indicate that one in every three medical devices that makes use of software for its operation has been recalled due to failure in the software itself” (Jetley 2010). These incidences and concerns are alarms and risk factors one must consider when using a IS/IT solution such as COS.

**The Theoretical Framework and Research Hypotheses**

This research is planned to draw from both Actor Network Theory and Agency Theory. The reasons for choosing these two theories is that the former sociologically focuses on the interaction between human and non-human elements during systems implementations, while the latter provides an appropriate platform to investigate not only the relationship between the principal and the agent, but also the achievement of goal-alignment behavior.

**Actor Network Theory**

Actor-Network Theory (ANT) is a sociological theory developed by French sociologist Bruno Latour and Michel Callon and British sociologist John Law (Muhammed and wickramasinghe, 2013; Muhammed et al., 2013; Balkrishnan et al. 2009; Bloom 2002; Underwood and Richards 2013). The essence of this theory is that the world is constructed of hybrid entities (Muhammed and Wickramasinghe, 2013) consisting of both human and non-human elements e.g. people, objects and organizations know as actors or actants, and these elements cannot be studied in isolation or separately (Muhammed and Wickramasinghe, 2013; Muhammed et al., 2013). ANT tries to bridge the gap between a socio-technical divide. Emphasis is also placed on the concept of heterogeneous networks because of the non-similar nature of elements and their relationship in network (Braithwaite et al. 2014; Muhammed and Wickramasinghe, 2013; Muhammed et al., 2013). Using ANT we model the context at the Hospital regarding chemotherapy ordering.

**Agency Theory**

The primary focuses of agency theory (Aarts et al. 2007; Fairbrother et al. 2014; Jensen and Meckling 1992; Alchian and Demsetz, 1972) is the relationship between the principal and the agent as well as the achievement of goal-aligned behavior. In healthcare contexts, the agent is typically a knowledge worker agent such as a physician (Aarts et al. 2007; Jetley 2010), nurse or pharmacist. In the private hospital sector, such as the ABC Hospital, there exist nested or multiple principle-agent relationships. Specifically, the principal requires certain specific tasks to be performed and hires knowledge worker agents (medical care professionals, who are experts with regard to these tasks) to perform them on his/her behalf (Wickramasinghe, 2000). In so doing, however, the principal needs to guard against sub-optimal behavior (or low goal-aligned behavior); i.e. the divergence between the agent pursuing activities, which facilitate his/her own goals in contrast to the achievement of the principal’s goals (Kaplan and Harris-Salamone 2009). ICT in general have been shown to help to reduce agency costs by enabling enhanced tacit monitoring and bonding activities as well as to enable effective and efficient operations to ensue in all areas but this is especially true in healthcare contexts (Jetley 2010; Kaplan and Harris-Salamone 2009).

Overall, based on the extensive analysis to the literature and the best practices, it is possible to identify the following key points in order to implement IS systems in healthcare contexts (Table 1):

<table>
<thead>
<tr>
<th>Key Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation and involvement (Groene et al. 2014; Serapioni and Duxbury 2014; Waterson 2014)</td>
<td>In general, participation leads to commitment not merely compliance (Kotter and Schlesinger 1979). Organized and scheduled reserves participation can often forestall resistance. Participation and involvement can happen at any stage of the system development life cycle (SDLC) or project life cycle.</td>
</tr>
<tr>
<td>Facilitation and support (Chaudhry et al. 2006; Waterson 2014)</td>
<td>It is very important that the leaders/managers are being supportive. It is most helpful when fear and anxiety lie at the heart of resistance (Bloom 2002). Support can be in many forms such as: training, giving time-off, listening, providing emotional support, counseling, encouragement, etc.</td>
</tr>
<tr>
<td>Negotiation and</td>
<td>Negotiation is important in healthcare IS/IT projects as it is a complex dynamic environment and it</td>
</tr>
</tbody>
</table>
### Key Points

<table>
<thead>
<tr>
<th>Key Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>agreement</strong> (Ludwick and Doucette 2009; Schmulson et al. 2014)</td>
<td>Involves many players/actors. With each actor focus on his/her own interests. Negotiation can be also used when it is clear that someone is going to lose out as a result of a change and this person/group power to resist is significant (Bloom 2002). Negotiation written agreements can be a relatively easy way to avoid major resistance. Negotiation is particularly important with VMO's as they are not subject to the controls which an organization has with salaried employees and there are always a number of different issues other than IT on which they must negotiate deal with hospitals which may become contemplated with IT issues.</td>
</tr>
<tr>
<td><strong>Influences</strong> (Ludwick and Doucette 2009; Waterson 2014)</td>
<td>Give a group leader/manager or someone with respect a key role in design and implementation of the change. Consider using peer pressure before the change plan. These actions can be an inexpensive and easy way to gain an individual’s or a group’s support (Bloom 2002).</td>
</tr>
<tr>
<td><strong>Education and training</strong> (Chaudhry et al. 2006; Schmulson et al. 2014)</td>
<td>Educate people about the project beforehand and afterwards. An education and communication program is ideal when resistance is based on inadequate or inaccurate information and analysis, and when resister’s help is needed in the implementation (Bloom 2002). Training programs must support different users and levels and should be ongoing.</td>
</tr>
<tr>
<td><strong>Communication</strong> (Carayon et al. 2014; Chaudhry et al. 2006; Kwamie et al. 2014)</td>
<td>This helps people see the need and logic for a change. Communication methods can be: one-to-one discussions, presentations, memos, reports, briefings, focus groups, announcements, posters, emails, intranet and internet posting, etc.</td>
</tr>
<tr>
<td><strong>Identify and mitigate risks</strong> (Chaudhry et al. 2006; Schneider et al. 2014)</td>
<td>Identify all the risks early, consider and analyze them deeply through-out all stages of the project. Indicate possible ways to mitigate the risks. Document in detail on: risk description, category, cause, triggers, level of impact, probability, potential responses, risk owner, progress status (Schwalbe 2013).</td>
</tr>
<tr>
<td><strong>Learn from the past and others</strong> (Ludwick and Doucette 2009; Schmulson et al. 2014)</td>
<td>Studying the success and failures can help prevent, and avoid mistakes in conjunction with turning a bad situation around.</td>
</tr>
</tbody>
</table>

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**Table 1. Key points in order to implement IS systems in healthcare contexts**

On combining the results from the preceding literature synthesis with an initial assessment of the data site(s), the following conceptual model was developed (figure 2) in order to examine the research hypotheses. This figure serves to capture the environment and multiple actors. It is noted that the chemotherapy ordering system has been defined as a computerized physician order entry COS, to be consistent with the extant literature. The patient is at the centre to reflect a patient centric view that is to be adopted at all times. Critical to an understanding of the proposed conceptual model is the defining and describing of the relevant clinical microsystems. Hospitals in many respects can be considered aggregations of clinical microsystems rather than more formal organizations in the conventional sense.

A clinical microsystem is defined as a small organized group of clinicians and staff working together with a shared clinical purpose to provide care for a defined set of patients. This conceptual model will be used to describe the delivery of chemotherapy services to cancer patients at the ABC Hospital and the impact that the introduction of a COS for chemotherapy will have on that care process. Critical processes are illustrated in figure 2 with a series of concentric hexagons which are described in more detail within the figure legend. The professional processes is operationalized either through a series of bilateral exchanges between healthcare professionals by various communication channels or more formally in a multidisciplinary meeting where all health professionals are represented. Individual professionals subsequently communicate directly with patients about aspects of their professional role or convey to the patient’s the deliberations of multidisciplinary meetings. Patients then express their preferences about the options they have been offered and make decisions about their treatment.
This study is assessing the benefits of a Chemotherapy Ordering System (COS) for the ABC Hospital context. To do this we will focus on the following 4 hypotheses:

**Hypothesis 1:** The implementation of an organizational wide COS to enable the ordering of chemotherapy drugs will enable higher goal aligned behavior according to ensue (Koppel 2005a; Koppel 2005b; Kotter and Schlesinger 1979). This hypothesis is derived directly from agency theory (Wickramasinghe, 2000) as described above.
Hypothesis 2: The implementation of an organizational wide COS to enable the ordering of chemotherapy drugs will enable greater bonding activities\(^1\) to ensue with knowledge work agents. This hypothesis is derived directly from agency theory (Wickramasinghe, 2000) as described above.

Hypothesis 3: The implementation of an organizational wide COS to enable the ordering of chemotherapy drugs will enable better data collection and monitoring of principles and knowledge worker agents. This hypothesis is derived directly from agency theory (Wickramasinghe, 2000) as described above.

Hypothesis 4a: The COS solution will enable stabilization of the heterogeneous network.

Hypothesis 4b: The COS solution will serve as an obligatory passage point. Both hypotheses 4a and 4b are derived from Actor network theory (Muhammed and Wickramasinghe, 2013; Muhammed et al., 2013) as discussed above.

Overall, what this section has tried to emphasize is that in modeling the actors and their integrations, we must realize that this is a dynamic and complex environment. Further, it has many nested principle agent relationships and is also impacted upon by exogenous factors within the larger ecosystem. Failure to recognize this complexity will serve to dramatically under represent key interactions that in turn are relevant and impact the well-functioning of the technology solutions. Finally, while beyond the scope of the present study it is also important to be cognizant of the wider health ecosystem which includes international and national policy, healthcare systems as well as laws and regulations; since, these will also have far reaching flow on effects to the COS, its successful implementation, adoption and ongoing use.

Research Method

As the COS is one of the ABC Hospital wide projects, the setting includes all hospital facilities that treat oncology patients with chemotherapy. Participants/key informants will include all individuals who will interact with the system such as private physicians, oncology nurses, pharmacy and consumers. Participation is voluntary. Recruitment is done via email and mail to:

a) Make the relevant individuals aware of the study and
b) Request their participation.

The study adopts a primarily qualitative approach using semi-structured interviews, focus groups and survey techniques to gather critical information. A questionnaire designed and developed in Germany specifically to assess usability and acceptance of technology in healthcare contexts is also used for data triangulation. The reason we used this questionnaire is that the Australian and German healthcare systems both are 2-tier systems, i.e. they both have private and public components compared to the British healthcare system (mainly public) and the American system (mainly private).

Analysis: As noted above, this is a predominantly qualitative study thus standard qualitative analysis techniques such as content analysis and thematic analysis is employed to analyze the collected data (Kaushal et al. 2003; Kohn et al. 2000; Koppel 2005a; Koppel 2005b). Literature, in particular ANT and Agency Theory serve to inform the design of the priori themes. From the questionnaire, it is possible to run simple frequency and regression analyses that serve to confirm prevalence of themes. To help illustrate the impact of COS and the interaction between different stakeholders and the COS system, an online survey was designed to target three categories of healthcare professionals and executives as follows:

1. Oncologists: 25 were targeted
2. Executives and Casual Users; but have access to the system: 9

\(^1\) Bonding activities as described in agency theory pertain to non-monetary provisions given by the principle to the agent that serve to reduce frustrations and complications for agents such as a parking space or tools to make workflow and their job easier and more streamlined ((Wickramasinghe 2000)).
3. COS Daily Users: 53 (comprising of nursing, pharmacy and administrative staff using COS to schedule or reference chemotherapy appointments)

Breaking the targeted respondents into these three categories helped understand the specific level to which each group deal with the system and the type and quality of this interaction, which was quite interesting. Insights generated from this survey form the basis of data analyzed in this paper.

Results

The highest response rate to the survey was 56% and resulted from the Executives and Casual Users category, which indicates the level to which these executives were engaged with the implementation of COS at the ABC Hospital. Oncologists responded to the survey with a rate of 36%, which also indicates their level of interest in the system. The lowest rate was from the COS Daily Users categories with about 10%. This unexpected finding needs a deeper analysis of the responses; which we plan to embark upon. It is noted that in viewing and interpreting the following it is important to keep in mind respective user response rates to determine overall significance. Demographic and professional insights are presented at the following table:

<table>
<thead>
<tr>
<th>Key items</th>
<th>Descriptions/Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Females: 60% of the respondents from Users and Executives categories</td>
</tr>
<tr>
<td></td>
<td>Male: 88.9% of the respondents from Oncologists</td>
</tr>
<tr>
<td>Age</td>
<td>33-39: 44.4%</td>
</tr>
<tr>
<td></td>
<td>40-49: 11.1%</td>
</tr>
<tr>
<td></td>
<td>50-59: 22.2%</td>
</tr>
<tr>
<td></td>
<td>60-69: 22.2%</td>
</tr>
<tr>
<td>Work Experience</td>
<td>Work experience was measured by two measures; the first was the number of years at the ABC Hospital, and the second in how many organisations in the health sector people had previously worked. The answers for both measures were broadly diverse, with a tendency to long working years at the Hospital and more healthcare organisations previously worked at for Oncologists, less years and less healthcare organisations previously worked at for Users, and more places previously worked at and relatively long years of work at the ABC Hospital for Executives.</td>
</tr>
<tr>
<td>Use of Computer</td>
<td>All respondents from all categories felt comfortable and very comfortable with respect to using computers in general, with the majority feeling very comfortable. All respondents reported that they utilized computers during work very often. i.e. more than 5 times per day. Answering questions indicates the advanced level of computer skills and use for all respondents, but does not reflect the significance of computers for daily work.</td>
</tr>
</tbody>
</table>

Table 2. Demographic and professional insights

Having these demographic and professional insights, as well as the way the respondents looked at computers for daily work helps to understand the following responses in three main areas of interest: user satisfaction, compatibility of the system, and expectations from this system.

- **User Satisfaction**

First, the survey asked the respondents how often they use COS system for daily work. As would be expected most of the respondents from oncologists and COS users stated they used the system several times a day, or daily, while less usage by Executives was identified. Figure 4 provides a summary of usage by respondents groups.
Compatibility of the System:

In this section, respondents were asked about the COS system, from the perspective of core functionality. In doing so, the respondents evaluated the system in four main statements included:

1. The COS will support decision making (reminders and warnings/alerts)
2. The COS will help preventing medication errors
3. The COS will provide an appropriate overview over the current patient situation and the daily treatment activities
4. The COS will help to improve the quality of care outcomes

The responses in general were positive across the three respondents’ categories, with a few skeptical responses from the oncologists group as table 3 shows. In the COS users group, all answers fell between 50/50 correct and correct, with majority tended to be correct and most correctly. Almost the same pattern can be seen in the Executives and Casual Users group. The responses from Oncologists took a different pattern, in which the evaluations of the abovementioned statements varied from N/A to Correct (Table 3).

<table>
<thead>
<tr>
<th>Statement</th>
<th>N/A</th>
<th>Incorrect</th>
<th>Mostly incorrect</th>
<th>50/50</th>
<th>Mostly Correct</th>
<th>Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>The COS will support decision making (reminders and warnings/alerts)</td>
<td>11.1%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>33.3%</td>
<td>22.2%</td>
<td>33.3%</td>
</tr>
<tr>
<td>The COS will help preventing medication errors</td>
<td>11.1%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>11.1%</td>
<td>33.3%</td>
<td>44.4%</td>
</tr>
<tr>
<td>The COS will provide an appropriate overview over the current patient situation and the daily treatment activities</td>
<td>11.1%</td>
<td>11.1%</td>
<td>0.0%</td>
<td>11.1%</td>
<td>44.4%</td>
<td>22.2%</td>
</tr>
<tr>
<td>The COS will help to improve the quality of care outcomes</td>
<td>11.1%</td>
<td>11.1%</td>
<td>0.0%</td>
<td>22.2%</td>
<td>22.2%</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

Table 3. The core functionality of COS as oncologists see it.

Expectations of the System

This part of the survey forms the basis upon which better understanding of the interaction between different stakeholders and the COS could be achieved. To do so, respondents from the three groups of respondents answered questions in four main interrelated areas:
1. The role of COS
2. How COS can help do the job and its related activities
3. How to maximize the benefits of COS system
4. How COS can enhance the job and its related activities.
5. Comments

The main comments from the three groups of respondents were about the need of more bedside computers, new policies, sufficient training, more details about the system and how it works, and finally a stronger commitment from the ABC Hospital to the project as whole. Table 3 summarizes the main themes and points for the expectations of COS by the three targeted groups.

<table>
<thead>
<tr>
<th>Area of Interest</th>
<th>Executives and Casual Users</th>
<th>Oncologists</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concerns about the role of COS</td>
<td>• Change management • Commitment of nursing and pharmacy staff to the system</td>
<td>• Inflexibility • Compatibility with current systems • Lack of control of chemotherapy ordering</td>
<td>• Ease of use • Reliability • Availability</td>
</tr>
<tr>
<td>How COS can help do the job and its related activities</td>
<td>• Easy to ACCURATELY order infusions • Reduces errors and confusion in ordering the chemotherapy • Reminders for doses and treatments • Gives timely access to patients records • Increases work efficiency</td>
<td>• Enables improved patient care • No need to make templates for new chemotherapies for patients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Enables us to monitor the usage of this system • Enables the Review of unexpected readmissions • Helps allocate resources, provides important data about scheduling and other clinical outcomes data • Standardizes the processes around medication management and nursing care delivery • Enables urgent clinical decisions-making</td>
<td>• Helps adhere to guidelines/protocols • Supports regimen provisions • Professionalizes the job.</td>
<td></td>
</tr>
<tr>
<td>How to maximize the benefits of COS system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Intuitive • Support clinical workflow • Accurate • Support evidence-based medicine • Technically supported by ITS and the vendor • Well-taught and trained before use • Resourced from an oncology pharmacy perspective • Used by all nursing, medical specialists and practice managers at a very early stage</td>
<td>• Compatible with current software and IS systems. • Flexible • Able to generate data and send it to other database management systems • Benchmarking enabler</td>
<td>• Easy to use • Available online for users • Aligned to national and international standards • 24/7 Available</td>
</tr>
<tr>
<td>How COS can enhance the job and its related activities.</td>
<td>• Enhancing clinical processes and patient safety • Reducing medication errors • Establishing best practice therapies • Enabling clinicians to monitor their patients’ records online.</td>
<td>• Being easy, fast and simple to learn and use • accurate • Improves communications and workflow • Improves reporting and recoding hospital-wide</td>
<td>• Adhering to policies, protocols, and guidelines • Enabling an online access to medical records • Enduring consistent processes</td>
</tr>
<tr>
<td>Comments</td>
<td>• Painless project • Less Commitments from the ABC Hospital side</td>
<td>• Lack of details how it works</td>
<td>• Huge change process • More bedside computers are required • Policies are needed</td>
</tr>
</tbody>
</table>

Table 4. Expectations of COS as the survey revealed
Taken together the results from the survey as well as the invaluable lessons learned from the phase 1 implementation show the importance and need for COS at the ABC Hospital. However it also serves to highlight critical success factors that must be considered if the full potential of the solution is to be realized at the ABC Hospital. In particular the following must be addressed:

1) Need to examine existing processes, policies and protocols and determine if there are possibilities to streamline and improve, standardize across all locations and perhaps even embrace lean and six sigma principles.
2) Need to engage all clinicians and develop appropriate strategies to foster Visiting Medical Officers (VMO) sponsorship. Further, this must be addressed early to ensure optimal clinical support.
3) Need to ensure smooth assimilation of solution, appropriate level of support, training and assistance.
4) Need to ensure correct, complete and accurate data capture, transfer which in turn will also support future analytic potential and seamless knowledge management.

Discussion

In this study, data analysis suggests that there are still many areas that need to be addressed before it will be possible to see germane and tangible changes to the underlying goal aligned behaviors. This indicates that having the systems is a necessary but not sufficient requirement to enhancing the consequent goal aligned behavior. From Agency Theory we know that in order to engage users it is important to ensure strong goal alignment between their tasks and their interactions with the system and the hospitals goals and objectives (Wickramasinghe, 2000). While the answer is simple to realize it in practice is not. In particular, it requires engagement with users training as well as effecting appropriate change management and organization culture/subculture modification changes. This in turn requires strong leadership and a project champion who is credible and respected by the clinical users. Our interview data highlighted that these aspects were not fully addressed during, pre or post implementation. We believe that this is an important deficiency that has led to the findings we note below namely that the COS to date has not led to the expected higher level of goal aligned behavior as was predicted. Other important findings included the key barriers, facilitators and recommendations captured by this study which are summarized in table 5:
Table 5. Barriers, facilitators and recommendations captured

Actor network theory notes that a system can provide an obligatory passage point (Muhmmmed and Wickramasinghe 2013; Muhmmmed et al. 2013). What we see with the implementation of the COS is that this system did indeed represent an obligatory passage point; i.e. clinicians had to enter data into the system and use date entered into the system to perform critical activities. However, at present there also needs to be an understanding and an adaptation to the performing tasks in combination with the COS and this requires time and a rigorous change management process. From an Agency theory perspective, indeed the COS has the potential to increase bonding activities and thereby align goals of the VMOs with the hospital (i.e. the principal); however, yet again we see that this cannot happen instantly on the implementation and go live of the COS system but rather is a more gradual process facilitated by training and understanding of the COS system itself and yet again the inclusion of a rigorous change management process. Taken together we realize the importance of training and change management to enable the COS to facilitate strong bonding and thus goal aligned behavior to ensue. Furthermore, we realize that the existence of an obligatory passage point is necessary but not sufficient to ensure higher goal aligned behavior and higher levels of bonding activities.
An important yet unexpected finding that emerged is that key barriers, facilitators and recommendations captured from this study are also equally relevant for implementing computerized physician order entry (CPOE) system. CPOE systems are widely viewed as crucial for reducing prescribing errors and saving hundreds of billions in annual costs (Potts et al. 2004). These systems are expected to become more prevalent in response to resident working-hour limitations and related care discontinuities and will supposedly offset causes (eg, job dissatisfaction) and effects (eg, ADEs) of nursing shortages (Alsweed et al. 2014; Berger and Kichak 2004). Hence, our study has also unearthed that the COS system can be modeled as a CPOE system and we plan to explore this in more depth in future research.

Overall, the study served to demonstrate that the COS is of tremendous benefit to support and facilitate the delivery of excellence in care for oncology and directly aligns with the ABC Hospital’s strategic priorities.

**Conclusions**

This study set out to answer a specific research question and address four key hypotheses. At this point in the assimilation of COS at the ABC Hospital it is not possible to definitively refute or uphold these hypotheses; however, directional data to date suggests that all hypotheses are likely to be upheld as summarized in table 6. We plan to have a further follow up after the COS has been in use for 6 months at which time we are confident we will have sufficient data to either uphold or reject the posed hypotheses.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Support from Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothesis 1</strong>: The implementation of an organizational wide COS to enable the ordering of chemotherapy drugs will enable higher goal aligned behavior according to recognized standards (Koppel 2005a; Koppel 2005b; Kotter et al., 1979) and better and safer healthcare delivery</td>
<td>The implementation of the COS is not sufficient to enable higher goal aligned behaviour to ensure. Change management and activities designed to fully engage oncologists and COS users are also required. This needs to be re-evaluated regularly.</td>
</tr>
<tr>
<td><strong>Hypothesis 2</strong>: The implementation of an organizational wide COS to enable the ordering of chemotherapy drugs will enable greater bonding activities to ensue with knowledge work agents.</td>
<td>At this stage, it would appear that H2 is upheld. But a better assessment needs to occur after more than one year of using the COS.</td>
</tr>
<tr>
<td><strong>Hypothesis 3</strong>: The implementation of an organizational wide COS to enable the ordering of chemotherapy drugs will enable better data collection and monitoring of principles and knowledge worker agents.</td>
<td>Indeed, the COS system does enable better data capture and monitoring</td>
</tr>
<tr>
<td><strong>Hypothesis 4a</strong>: The COS solution will enable stabilization of the heterogeneous network.</td>
<td>It is too early to state if the heterogeneous network is more stable; again, this needs to be assessed after at least one year of use.</td>
</tr>
<tr>
<td><strong>Hypothesis 4b</strong>: The COS solution will serve as an obligatory passage point.</td>
<td>The COS was definitely an obligatory passage point since all treatments, data used and required were stored and accessed using the COS and it was not possible to treat patients without the COS.</td>
</tr>
</tbody>
</table>

Table 5. Summary of the study findings regarding the Hypotheses

Further, in trying to answer the posed research question “How can a group of non-employee clinicians’ goals be aligned to use a single IS system? What are the barriers, facilitators and critical success factors that must be addressed?” several key findings have been unearthed and significant recommendations developed. It is apparent for the study that the COS holds many potential benefits to the ABC Hospital not just in the short term but possibly more importantly in the longer term. This necessitates prudent and thoughtful assimilation so that it will be possible to realize these benefits. Furthermore, it has been noted that the full potential of COS at the Hospital cannot ensue unless the six significant recommendations are
embraced. Finally, while there is evidence to suggest that the COS will enable a high level of goal aligned behavior this does need to be re-examined after 6 months of using the system.

In closing, it is essential to take a holistic perspective when considering COS at the Hospital. This includes adequate attention to the health ecosystem, the system structure, the delivery operations as well as the clinical structure. Further, these must be thought of simultaneously in terms of strategic, infrastructure, transitional and informatics perspectives. Ultimately the potential to improve cancer care through health information technology necessitates the adoption of a learning healthcare information technology system (de Moor et al. 2013). It has been noted by scholars that creating such a learning cancer care system might initially be slow to evolve but its benefits are far researching and significant (Bloom 2002). COS provides private healthcare sectors with this possibility and it would behoove them to seize this opportunity.

References:


