Order Sets in the Clinical Setting

by

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Supervisory Committee

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Abstract

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  Clinicians and hospital administrators are increasingly challenged to achieve efficient evidence-based care. Clinical decision support (CDS) tools are being introduced into the clinical setting to facilitate the bridging of knowledge gaps at the point of care. Order sets are one of the tools used to facilitate this knowledge translation.

  Using the realist review methodology and a focus group of interview participants, this thesis explored retrospectively some of the causal relationships that lead to effective and successful order set adoption. Findings demonstrate the need for in-depth and regular review of context and order set adoption. Technology can offer some enhancements in the form of delivery tools, but it also introduces new and complex challenges for development and implementation. Ongoing software development is needed to improve delivery formats as well as incorporate effective tools to allow for efficient continuous quality improvement supports.

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Dedication

To my three children and grand-daughter.
My purpose and my inspiration.

Chapter 1 Introduction

1.1 Research Rationale

Internationally spiralling costs and questions of care quality have brought healthcare efficiency and patient safety into increasingly central focus for healthcare administrators. At the same time, the explosion of information in healthcare has created significant gaps between knowledge and clinical practice. Clinicians and hospital administrators are challenged to achieve efficient evidence-based care for their patients. To bridge this knowledge gap, clinical decision support (CDS) tools are being introduced into the clinical setting; standardized order sets are one of these CDS tools. This thesis will explore some of the causal relationships that lead to successful standardized order set adoption within a healthcare organization.

1.1.1 Standardized Order Sets

In the clinical setting, patient care is delivered based on clinical care orders. Orders may be written by physicians or other designated care providers. A standardized order set is a group of orders with a common functional purpose (Canadian Nursing Informatics Association, 2009). For example, a set of orders for a patient admitted to hospital with pneumonia might include the following: antibiotics to be administered, a diet, tests to be administered, etc.

Standardized order sets are predefined orders that can be implemented in isolation or in conjunction with other CDS tools. For the purposes of this thesis, standardized order sets will be referred to as order sets. A predefined set of orders should make it efficient and easy for clinicians to prepare and act on the orders; they should deliver the embedded

evidence-based practice research to the point of care. An order set has the potential to improve patient outcomes (Fonarow, Gawlinski, Moughrabi, & Tillisch, 2001), reduce risk, and facilitate evidence-based practice care (Ballard et al., 2008).

1.1.2 Clinical Decision Support

Clinical Decision Support (CDS) can be defined as "a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery" (Healthcare and Information Managment Systems [HIMSS], 2012). Tools often used in conjunction with order sets are clinical practice guidelines, clinical protocols, and care pathways or care maps (see Appendix A). Order sets make these tools actionable at the point of care (see Appendix B).

Clinical practice guidelines are systematically developed statements that assist practitioners and patient decisions with decisions about appropriate healthcare for specific clinical circumstances (Field & Lohr, 1990). For example, within the Recommendation for Stroke Care document (update 2010), one of the guidelines is related to blood pressure management. "Hypertension is the single most important modifiable risk factor for stroke. Blood pressure should be monitored and managed in all persons at risk for stroke. All persons at risk of stroke should have their blood pressure measured routinely, ideally at each healthcare encounter, but no less than once annually [Evidence Level C]" (Canadian Stroke Network, 2010, p. 26).

Clinical protocols are more specific than clinical practice guidelines. They provide greater detail with specific instructions (Field & Lohr, 1990). Figure 1 below is an excerpt for vital sign monitoring for a patient with acute stroke receiving Alteplase.

Clinical pathways, or maps and order sets, are intended to support the translation of these guidelines and protocols at the point of care (Benson, 2005). Clinical pathways are structured inter-professional plans of care designed to support the implementation of practice guidelines and protocols. For example, a care map or pathway may be developed based on systematically researched evidence-based care for post-operative knee surgery. A standardized order set can be developed in conjunction with that care map to initiate the care delivery process (see Appendix C).

Figure 1 Excerpt from Acute Stroke with Alteplase (tPA) Administration Order Set

Vitals/Monitoring

Vitals

● Temperature, HR, RR, BP q15 min for 2 hours **THEN** q1 h for 22 hours **THEN** q4 – 6 h for 48 hours **THEN** reassess

● Notify physician if systolic BP is greater than _____ mmHg, or less than _____ mmHg **OR** diastolic BP is greater than _____ mmHg, or less than _____ mmHg

(Antihypertensive therapy with labetalol recommended for systolic BP greater than 185 mmHg or diastolic BP greater than 110 mmHg)

● Angioedema monitoring at 30, 45, 60, and 75 minutes following alteplase (tPA) initiation, then q4 - 6 h for 24 hours

Neurovitals

● Canadian Neurological Scale (for alert or drowsy patients) **OR** Glasgow Coma Scale (for stuporous patients):
    q15 min for 2 hours **THEN**
    q1 hours for 22 hours **THEN**
    q4 – 6 h for 48 hours **THEN** reassess

(Kingston General Hospital, 2012)

The implementation of CDS tools and standardized order sets is a multifaceted intervention occurring in clinical settings that are socially complex. A complex intervention is non-linear or has the potential for multiple components and outcomes versus a simple intervention, which would have linear or predictable outcomes (May,

Mair, Dowrick, & Finch, 2007). In addition, the clinical setting is a complex adaptive

social system that by definition is a system whose behaviour cannot be easily or

intuitively predicted (Minai, Braha, & Bar-Yam, 2010). Both the implementation and the

setting have the potential to impact outcomes, making the results highly unpredictable.

When traditional study methods have been employed to explore complex interventions

carried out in complex social settings, the findings are often mixed. An explanatory

review of this type of intervention can provide an understanding of what works, for

whom, and in what context. This type of information about the mechanism of action for

interventions can support care managers and policy makers facilitating planning and

implementation strategies.

1.1.3 Realist Review

The traditional systematic review method is well-suited to a summative review with a

focus on simple, or linear, interventions. However, when interventions take place in a

complex social setting like a hospital, the resulting evidence can be mixed or conflicting.

Few or no clues may be provided as to why the intervention worked or did not work

when applied in different contexts or circumstances, deployed by different stakeholders,

or used for different purposes. Lomas (2005) suggests that this type of summative review

focuses on questions of effectiveness and that an interpretive approach is better suited for

transferability of findings. This transferability will support the needs of healthcare

managers and policy makers. An interpretive approach can support complex questions by

informing broader factors related to context (E.g. "What works?" versus "What works

when…").

The realist review is a methodology developed by Pawson, Greenhalgh, Harvey, & Walshe (2004) to address complex social interventions in complex social systems. It is a theory-driven interpretive methodology that can accommodate the use of evidence from the formal study reports (quantitative and qualitative), case studies, and other diverse sources. Reviewers can integrate the information by using them as forms of proof or refutation of a theory. It serves as a methodological orientation or approach (i.e., logic of inquiry) to developing and selecting available research methods to study the intervention under review. With roots in philosophy, this method employs seven principles (Pawson et al., 2004) that are listed as follows:

1. Interventions are viewed as theories. A review will pick up, track and evaluate program theories that implicitly or explicitly underlie families of interventions.

2. Tracking the successes and failures of interventions will allow a reviewer to discover at least part of the explanation in terms of reasoning and personal choices of different participants; i.e., effects of interventions are achieved by the active input of individuals, making the knowledge of individual stakeholders' reasoning integral to understanding outcomes.

3. Realist reviews examine the integrity of the implementation chain by identifying intermediate outputs that need to occur to achieve successful outcomes; i.e., the different theories underlying the series of events that comprise an intervention are all fallible, and the intended sequence may alter at any point, leading to unintended consequences.

4. The relative influence of different parties is able to affect and direct an intervention i.e. intervention chains are not linear and sometimes go into reverse. For example, stakeholder engagement in the process will result in negotiation of the process.

5. The same intervention will achieve both success and failure when applied in different contexts and settings; i.e., in addition to the intervention theory, contextual factors (individual, interpersonal, institutional, and wider infra-structural) will influence efficacy.

6. The same intervention will be delivered in a mutating fashion; i.e., the outcomes of an intervention will be dynamically shaped by refinement, reinvention and adaptation to local circumstances. For example, if an intervention encounters a challenge, alternative solutions may be implemented to overcome the obstacle.

7. The review will examine intended and unintended effects of interventions; i.e., learning changes people and organizations and subsequently alters program interventions. For example, if a challenge is encountered, a work-around may be developed rather than achieving the intended intervention change.

The traditional secessionist model of research is well-suited to exploring linear or simple interventions. An example from physical science might be the administration of pain-relieving medication and the outcome of pain relief or no pain relief. The generative model of realist review will look to explain the less predictable outcomes of a non-linear or complex intervention occurring in a complex social setting. This review will attempt to explain causal outcomes between two events by exploring the underlying mechanism that connects them within varied contexts.

1.2 Thesis Objectives

Using the realist review process, this thesis will explore retrospectively some of the causal relationships that lead to effective and successful order set adoption. The objective of this thesis is to develop a detailed and practical understanding of some of the approaches that will support clinical order set adoption strategies; In other words, what works (and why) in one context and what works better in another context. Specifically, there are four main objectives:

1. Explore the underlying assumptions about how order set adoption is meant to work as well as the expected impacts of the various implementation strategies in different contexts.

2. Using data collected through literature review and participant order set user interviews, apply the realist review methodology, build a thematic framework of actions employed, and develop theory chains describing and defining the underlying mechanisms of action.

3. Facilitate understanding by re-engaging the initial interview participants for feedback related to the identified mechanisms of action.

4. Support insights from hospital policy makers in identifying and developing evidence-based policy that will support order set adoption within varied and unique social contexts.

Research Question

What are some of the approaches that successfully affect causal relationships encountered in different contexts in order to achieve order set adoption?

1.3 Thesis Overview

This thesis is organized into five chapters including the introduction in Chapter 1. Chapter 2 provides an introduction to standardized order sets. Chapter 3 focuses on the design and methods employed for the thesis review; it incorporates an overview of the research methodology and data collection through literature review and interview participants. Chapter 4 provides details of the results from each step of the process as well as the findings. Chapter 5 is a discussion of the process, the key findings, and the conclusions; recommendations and suggestions for future work are also incorporated.

Chapter 2 Order Sets in the Clinical Setting

2.1 Order Sets

The translation of evidence-based practice knowledge into the hospital care setting is challenging; the use of evidence-based practice tools such as clinical practice guidelines, care pathways, and order sets is an attempt to facilitate that process by embedding the evidence-based practice choices into current clinical workflows.

Hospital healthcare is complex, and a multifaceted and multi-layered bureaucracy is needed to manage organizational size and number of people engaged. At the national level, the structure of healthcare imposes restrictions; there are constantly evolving standards to be met and reported (e.g. wait times) as well as national fiscal constraints and priorities competing with healthcare. At the meso level, organizations are often multi-site facilities with unique cultures within each care site. Embedded within each of these cultures are professionals with occasionally conflicting health care college standards (e.g. College of Nurses versus College of Physicians and Surgeons). There are constant communication challenges involving professional and personal priorities at all levels, between and among providers (e.g. nurses changing shifts) and provider groups (e.g. physicians and pharmacists), at transitions of care within the hospital (e.g. from critical care to the regular ward), and into and out of the acute hospital care setting.

Each level of the system is also experiencing constant change. For example, a new Minister of Health, organizational CEO, or departmental manager would each result in trickle-down impacts that introduce change. Within each facility, there are constantly rotating residents or new staff, updated evidence-based practices, and technology or tools arriving at the patient care units.

All of the above leads to complex communication challenges, gaps in knowledge for bedside care, and a lack of standardization, all impacting the quality and efficiency of care.

When order sets are introduced into the clinical setting, they serve both as a means to standardize practice and as an educational tool for new staff. Order sets provide a check list of sorts to facilitate all aspects of care considered and addressed. Critical thinking is applied as alternative options on the "checklist" are assessed and determined (Abramson, 2007).

However, the introduction of order sets has been heavily debated among physicians. Some view them as "cookbook" medicine, but other physicians view them as a tool to manage routine aspects of care that frees them to focus on the unique aspects of individual patient needs.

2.1.1 Order Set Delivery Formats

Order sets can be made available to clinicians at the point of care in either paper or electronic format. The paper format is often supplied on non-carbon (NCR) paper, which generates copies of the original. When the order is completed and signed, the original page is retained in the patient's paper record. If medications are required from the pharmacy, a copy of the original order set is delivered to that department. Upon receipt in the pharmacy, the medications are dispensed by the pharmacist and delivered to the ward for the patient. The original copy of the orders that have been retained in the patient care area are viewed and transcribed for communication and/or action. For example, the medication order might be transcribed to a format such as a medication administration record to cue the nurse how and when to administer the ordered medications.

Alternatively, an order for blood work might initiate the completion of a laboratory requisition and collection of the blood sample. The sample and requisition would then be forwarded to the laboratory for testing.

An electronic order set process could be the completion of the order set form on a computer with supporting processes being similar to the paper flow (e.g. the completed electronic form might be electronically forwarded to the pharmacy department or a copy printed and forwarded using paper processes). The other orders would follow the same process as paper, using either a printed version of the completed electronic form or viewing the order set on the computer.

The preferred electronic format is computerized provider order entry or CPOE. In the CPOE system, the computerized order entry component is interfaced to the pharmacy system as well as other ancillary systems (e.g. the laboratory system). The implementation of CPOE with these interfaces eliminates the transcription of the order in multiple locations, greatly reducing the potential for error. CPOE also offers the opportunity to embed additional CDS. For example, a drug responsible for an adverse reaction may be prescribed to a patient because of an oversight. If the computerized system has recorded a history of adverse reactions for the patient, the system could prompt the order writer to reconsider the medication order using an allergy alert.

While the use of technology can overcome some of the challenges of order set use (e.g. communication with pharmacy), it has been noted that the people and process issues are just as important. The way the order sets are implemented and utilized in a particular organizational setting is dependent upon on the context of each care unit and/or organization.

There is little in the research that explores implementation of order sets and strategies to support effective adoption.

2.1.2 Standardized Order Set Processes

To employ order sets, a number of support structures are required. Policies, protocols, monitoring and change management support structures are needed to facilitate the changes. The order sets must be maintained according to current evidence-based practice standards so that as knowledge grows the order sets evolve; an order set life cycle management process must, therefore, be implemented (see Figure 2 below).

Figure 2 Order Set Life Cycle Management
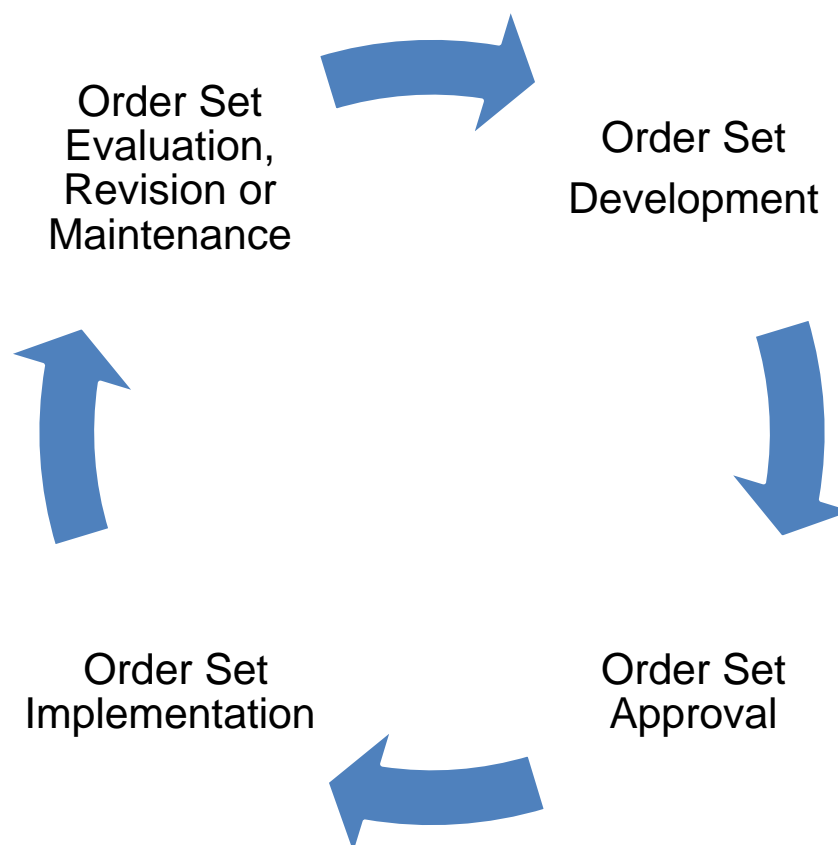
An order set is developed based on literature review, clinical practice guidelines and protocols and/or care pathways. An approval body within the organization often takes on

the role of assuring that the new order set meets organizational policies, protocols, guidelines and formatting structures. For example, the medication orders within the order set cannot contain medications that are not available in the organization's pharmacy/formulary. Organizational support structures are needed to implement the new order sets. This might include enhancing user awareness of availability of the new tool, educational supports, and/or deployment resources (e.g. removal of out-dated order sets, and printing for paper order sets). A process will be required to assure that order sets remain current; an outdated order set will perpetuate outdated care practices.

Order set life cycle management is a major undertaking for health care organizations. These organizations already struggle with competing priorities and a need for updates in evidence-based care.

Chapter 3 Methods

3.1 Research Methods Overview

In the context of the realist review, interventions are not viewed in the traditional perspective of resources (human, financial and equipment) but as actions undertaken based on possible theories and/or assumptions about potential impacts of that action. For example, an intervention might be education, and the associated action would be the organizational provision to educate staff about new initiatives or equipment. The action of providing education may be undertaken with the assumption or theory that educated staff will participate in the new initiative or engage in use of the tool because individuals have an intrinsic desire or motivation to grow and expand professional competence (see Table 1 below). Reingold & Kulstad (2007) explored the effectiveness of the theory or assumption that the use of human factor design elements to develop an order set delivery tool would have an impact on clinician adoption of congestive heart failure order sets.

Table 1 Assumption or Theory Underlying Intervention of Education

*Arrows pointing to the right signify theory chain is moving in an intended and/or positive direction

Assumption or Theory	Assumption or Theory Intervention	Action	Outcome
Individuals have an intrinsic desire/ motivation to grow and expand professional competence	This desire/ motivation will lead to adoption of new initiatives or tools when educated about them	Education of new initiative or tool is provided	New initiative or tool is adopted

Interventions and actions are active. They have an active input on individuals (i.e., behavior change) and individuals have an active input on interventions and actions. Individuals participating in the intervention will interact with an informal knowledge

exchange, potentially leading to modification of the intervention (Pawson, Greenhalgh, Harvey, & Walshe, 2005). Chains of theories and/or assumptions for interventions, actions, and outcomes develop and modify while attempting to move towards the desired outcome (see Tables 2 and 3).

Table 2 Interventions Have Active Input on Individuals

Intervention and Theory or Assumption	Action	Intended Outcome
Education will result in desired behavior change e.g. participation in new initiative or use of new tool	Education delivered	Education is effective and desired behavior change is achieved

Table 3 Individuals Have Active Input on Interventions

Intervention and Theory or Assumption	Action	Unintended Outcome	Action on Intervention
Education will result in desired behavior change e.g. participation in new initiative or use of new tool	Education delivered	Education results in desired behavior change but additional behavior change not anticipated e.g. new tool used correctly in an additional and effective context	Education modified to incorporate new use of tool

If the unintended outcomes are not positive, an alternate intervention rather than a modified intervention may be required. For example, an intervention of education to introduce staff to a new tool may have the unintended outcome of the staff using the tool in an inappropriate context (see Table 4). Unintended or negative outcomes are demonstrated in the table with arrows moving to the left.

Table 4 Interventions Have Unintended Negative Outcome

*Arrows pointing to the left signify theory chain is moving in an unintended and/or negative direction.

Intervention and Assumption or Theory	Action	Unintended Outcome
Education will result in desired behavior change e.g. participation in new initiative or use of new tool	Education delivered	Education results in behavior change but not the desired behavior change e.g. new tool used correctly but in inappropriate context

A realist review is focused on the action behind the intervention in an area of study, which in this case are the actions that lead to outcomes in the components of order set life cycle management for order set adoption. In this review, the action behind the area of study will be varied by the use of paper order set management, electronic order set management, and CPOE order set management.

Each intervention is chosen based on an assumption or theory that it will result in an intended outcome (desired change in behavior). Interventions may need to be altered to adapt to the various complexities of organizational social settings (e.g. conflicting individual or group objectives, individual personal preferences, and/or work demands). There is added complexity when a component of the intervention varies (e.g. paper versus electronic). To effectively achieve the desired outcomes or behavior change, alternate interventions and actions may need to be considered for each variation and in each context. The actions and resulting outcomes of these interventions are the subject of the review, not order sets themselves.

For this realist review, data collection by the reviewer involved an initial literature review, initial interviews with participants, a second more detailed literature review, and follow-up stakeholder interviews. The initial literature review was used to develop semi-

structured interview questions to engage the interview participants. The initial interview data were reviewed and abstracted, and then identified interventions were sorted into theme types based on reviewer assessment. This provided an initial framework of themes. The post-interview participant literature review was more detailed and incorporated relevance and quality assessment of each paper, data extraction for general content, and extraction of data more specific to order sets. All data were then sorted into approaches, and the initial framework of approaches was expanded to be more comprehensive, with some approaches having additional themes within the approaches. Identified approaches and themes within the approaches were reviewed for possible explanations of the assumptions or theories behind them, the actions engaged to support the intervention, and the intended and unintended outcomes. Explanatory theory chains were developed by the reviewer to reflect reviewer-suggested assumptions for choice of intervention intentions and identified outcomes. This was done for each approach and any themes within the approach. Interview participants were engaged for a follow-up interview to review the theory chains, compare and contrast their experiences with the theory chains, and add any additional insights. Data were again extracted from interviews and the findings modified to reflect new insights. Table 5 describes an overview of the timeline of activities and outputs for this review.

Table 5 Methods Workflow

	Literature	Interview Participants	Output
Timeline	Conducted initial literature review. Search terms: order sets, corollary orders, reflex orders, anticipatory orders and standardized order sets		Initial set of papers for review. Questionnaire for initial interview participants
		Snowball recruiting and conducted initial interviews. Extracted and analyzed data for themes discussed	Initial stakeholder interview data. Initial draft of themes
	Added search term from interview participant results and conducted second literature review for more papers		Updated set of papers for review
	Selected and assessed papers for quality and relevance		Quality scoring for each paper
	Conducted general data extraction e.g. author(s), publication year, type of literature, interventions and metrics (if applicable)		General data for each paper
	Conducted additional data extraction for review of order set-specific data describing order sets, context(s) for implementation and use, order set users, order set tools and processes, patient related facts and strategies for implementation and to enhance use. Impacts of order set use were not included		Order set specific data for each paper
	Returned to discarded literature. Papers on the effectiveness of implementation strategies for clinical guidelines (rather than order sets) retrieved for re-evaluation		Expanded set of papers
	Identified evidence based practice clinical guideline		Refined themes and sub-themes of intervention

	Literature	Interview Participants	Output
	interventions		
		Compared and contrasted current interview participant data sorted in derived themes to intervention approaches from guideline literature (new papers)	Approaches from guideline literature in alignment with interview participant observable behavior themes (e.g. education) Themes (e.g. education for implementation versus education for new staff)
		Applied framework of approaches from guideline literature to the stakeholder interview data that did not describe observable behaviors (e.g. attitudes)	Alternative framework of approaches to reflect observable behaviors (e.g. some attitude stakeholder interview data re-sorted to epidemiological theme). Additional themes within the approaches (e.g. some attitude stakeholder interview data sorted to behaviorist approach - ease of use - delivery format or behaviorist approach - ease of use - perceived ease of use/ usefulness)
		Revised and re-sorted interview participant data themes	Foundational framework of approaches and themes of approaches
	Sorted literature order set specific data using new theme framework strategy and sub-themes		Sorted literature data reflecting themes. Identified and applied further sub-themes
	Analyzed approaches and themes within approaches and developed theory chains describing possible explanations of actions and resulting intended and unintended outcomes	Analyzed approaches and themes within approaches. Developed theory chains describing possible explanations of actions and results for intended and unintended outcomes	Explanatory theory chains of actions and outcomes based on approaches and themes within approaches
		Presented to interview participants in follow-up interview the theory chains reflecting actions and outcomes based on approaches and themes within approaches to obtain confirmation contradiction and alternate explanations and insights to finalize approaches and themes within approaches	Final version of approaches, themes within approaches and theory chains

3.2 Methods for Data Collection

3.2.1 Literature Search

The initial literature search was undertaken in November 2010. Five databases were explored: Ovid Healthstar 1966 to October 2010, PsychINFO 1967 to week 2 November 2010, Ovid MEDLINE (R) 1950 to November week 1 2010, Ovid MEDLINE (R) In Process & Other Non-Indexed Citations November 12, 2010, and Ovid MEDLINE (R) Daily Update November 11, 2010. The search terms used were "order sets", "corollary orders", "reflex orders" and "anticipatory orders". The search terms reflect the historical evolution of the term or name "order set" introduced into care settings, and the broad search of years was used to capture this related information. In January 2012, after the initial stakeholder interviews, the literature search was repeated with the same databases and search terms. An additional search term of "standardized order sets" was used as well because it was identified during the stakeholder interviews. The same inclusion and exclusion criteria were employed for both the initial and final literature search.

Eligible articles included quantitative and qualitative studies, case reviews, and viewpoint and non-peer reviewed literature. The abstracts were reviewed, and papers that focused on order set life cycle management and adoption were included. Papers that were excluded focused on the impact of order sets on clinical outcomes, financial outcomes or organizational costs (e.g. laboratory ordering practice), patient safety, process or adverse events, order set content development methodologies, vendor solutions, order set impact on ordering practices (e.g. increase or decrease use of specific laboratory tests or medications), and other miscellaneous reasons.

Papers focusing on clinical guidelines or care pathways were included when they incorporated discussion of the development and adoption of order sets. Additional papers from reference lists were retrieved and reviewed. Papers that focused on clinical guidelines or care pathways with limited mention of order sets (i.e., little or no description or discussion of order set adoption) were excluded.

After review of the literature for relevance and quality, data were extracted for general information (e.g. publication date, author(s) and order set-specific information). No papers retrieved explored the effectiveness of intervention strategy alternatives; thus the reviewer returned to the discarded literature to review them with the new inclusion criterion: the effectiveness of implementation themes to bring evidence-based practices to the point of care. The previously reviewed and discarded papers were retrieved. A second review was completed. Additional references within these papers were also retrieved and reviewed, and the papers supporting the new criterion were incorporated into the review.

3.2.2 Initial Literature Review

The initial review of the literature identified interventions, order set adoption, and relevant successes and barriers to adoption. The findings were used to develop the initial semi-structured interview questions.

3.2.3 Literature Review – Relevance and Quality Assessment

Literature quality appraisal involved several steps for each paper. The first phase assessed the relevance of the paper to addressing the research question with details describing intervention types, actions, and outcomes related to order set adoption within the phases of the order set life cycle (see Appendix D).

The second phase was an assessment and rating of the quality of the literature. Although the quality of the literature did not impact exclusion or inclusion in the review, it was used to provide relative weighting to the data extracted and synthesized.

Ammenwerth et al. (2003) developed a checklist of quality criteria for medical informatics papers. This tool provides a set of defined quality criteria - general criteria as well as specific types for different types of manuscripts. It is not a validated instrument but does facilitate reviewer assessment of literature. This checklist was used for a methodological quality review of all papers retrieved (see Appendix E). Each document was appraised and rated according to the appropriate criteria for quality and validity.

Quantitative literature was rated by the Ammenwerth et al. (2003) numerical score from 0 to 10 while qualitative papers were assessed using the qualitative criteria in the tool. For example, viewpoint papers were assessed against seminal and viewpoint criteria. These qualitative review criteria did not result in a numerical score rating.

To facilitate the review, all papers were further categorized into qualitative groups (i.e., Level A, Level B and Level C). To obtain a comparative rating of the qualitative papers, the reviewer assigned each a value in one of three groups. Papers that were assessed by the reviewer to meet most or all of the identified appropriate criteria were allocated to a level labeled A. Papers that were assessed to meet some of the appropriate criteria were assigned to a level labeled B, and those papers meeting only minimal criteria were assigned to a level labeled C. The quantitative literature was also allocated to three levels based on the derived numerical score. The quantitative literature was divided into Level A based on a qualitative score of 7 to 10, Level B was assigned based on a score of 4 to

6, and Level C was scored from 0 to 3. The three groups provided a relative weighting of the data.

3.2.4 Literature Review - Data Extraction and Synthesis

The literature included in the study was not restricted in focus to the effectiveness of any specific intervention or outcome nor did it focus on specific types of order sets, content or quality; data extraction evolved as reviewer learning evolved. There was little in the literature that specifically identified the effectiveness ("what works") of various implementation themes for order set adoption. A few specific approaches for implementation were highlighted in papers; for example, some papers discussing order sets implemented in the CPOE delivery format focused on the value of human factors design features and ease of use development features. Other papers noted the importance of the quality of the order set content to enhance adoption and use. Within the body of the order set literature reviewed, no frameworks or theories were discussed related to overall implementation strategies.

All literature categorized by quality was reviewed to extract and assimilate primary inferences about intervention themes related to order set adoption. Associated actions and outcomes were also assimilated to develop theory chains reflecting the underlying theories and assumptions about intervention themes, associated actions, and outcomes encountered. A custom-made tool was developed for data extraction and notation (see Appendix F).

There were two phases to the data extraction. The initial focus was on general data related to the paper such as author(s), publication year, type of literature, interventions, and metrics, if applicable.

The second phase of data extraction focused on review-specific data. There were a number of foci within the data set concepts; for example, order set data included the order set delivery method, order set development processes, the complexity of order sets discussed and the use of order set vendor products. User data were also a focus. Data extracted included user workflows, workload, attitudes, behaviors, engagement strategies, personnel rotation (e.g. resident rotations into the setting), and specific roles (e.g. nurse versus physician). The context data were extracted and included culture and context from organizational and/or unit specific (e.g. senior leadership support) to national (e.g. national evidence-based practice guideline initiatives) as well as resources (e.g. human and physical). Patient data capture included patient location of admission, time of admission, system entry point (e.g. emergency department versus operating room), patient diagnosis, co-morbidities (e.g. type and number) and demographics (e.g. age, race). Intervention data such as the process strategies, process, methods or tools (e.g. Lean, human factors design, vendor purchased order sets) were also extracted. When metrics were available they were extracted (e.g. number of order sets). When there were descriptions of successes, challenges, barriers, sustainability challenges, and suggested contributing factors (e.g. unique culture), these data items were also captured.

Through the data extraction process, the depth of detail of data mined to populate the extraction tool increased and encompassed a broad range of interventions and actions, resulting in a matrix of types of interventions, actions, and contexts within the multiple phases of the order set life cycle. For example, education strategies varied with implementation (e.g. order set content or delivery method) versus sustainability (e.g.

orientation of new staff for awareness of availability) or with the clinician role (e.g. physician versus nurse).

Literature data extraction, review of stakeholder interview data, and theme development were iterative throughout the review process. New and refined themes developed and evolved as reviewer learning evolved. Literature was read and re-read in order to identify relationships, similarities and differences.

To facilitate theme development the reviewer returned to discarded literature. Discarded papers discussing the effectiveness of implementation strategies that bring evidence-based practice to the point of care were retrieved for re-evaluation. Additional references within these papers were also retrieved. An expanded set of papers was obtained at this time.

During this iterative review process of data extraction and synthesis, the reviewer continually sought to identify and refine potential intervention themes, sub-themes, actions and outcomes to better explain all findings. By using thematic analysis, or the systematic examination of similarities between social phenomena (i.e., under what conditions do patterns arise and under what contexts do exceptions to patterns arise), the themes and actions were sorted into the initial broadly-themed categories and then into sub categories. Themes were grouped together and amended until they were clarified. When actions presented differences, data were re-evaluated and categories further narrowed or sub-divided. For example, themes related to ease of use of order sets were further categorized by ease of use related to perceived needs of users and ease of use based on the order set delivery format.

Themes were then used to initiate and develop theory chains. For each theme and sub-theme, possible explanations for the choice of intervention were explored. An inferred and sometimes implicit assumption about the intervention and intended outcome for each action was described. The intervention served as the first link in the theory chain, and the action served as the second link. Chains were expanded with additional links to describe possible explanations of all intended and unintended outcomes identified. Theory chain development was iterative as data were extracted, compared and contrasted to findings (i.e. matching identified patterns or introducing variations in patterns).

Finally, the stakeholders were contacted for a follow-up interview by telephone to review the thematic theory chains and provide feedback and additional insights.

3.2.5 Initial Participant Interviews

Ethics approval was obtained from the Research and Ethics Boards for Kingston General Hospital/Queens University (Queens Study Code NURS-269-11) and University of Victoria (Protocol Number 11-222). Prospective interview participants were sought from organizations located in Ontario in order to facilitate reviewer access. Organizational administrators from tertiary care organizations employing different order set delivery formats (i.e. paper versus electronic or CPOE) were targeted. Research Ethics Boards associated with the participant organizations were contacted to confirm that adequate ethics review was completed prior to engaging participants. Permission was requested to engage up to ten participants at each site. Initial contacts were also requested to initiate a snowball recruiting strategy.

A convenience sample of 16 participants was recruited from each organization based on role. Physicians, pharmacists, nurses and order set administrators were targeted. The physicians, pharmacist and nurses are users of order sets and provided an understanding of workflows and order set challenges. Order set administrators provided insight into current implementation strategies and past experiences of successes and failures.

All subjects were engaged in 15 to 30 minute telephone interviews. Individuals who accepted the invitation received electronic Information and Consent Forms along with proposed semi-structured interview questions (see Appendix G). Follow-up contact for the final interview was discussed during initial contact.

At the beginning of each interview, stakeholders were provided with an additional verbal overview of the study. The identity of the sponsors for the research was reviewed and consent and confidentiality were discussed and confirmed. Participants were also informed that an executive summary of results would be provided to participant organizations at the completion of the research study.

3.2.6 Initial Participant Interview Data Extraction and Synthesis

The initial participant interview questions were focused on the participant-identified attitudes associated with order set adoption and the facilitators and challenges associated with various delivery formats. Data from the interviews were extracted and sorted by individual participant to allow for enhanced familiarization with the feedback. Using thematic analysis patterns, data were re-sorted and initial themes were identified. As learning developed, groupings were altered and modified, and subsets of themes were grouped into larger themes.

Not all of the themes initially emerged to reflect the underlying actions or observable behaviors. Some initial themes reflected characteristics of users (e.g. attitudes based on role such as nursing or physician) and characteristics of order sets (e.g. admission order sets versus preventative care order sets) that impacted order set adoption. During the literature review, papers added with new inclusion criteria described approaches of interventions from the implementation of clinical guidelines. These approaches were compared and contrasted with themes derived from the participant interviews. Themes reflecting observable behaviors were in alignment (e.g. education), and approaches from the framework were identified for themes that did not reflect observable behaviors (e.g. attitudes). This allowed for a reframing of some themes to identify underlying interventions and actions (e.g. some attitude themes reframed to behaviorist approach - ease of use). Some themes within the approaches also began to emerge (e.g. education during implementation versus education during hires of new staff).

Approaches and themes were then developed into theory chains describing the underlying assumptions of the various mechanisms of action and the resulting intended and unintended outcomes identified by stakeholders and in the literature.

3.2.7 Follow-up Participant Interview and Data Synthesis

Follow up engagement was arranged with an email that included the same Information and Consent Form. Following receipt of signed final interview Consent Forms, telephone meeting times were arranged and stakeholders were sent an overview of the derived theory chains in preparation for the follow-up interview (see Appendix H). At the beginning of each interview, general updates of the current organizational context were discussed. Each of the theory chains derived from the identified approaches and themes

within the approaches, actions and outcomes were then verbally described and feedback was sought to test findings. Opinions were sought and comparisons and contrasts to stakeholder experience were discussed. In some cases, theory chains were confirmed with stakeholder experiences and further insights into potential explanations were incorporated into the findings. When stakeholders reported variances to the findings, this new deviation was incorporated to refine the theory chains. Theories were then further refined to facilitate the development of recommendations.

At the conclusion of the follow-up interview, participants were reminded that an executive summary of results would be provided to participant organizations at the completion of the research study, and a copy would also be sent to each participant. The feedback from participants was again extracted from the handwritten interview notes. Feedback and insights were aligned with the framework of approaches and themes and with new potential explanations incorporated in to the theory chains and the review discussion.

Chapter 4 Results

This chapter will first provide the results of the steps of the review process, and then present a synthesis of those results in the second section of the chapter. The extracted data from papers and interview participants has been sorted based on the Grol and Grimshaw (1999) framework, and the resulting approaches and themes were used to develop theory chains.

4.1 Results of Review Process

4.1.1 Literature Search Results

The search terms "order sets", "corollary orders", "reflex orders" and "anticipatory orders" were used. There were no citations returned with the search term anticipatory order, which was an early term applied to the concept. The remaining terms were combined and the duplicates were removed, resulting in a list of 198 citations.

Seventy-four papers were retrieved after the citation abstracts were reviewed; of the 74 papers, another 49 papers were discarded after further review. Additional papers were retrieved from the reference lists of the papers reviewed. By applying the same inclusion and exclusion criteria, two additional papers were added to the study, resulting in an initial number of 28.

A final literature search was undertaken after the initial participant interviews to ensure that all currently published papers were considered, and twelve new papers were retrieved. Using the same initial inclusion and exclusion criteria, eight of the twelve were accepted into the review, resulting in a total of 35 papers for review. This number incorporated 19 qualitative and 16 quantitative papers.

To facilitate reviewer learning and thematic data sorting, the 49 discarded papers were retrieved and re-examined after the initial participant interviews and prior to data extraction from the literature. A few papers discussing clinical practice guidelines with limited information of order sets addressed the transition of research evidence into practice and/or practice guidelines. Although these papers did not meet the initial inclusion criteria of the review, eight of these papers were retrieved for further review. From the reference lists of these eight papers, four additional papers were retrieved for a total of twelve papers. Of these twelve papers, six were selected for full text review related to approaches and barriers impacting the transition of research evidence to the clinical setting (see Figure 3).

Papers accepted for the realist review were assessed for quality, and data from each paper were extracted in two phases. The first phase involved general data capture such as author(s), publication year and type of literature, plus interventions and outcomes if applicable. The second data extraction was to capture order set-specific data for each paper, including order set-specific data describing order sets, context(s) for adoption and use, order set users, order set tools and processes, patient-related facts, and strategies for implementation and enhanced usage. Impacts of order set use were not included (e.g. patient outcomes).

Figure 3 Literature Search

Citations from Ovid Healthstar , PsychINFO, Ovid MEDLINE (R), Ovid MEDLINE (R) In Process & Other Non-Indexed Citations and Ovid MEDLINE (R) Daily Update November 11, 2010. *n* = 198

Papers excluded on title and abstract *n*= 124

Papers selected for full text review *n*= 74

Papers identified from reference lists *n*= 2

Papers excluded on full text review *n*=49

Citations from second Ovid Healthstar , PsychINFO, Ovid MEDLINE (R), Ovid MEDLINE (R) In Process & Other Non-Indexed Citations and Ovid MEDLINE (R) Daily Update January 11, 2012 n=12

Papers excluded on full text review *n*=4

Articles abstracted in detail *n*=35

Discarded papers retrieved for second review *n*=8

Papers identified from reference lists *n*=4

Papers excluded on full text review *n*=6

Papers added for full text review to facilitate reviewer learning *n=6*

Number of papers reviewed *n*=41

4.1.2 Literature Review –Quality of Results

As a part of the Realist Review, each paper was then reviewed using the Ammenwerth Quality and Validity Assessment Tool (Ammenwerth et al., 2003). To assist the reviewer in managing the volume, both the qualitative and quantitative papers were further categorized into levels identified as A, B and C. These categories were defined by the reviewer and then categorized based on reviewer assessment. For example, the qualitative papers that were of better quality (i.e., meeting all or most of the appropriate assessment criteria) based on the review with the Ammenwerth Assessment Tool (2003) were sorted to the A level. Papers of moderate quality (i.e., meeting some of the appropriate assessment criteria) were grouped into the B level. Those of lower quality standards (i.e., meeting minimal appropriate assessment criteria) were grouped into the C level. The same system was applied to the quantitative papers based on the quality review scores obtained using the Ammenwerth Assessment Tool (2003) that resulted in a numerical potential to range from 0-10. Papers rated 7-10 were placed in the A level, and papers rated 4-6 were sorted to the B level. Papers scoring 3 or less were assigned to the C level. The results of the quality content review are available in Table 6.

Table 6 Literature Quality

Qualitative Literature		Quantitative Literature		
Quality Level	**Number of Studies**	**Quality Level**	**Number of Studies**	
			Score	*Frequency*
A	2	A (scoring 7-10)	10	0
			9	1
			8	0
			7	3
B	9	B (scoring 4-6)	6	3
			5	2
			4	3
C	8	C (scoring 0-3)	3	0
			2	1
			1	3

4.1.3 Literature Review – Data Extraction

All papers categorized by quality were reviewed and general data such as author(s),

publication year, type of literature, interventions and outcomes (if applicable) were

extracted (see Appendix I). The second phase of the extraction was focused on order set

adoption. The papers were examined for variations based on context of adoption, order

set tools and processes, prescriber and patient characteristics, and strategies to promote

adoption as well as the trends of use over time (see Appendix J).

Some papers applied metrics. Order set characteristics (e.g. amount of the content used

and the types of content used); use based on patient characteristics (e.g. patient severity

of illness, patient demographics, patient location of admission within the organization,

time of admission); user characteristics (e.g. patterns related to prescriber traits, pre/post

intervention trends); patters of use over time; and organisational trends were studied (see

Appendix K).

Order Set Data – Metrics

   Order Set Characteristics - Order set characteristics were described in relation to

purpose, content (McAlearney et al., 2006) and delivery format (Khajouei, Peek,

Wierenga, Kersten, & Jaspers, 2010).

   McAlearney et al. (2006) examined specific order sets and noted that use for an asthma

order set started high and increased over time ($z=-3.02$, one sided $p=0.001$);

appendectomy order sets started high but showed a significant but small negative trend

over the study period ($z=2.10$, one sided $p=0.018$). This declining trend was suggested to

be associated with the arrival of new residents. Use of a community-acquired pneumonia

order set was relatively low at implementation and did not show evidence of increased

utilization over time ($z=0.626$, one sided $p=0.266$).

   Another paper (Khajouei et al., 2010) compared computer mouse clicks and keystroke

variations by physician and by electronic orders versus predefined order sets. This paper

suggested that when using an electronic delivery format, the use of order sets facilitates

ease of use ($p<0.01$).

   Patient Characteristics - Data describing patient characteristics included complexity of

the patient or severity of illness, demographics, location of admission, and time of

admission.

   The complexity of the patient or severity of illness characteristic presented mixed

findings. Severity of illness was assessed using the All Patient Refined Diagnosis Related

Groups (APR-DRG) simultaneously with the Greenfield Co-Morbidity Index or the Index

of Co-Existent Disease (ICED). Findings indicated that order sets were less likely to be

used for patients with greater APR-DRG severity of illness ($p<0.01$) and APR-DRG risk of mortality ($p<0.01$). In contrast, there was no significant relation using ICED ($p=0.42$) (Ballard et al., 2008). Other papers demonstrated similarly conflicted findings (McAlearney et al., 2006; Reingold & Kulstad, 2007).

Patient demographics also presented some contradictions. There was no identified significant finding associated with order set adoption and patient insurance (McAlearney et al., 2006), age (Fleming et al., 2009; McAlearney et al., 2006; Reingold & Kulstad, 2007), sex (Fleming et al., 2009; Reingold & Kulstad, 2007), or race (Fleming et al., 2009; McAlearney et al., 2006). However, McAlearney et al. (2006) found that children of black race had one-third the odds of having the community-acquired pneumonia order set used as compared to children of white race.

McAlearney et al. (2006) examined location of patient admission. Patient admissions to units that admit large numbers of patients with a given condition were more likely to result in order set utilization; informal conversations suggested that this association may have been driven by the attending physicians on the units who serve as strong proponents for use.

For some order sets, location of patient admission was the greatest predictor for adoption (OR=12.2, 95% CI1.4-6.7) (e.g. patients can be admitted "off- service" where staff may not be familiar with supporting order sets). After discussion with staff in different areas of study, it was suggested that this adoption may have been driven by strong attending physician champions (McAlearney et al., 2006). Day of the week as well as time of day also impacted order set adoption (McAlearney et al., 2006).

User Characteristics - Cheekati, Osbourne, Jameson, and Cook (2009) examined user

characteristics (e.g. prescriber awareness, patterns of use based on role) related to use and

identified the most commonly cited barrier to use was lack of knowledge about the

subject matter. It was also identified through survey data that there was an openness to

use decision support tools, at least by lesser experienced physicians (Asaro, Sheldahl, &

Char, 2005).

Patterns of Use - Order set use over time was assessed in a number of papers. Various

papers demonstrated increased use of order sets over time in settings using the CPOE,

electronic, and paper formats (Fleming et al., 2009; Heffner, Bower, Ellis, & Brown,

2004; Munasinghe, Arsene, Abraham, Zidan, & Siddique, 2011; O'Connor, Adhikari,

DeCaire, & Friedrich, 2009). Reingold and Kulstad (2007) explored pre and post-

implementation usage. Prior to implementation, national and local experts gave lectures

and memos were sent from the chair of quality improvement with limited impact on use

(Pre – 9% [95% confidence interval CI=5% to 17%; $p<0.001$]). Order sets were

redesigned with more inclusive stakeholder engagement and the application of human

factor design elements to the paper order sets in order to facilitate ease of use. The result

was improved order set use identified in the three post-intervention assessments: Post 1 –

31% ($p<0.001$); Post 2– 60% ($p<0.001$); Post 3 – 72% ($p<0.001$) (95% confidence

interval CI=52% to 82%).

Adoption continuously improved over time, even when changing to a new delivery

format. It was also demonstrated that other factors such as user engagement can facilitate

this trend. Peshek et al. (2010) reported usage of order sets pre-CPOE (paper) compliance

at 37% and post-CPOE implementation at 70-83%.

Organizational Trends - Context of adoption was explored at several levels. Comparison of use across organizations demonstrated variation (Fleming, Ogola, & Ballard, 2009). Ballard et al. (2008) noted that despite system wide promotion there was variation in use between hospitals, with a range from 43% to 91% ($p<0.01$).

The review of metrics used in deriving outcomes identified in the papers was useful in recognizing trends and components of order sets that influenced adoption; however, the review also clearly demonstrated many variants, making it challenging for researchers or administrators to reproduce strategies for success. This reinforced the need for explanatory review to identify effective actions facilitating successful order set adoption.

4.1.4 Participant Interviews

Two tertiary care organizations employing different order set delivery formats (i.e. paper versus electronic or CPOE) took part in the participant interviews. Only two organizations were targeted due to resource and time limitations.

Site One: Setting
Site One is a multi-location academic health centre that incorporates three hospitals (one oncology and two general) in a large metropolitan area. Between the three locations, there are approximately 770 beds with 500 standardized order sets in place.

There was some variation in order set delivery format across the locations. At Site One, the two general hospitals delivered order sets using a hybrid of CPOE and paper. The transition to order sets using CPOE took place four years prior to the initial interviews. Within the general hospitals, CPOE was used for diagnostic, lab and most medication orders. Complex medication orders (e.g. heparin infusions, drugs with weight-based dosing) were completed on paper. Within the organization specializing in oncology,

outpatient orders were sent electronically then printed in pharmacy and entered into the

pharmacy system by the pharmacist. The inpatient orders were completed on paper. In

the time between the initial interviews and the follow-up interviews and with the support

of the organizational administration, one department within this setting purchased a

membership to an order set collaborative[1] to facilitate order set development and life

cycle management. The rest of the organization was exploring opportunities with this and

other vendor solutions.

Site Two: Setting

The second site was a 1,200 bed multi-location (seven) academic teaching centre that

included a children's hospital and an oncology hospital.

Two hundred and seventy portable document format (pdf) order sets were available

electronically (with an embedded password) through a Citrix connection on unit in-

patient desktops. The printed copy of these order sets (paper) became part of the

permanent patient record. Although orders could be completed electronically, they were

printed for both processing and to serve as a part of the permanent record. Orders could

also be printed and completed by hand. Processing of the orders involved transcription of

the information to other chart and communication tools such as the medication

administration record. The transcribers printed a copy of the completed order and then

faxed or placed it in a pharmacy box for pick up. This organization also participated in a

web-based order set collaborative intended to provide and share evidence-based order

sets, provide an order set review tool set, and centralize management processes. It was

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[1] a vendor web based solution to manage and share evidence based order sets

also noted that processes introduced through the order set collaborative membership

supported content development as well as an order set format and approval strategy.

In the 18 months prior to the initial interviews, Site Two moved from a paper format to

electronic orders. The next stage in the implementation was to move to full CPOE within

12 to 18 months. This implementation date was moved out indefinitely.

Initial Interviews

Nine participants were interviewed by telephone at Site One. Participants represented a

variety of roles (e.g. pharmacists, nurse managers, clinical administers and information

management staff). Seven participants were interviewed from Site Two, including

individuals from nursing, pharmacy, physician, medical, and laboratory and order set

administrators. All 16 pre-study participants participated in the follow-up interviews

(post-interview response rate 100%) and included the same range of roles (pharmacists,

nurse managers, physicians, clinical administers and information management staff) (see

Table 7).

Table 7 Comparison Site One and Site Two

Variable	Site One	Site Two
Setting	774 bed multi-location academic health center incorporating 3 hospitals (1 oncology and 2 general)	1,200 bed multi-location (7) academic teaching center incorporating a children's hospital and oncology
Order Set Delivery Format	Variation across locations, General hospitals hybrid CPOE and paper format (complex orders done in paper format e.g. weight based dosing. Oncology outpatients electronic. Oncology inpatients paper	Electronic hybrid order sets available through Citrix connection. Can be completed electronically and printed or printed and completed by hand
Organizational Set Context	Transition to CPOE initiated 4 years prior to initial participant	Changes occurring within the year of initial participant interviews

Variable	Site One	Site Two
	interviews	
Participants	9 participants representing pharmacists, nurse managers, clinical administrators and information management staff	7 participants representing pharmacists, physicians, nurse managers, clinical administrators and information management staff

4.1.5 Synthesis Process

The analysis of the initial participant interviews revealed themes similar to those identified in the questions for the semi-structured interviews. These initial themes included the context where the order sets were used; characteristics of the users such as attitudes based on user role (e.g. resident versus nurse); characteristics of the order sets such as order set type based on purpose (e.g. admission order set versus preventative care order set); order set delivery formats; and process challenges.

As reviewer learning developed, groupings were altered and modified, and subsets of themes were grouped into larger themes. Themes first evolved to highlight greater depth and detail of order set adoption then regrouped according to the larger themes with variations of focus. For example, context of use reflected many factors: use, attitudes of users within the context, quality of the order set content, ease of use, variations with context, delivery format within context, education, communication, and leadership. Characteristics of order set users was found to reflect multiple factors such as general attitudes related to the concept of order sets, quality of order set content, ease of use of the order set, and order set delivery format. These multiple factors became new detailed groupings or evolving themes. At this point, these evolving themes became use, senior leadership support (at multiple levels), communication strategies, education strategies

(e.g. training and awareness), attitudes, quality of content, delivery format, ease of use, and life cycle management process.

Further assessment and alignment of groupings resulted in an initial set of revised themes. For example, attitudes became a larger theme with sub-themes that were order set-based (e.g. order set type, content, delivery format, development and implementation) and clinician or role based (e.g. attending physician versus resident physician). The evolving themes of education and communication became the larger theme of education, with sub-themes reflecting differences in the education focus (e.g. user awareness, order set purpose, and order set delivery format skills development [see Table 8 below]).

Table 8 Initial Theme Sorting

Initial Themes	Evolving Themes	Revised Initial Themes
Context for Use	Use	Attitudes
		Order Set Based Attitudes
Characteristics of Order Set Users e.g. Role Based Attitudes	Attitudes	- Order set type
		- Order set content
Characteristics of Order Sets	Quality of Content	- Order set delivery format
		- Order set development and implementation process
Delivery Format	Ease of Use	*Clinician Based Attitudes*
Process Challenges		- Role or Clinical Group
	Delivery Format	
	Life Cycle Management Process	
	Education Strategies (training, awareness	Education
		- Awareness
		- Purpose
	Communication Strategies	- Delivery tool skills development
	Senior Leadership (at multiple levels)	Leadership Support
		- Champion
		- Resources
		- Senior Leadership
		- Engagement

Some of these revised initial themes (e.g. education) reflected interventions, but some reflected characteristics of users (e.g. attitudes based on the role or group role such as nursing) and characteristics of order sets (i.e. admission order sets versus preventative

care order sets) that impacted order set adoption. Further analysis was necessary to identify the themes as actions or interventions with observable behaviors.

To facilitate reviewer learning and thematic data sorting, the 48 discarded papers were retrieved and examined a second time after the initial interviews and prior to data extraction from the papers. A few papers discussing clinical practice guidelines included limited information of order sets but addressed the transition of research evidence into practice and/or practice guidelines. Although these papers did not meet the initial inclusion criteria of the review, 9 papers were retrieved for further review. From these 9 papers, 4 additional papers were retrieved from the reference lists. Of these 13 papers, 6 were selected for full text review related to approaches and barriers impacting transition of research evidence to the clinical setting (Bero et al., 1998; Blomkalns et al., 2007; Davis & Taylor-Vaisey, 1997; Sinuff, Kahnamoui, Cook, & Giacomini, 2007; Doherty, 2006; Gagliardi, Fenech, Eskicioglu, Nathens, & McLeod, 2009; Gerhardt, Schoettker, Donovan, Kotagal, & Muething, 2007; Grol, 2001; Grol, 2004; Grol & Grimshaw, 1999; Grol & Grimshaw, 2003; Grol et al., 1998; van Dijk, Hooft, & Wieringa-de Waard, 2010).

Some of these papers explored barriers to (Grol, 2004) and incentives for achieving evidence based practice in medicine (Grol, 2004; van Dijk et al., 2010). Several papers reviewed a collection of studies or systematic reviews focused on various factors supporting effective intervention strategies (Bero et al., 1998; Grol, 2001; Grol & Grimshaw, 2003). Within these papers, intervention themes were grouped in a number of different ways. For example Grol and Wensing (2004) grouped the intervention themes by those directed to individuals, those directed to social context, and those with an

organizational or economic focus. Van Dijk et al. (2010) explored barriers with themes grouped related to time, attitude, knowledge, skills and resident (individual) specific barriers. Grol and Grimshaw (2003) grouped themes based on characteristics of the evidence, complexity of performance change, barriers and facilitators, individual and professional, team or unit, and hospital or health centre.

Other papers noted that there was no evidence to support one intervention type over another. It was also noted that it was difficult to disentangle the effects of the interventions from the context where they are employed (Bero et al., 1998; Grol, 2001). This reinforced the value of the realist review to explore intervention alternatives that would result in desired outcomes.

Among these papers, one explored theoretical perspectives to address the challenge of bringing evidence based implementation strategies to evidence based practice (Grol & Grimshaw, 1999). This Grol & Grimshaw framework (Appendix L) of seven approaches, or types of intervention themes, was based on actions. These approaches included the following:

- Epidemiological, which focus action on rational aspects of behavior;

- Educational, which focus action on intrinsic motivation;

- Marketing, which focus on development and marketing of attractive products or message;

- Behaviorist, which are based on theories and actions about conditioning or controlling behavior;

- Social Influences, which emphasize professional communication

- Organizational, which rather than focusing on individuals focus on creating
  conditions necessary for change; and

- Coercive, which involves pressure and control action (see also Appendix L).

Some of these approaches were founded on empirical perspectives, and others were

based on assumptions about change. The identified approaches in this paper included

both organizational and provider behavior change strategies (some based on scientific

evidence and others more speculative) that had different emphases and assumptions about

change but all contributed to observable behavior change. These approaches were

compared and contrasted with emerging themes in the order set data extraction from the

initial interviews and literature. This general thematic framework supported the goals of

this review to identify interventions and actions used to implement order sets. All themes

identified in the review papers and by the reviewer resulted in overlaps. However, this

general framework of approaches facilitated theme alignment with action-oriented

interventions.

Revised initial themes such as attitudes that did not reflect observable behaviors were

reviewed and re-integrated into the framework of approaches that reflected actions or

interventions to impact outcomes. For example, some of the initial revised themes of

attitudes were re-sorted into epidemiological approaches such as those related to order set

type and order set content.

Other initial revised themes such as education were in alignment with the framework of

approaches and reflecting actions and outcomes with observable behaviors. However, the

initial revised themes for education were awareness, purpose and delivery skills tool

development. The purpose and delivery tool skills development themes were re-sorted

into the education approach, but the awareness was re-sorted into the marketing

approach. New themes within the approaches also began to emerge (e.g. awareness

evolved into pre-implementation awareness, implementation awareness and sustainability

awareness) (see Table 9).

Table 9 Thematic Sorting

Revised Initial Themes	Grol and Grimshaw Framework of Approaches	Final Review Approaches and Themes
Attitudes Order set based • Order set type • Order set quality of content • Order set delivery format • Order set development and implementation process Clinician based • Role or Clinical Group	**Epidemiological**	**Epidemiological** • Stakeholder Engagement • Quality of Content
Education • Awareness • Purpose • Delivery Tool Skills Development	**Educational** **Marketing**	**Educational** **Marketing** • Pre-Implementation • Implementation • Sustainability
Leadership Support • Champions • Resources • Senior Leadership Engagement	**Social Influence**	**Social Influence**

	Organizational	**Organizational**
		 • Leadership and Resource Management
		   - Pre-Implementation
		   - Implementation
		   - Sustainability
		 • Ease of Use -Life Cycle Management

	Behaviorist	**Behaviorist**
		 • Perceived Ease of Use – Usefulness
		 • Ease of Use
		   - Delivery Format
		   - Learning Tool
		   - Empowerment

	Coercive ⟶	**Coercive**

4.2 Results Data Synthesis

Using the Grol and Grimshaw (1999) framework of approaches as a foundational sorting structure, the interview participant feedback and data from the review papers were sorted into approaches. This foundational structure of seven approaches supported the sorting of all data, but a number of themes within the approaches emerged. All approaches and themes were based on theories of the underlying mechanism of action. The themes within the approaches were aligned with the approach and the initial underlying theories, but theory chains evolved along different pathways (see Appendix M). The identified approaches and themes included the following:

- Epidemiological approaches

    o Stakeholder engagement theme

    o Quality of content theme

- Educational approaches

- Marketing approaches

    o Awareness pre-implementation theme

    o Awareness implementation theme

    o Awareness sustainability theme

- Social influence approaches

- Organizational approaches

    o Leadership and resource management theme

    o Life cycle management theme

- Behaviorist approaches

    o Perceived ease of use and usefulness theme

    o Ease of Use – Learning tool theme

    o Ease of Use – Empowerment theme

    o Ease of Use – Delivery format theme

- Coercive approaches

The variable of focus for each of the approaches and themes within the approaches was then translated into theory chains. The next section will explain more about these approaches and themes. Each of these approaches and themes are presented with the associated theory chains.

4.2.1 Epidemiological Approaches

Epidemiological approaches are based on the assumption that decisions are made based on rational factors associated with costs, benefits, harms and preferences. These approaches are derived from decision-making theories (e.g. rational choice theory) or cognitive theories (e.g. theory of planned behavior).

Stakeholder Engagement Theme
This epidemiological theme is based on the underlying theory that engagement leads to awareness, participation and ownership (see Table 10).

Table 10 Epidemiological Approaches: Stakeholder Engagement Theme

Theory 1: Communication Stakeholder Engagement	Theory 2: Feelings of Ownership	Theory 3: Engagement Attempts Rejected (a)	Theory 4: Engagement Attempts Rejected (b)
Engagement leads to awareness, participation and feelings of ownership	Ownership will provide acceptance and then adoption	Engagement unsuccessful as stakeholders reject message e.g. alternative tools in place and order set of no value; concept of order set not viewed as valid; reluctance to engage in change	Engagement unsuccessful as stakeholders reject messengers e.g. underlying tensions between stakeholder and messenger or messenger not respected
Theory 5:Feelings of Ownership (a)	**Theory 6: Feelings of Ownership (b)**	**Theory 7: Adoption Despite No Direct Engagement**	
Engagement positive but stakeholder feedback not incorporated and feelings of ownership not developed e.g. unique challenges of setting not addressed; content feedback not incorporated	Engagement positive but one/some stakeholder(s) overlooked in engagement process	Engagement has taken place at another level or in another context e.g. national standards development	

Stakeholder engagement was recognized as time consuming. Challenges were identified when stakeholders rejected the message or, alternatively, the messengers. Overlooking a stakeholder group also contributed to challenges. It was also identified that stakeholder engagement may have taken place in another context and reduce the level of engagement

required in the current context. For example, national best practice initiatives may have

preceded the introduction of an organizational order set.

Epidemiological Approaches Quality of Content Theme
   This approach is founded on the epidemiological theory that prescribers will make the

decision to use a tool if it provides benefits. In addressing this variable, the actions were

focused on the quality of the order set content and users' perceived ease of use and/or

usefulness of the order set (see Table 11).

Table 11 Epidemiological Approaches: Quality of Content Theme

Theory 8: Cognitive Choice	Theory 9: Order Sets are a Valid Tool (a)	Theory 10: Order Sets are a Valid Tool (b)	Theory 11: Order Sets are a Valid Tool (c)
Decision making is done by cognitive choice	Concept of order sets accepted as valid clinical tool	Concept of order sets not accepted as valid clinical tool (e.g. impede treatment of patient as unique individual)	Concept accepted and order sets of quality content but relevant references not available at the point of care to demonstrate quality
Theory 12: Order Sets are a Valid Tool (d)	Theory 13: Order Sets are a Valid Tool but Question Available Research	Theory 14: Order Sets are a Valid Tool but Research in Progress	
Concept accepted and order sets with relevant references available at the point of care but content is not current with published research	Concept accepted but order sets not of quality content (e.g. broadly accepted evidence based practice – may or may not be evidence based)	Prescribers may be researchers exploring new alternatives or aware of new research not currently published	

   Both interview participants and the review papers identified scenarios where the

concept of order sets was not viewed as a valued clinical tool. However, when the

concept of order sets was accepted as a valid tool, other challenges were identified. These

challenges included the ability to confirm the content as evidence-based practice at the point of care and maintaining currency of order set content (reflecting current published evidence-based research). There were also questions about availability of empirically-based evidence and what constituted evidence (i.e. sufficient volume and/ or quality of evidence). Another challenge (p. #17) was associated with large teaching centres where prescribers were involved in, or aware of, leading edge research or theories that they wanted to incorporate into daily practice.

4.2.2 Educational Approaches

Only a few papers mentioned education, and the discussion was limited in terms of content (Anonymous, 2009; Ballard et al., 2008; Formea et al., 2010; Fratino et al., 2009; Maynard, 2009; Perkins et al., 2008; Peshek et al., 2010). It was most often discussed in the context of implementation of electronic or CPOE delivery formats, and focus was directed to use of the electronic tools. Education to support order sets themselves was more limited (see Table 12 below).

A number of educational strategies were described such as use of multiple venues, in-service, packages, newsletters and memos (Anonymous, 2009; Meleskie & Eby, 2009). Some education was directed to the subject matter (e.g. diabetes management) of the order set with the objective of facilitating or enhancing order set use (Perkins et al., 2008). It was noted by a participant from Site Two (p. #12) that some senior physicians declined education on order sets and new electronic tools, suggesting that it should be directed to the resident staff. One participant (p. #16) shared that an educational event had the unintentional impact of serving as a marketing tool.

Table 12 Educational Approaches

Theory 15: Desire to Grow	Theory 16: Motivation	Theory17: Education Method	Theory 18: Education Content Validity (a)
→	→	←	→
Individuals have an intrinsic desire/motivation to grow and expand professional competence	This desire/ motivation will support the adoption of order sets	Content of education subject appropriate but method of engagement inappropriate e.g. use of adult learning strategies and individuals not motivated to absorb/accept the subject matter	Contents of education accepted as valid and appropriate desire to grow engaged
Theory 19: Targeted Stakeholders Non Receptive	**Theory 20: Education Content Validity (b)**		
←	→		
The targeted stakeholders do not have the desire to grow and develop professional competence in the proposed educational direction	Non-targeted education mentioning order sets leading to inquiries from other setting		

4.2.3 Marketing Approaches

Marketing approaches are founded on innovation and communication theories. The focus is directed towards the development of an attractive product or message that is adapted to the target group. The approach is presented in multiple formats (e.g. person to person, networks of professionals, media). The broadness of the intervention types facilitates capturing a wide range of target individuals and groups (Grol & Grimshaw,

1999). Marketing planning can include pre-implementation strategies, implementation

strategies, and sustainability and enhancement of use strategies.

Marketing Approaches Pre-Implementation Theme

Pre-Implementation marketing theories were directed towards creating a culture of

interest or desire for change. Attention is drawn to what is relevant. Perceived need will

influence desire for change. The desire for change will increase reception to marketing

message. One of the interview participants indicated in hindsight that a campaign before

order set implementation directed at identifying quality problems and introducing a

perceived need for change might have facilitated engagement and receptiveness to

messages (see Table 13).

Table 13 Marketing Approaches: Pre-Implementation Theme

Theory 21: Identify Product or Service of Interest	Theory 22: Target Product or Service of Interest	Theory 23: Perceived Need (a)	Theory 24: Perceived Need (b)
Target or message is attractive to potential stakeholders and leads to adoption	Target areas of complexity or frequency of use where order sets will support greatest perceived need i.e. manage complexity improve workflow	Attention is drawn to what is relevant. Perceived need will influence desire for change	The desire for change will increase reception to marketing message
Theory 25: Perceived Need Lacking	Theory 26: Create Perceived Need (a)	Theory 27: Create Perceived Need (b)	
Area of focus does not have a perceived need for change	Create perceived need for change through enhanced awareness and needs for quality improvement	Unsuccessful in creating perceived need for change	

Marketing Approaches Implementation Theme

Good communication structures that reach to the front lines were identified as essential (Ballard et al., 2008; Cheekati et al., 2009; Hagland, 2009). It was also noted by the participants (p. #15) that implementation across locations was "huge" and must incorporate repeated education and reinforcement with multilevel support and engagement. Some stated that the biggest challenge was bringing the first location on board. Individuals from the first implementation locations who rotated throughout the organization facilitated the process with word-of-mouth marketing.

It was suggested that variability of physician leadership and buy-in had the potential to impact adoption. Limitations in the infrastructure were also noted to present some challenges (e.g. insufficient computers or printers, routing of order sets to appropriate printers) (see Table 14).

Table 14 Marketing Approaches: Implementation Theme

Theory 28: Communication (a)	Theory 29: Message Does Not Reach Target	Theory 30: Communication of Availability and Advantages	Theory 31: Communication Message Effective but Does Not Reach Target Audience
Awareness and understanding will lead to use	Message does not reach all target areas e.g. broad target audience; numerous contexts for delivery of message	Order Sets are valued and awareness facilitated by word of mouth. Initial implementation facilitates following implementations	Effective marketing strategy but wrong messenger

Theory 32: Communication Effective but Order Sets Not Available
Structure not in place to support use e.g. not enough computers, cannot find paper order

Marketing Approaches Sustainability Theme

Participants noted that sustaining awareness was a constant challenge. Staff changes and resident rotations also add to the complexity by creating a constantly changing target audience. During the review, it was identified that there are formal and informal marketing strategies that are developed or evolve to sustain awareness and use of order sets. Nursing often supports the marketing process but is not the best resource in all contexts. In some cases a senior resident acts as the primary source of communicating awareness while in other contexts it is a function of the group (e.g. peer awareness) that facilitates use. It was noted that, contrary to marketing for implementation, the marketing

for sustaining use was often more effectively achieved in the larger contexts than the

smaller closed settings. It was suggested that this could be the result of more formal

structures in the larger contexts (e.g. senior resident, junior resident).

Awareness can also be impacted by the number of order sets used. For example, in a

particular unit the admission orders would be used frequently and the awareness of the

availability of the order set would be high. Other order sets available to support care may

be needed infrequently or rarely. Awareness and/or remembering that an order set is

available to support this care can be more difficult to sustain (see Table 15).

Table 15 Marketing Approaches: Sustainability Theme

Theory 33: Communication (b)	Theory 34: Product Change	Theory35: Message Communicated but Target Changed	Theory 36: Message Re-Communicated Formal and Informal Structures
→	←	←	←
Awareness and understanding will lead to use	Evidence-based practice changes and order set updates must be communicated	Message communicated but prescribers departed with new prescribers missing the message	Message shared by stationary unit population formal and informal structures

Theory 37: Message Facilitated by Frequency of Use	Theory 38: Message Not Facilitated by Frequency of Use		
→	←		
Awareness of order set sustained despite transitional prescribers	Awareness difficult to sustain due to infrequency of order set use		

4.2.4 Social Influence Approaches

Social influence approaches are founded on the theory that the opinions and feedback

from significant individuals within a social network impact behaviors. The focus of these

types of approaches is based on learning and changing achieved as a result of influence

and interactions with others. This strategy is supported by professional communication

(Grol & Grimshaw, 1999) (see Table 16).

Table 16 Social Influence Approaches

Theory 39: Interaction in Social Networks	Theory 40: Formal and Informal Leaders	Theory 41: Formal and Informal Leaders All Levels	Theory 42: Formal and Informal Leaders Attitude
Learning and changing is achieved as a result of interaction in social networks	Opinions, feedback or pressure coming from significant individuals in a social network have impact on adoption	Champions identified at all levels (front line [for all provider types] to administrative levels) to provide positive opinions and pressure to support use	Leaders may have positive or negative attitude
Theory 43: Formal and Informal Leader Availability	**Theory 44: Formal and Informal Leader Turnover**		
Champions not available at all levels. Message is not effectively conveyed resulting in lack of awareness of positive opinions and feedback	Formal or informal leaders change and bring new or conflicting attitude		

The importance of champions at all levels, including respected physician champions to

engage physicians, was frequently mentioned in the literature (Abramson, 2007; Ahmann

& Maynard, 2008; Ellerbeck, Bhimaraj, & Hall, 2006; Fear, 2011; Fleming et al., 2009; Maynard, 2009; Peshek et al., 2010; Reingold & Kulstad, 2007). Social influences can provide both positive and negative impacts. Asaro et al. (2005) noted that attending physician attitudes can have a trickledown effect that was not always positive.

Ellerbeck et al. (2006) noted that "smaller hospitals" were much less likely to have implemented standardized order sets and less likely to have identified physician champions. One participant (p. #01) noted that challenges were encountered in one unit when the formal leadership changed and did not support the order sets in use.

4.2.5 Organizational Approaches

Organizational approaches do not focus on individuals but rather on creating conditions that permit individuals to make the changes that are the focus of the intervention. This type of approach is reflected in continuous quality improvement and total quality management strategies. The goal is to provide an environment that facilitates the achievement of the goals (Grol & Grimshaw, 1999).

Organisational Approaches Leadership and Resource Support Theme

The importance of solid order set governance at all levels (e.g. senior organizational and departmental leadership, front line champions, professional practice leadership) (Fear, 2011; Hagland, 2009; Peshek et al., 2010), a plan with appropriate resources (e.g. physical, financial and human) for process redesign, standardization, and safe implementation (Abramson, 2007; Hoffman et al., 2011; Meleskie & Eby, 2009) were mentioned in the literature (Hoffman et al., 2011) but not discussed extensively. In the electronic formats, the need for well-maintained computer networks and sufficient numbers of computers, monitors and printers in clinical areas was noted as key to

adoption success (Heffner et al., 2004). One participant (p. #13) indicated that in early

stages there was an initial lack of computers, but as the organization moved forward on a

larger informatics project these challenges were addressed as part of that work, with more

and faster computers being installed. The bigger challenge was noted to be the

maintenance component relating to the human resources needed to support regular best

practice review and corresponding order set updates (see Table 17).

Table 17 Organizational Approaches: Leadership and Resource Support Theme

Theory 45: Leadership and Resource Support	Theory 46: Leadership Support	Theory 47: Resource Support (a)	Theory 48: Resource Support (b)
→	←	←	←
Senior leadership recognizes and makes available the appropriate resource requirements	There is not recognition of all resources needed to support order sets process	Recognition is present but resources not available to be put in place	Recognition is present but resources for life cycle management are not deployed

Theory 49: Resource Support (c)
←
Resources and support provided for early phases but deplete in later stages

Organizational Approaches Life Cycle Management Theme

Impacts to workflow influenced order set adoption (Abramson, 2007; Ahmann &

Maynard, 2008; Fear, 2011; O'Connor et al., 2009). Workflow was found to be impacted

both at the point of care and in life cycle management. The life cycle of order sets is

composed of 4 phases that include development, approval, implementation and

maintenance and requires an administrative support structure to sustain the process (see

Figure 4).

Figure 4 Components of Order Set Life Cycle Process
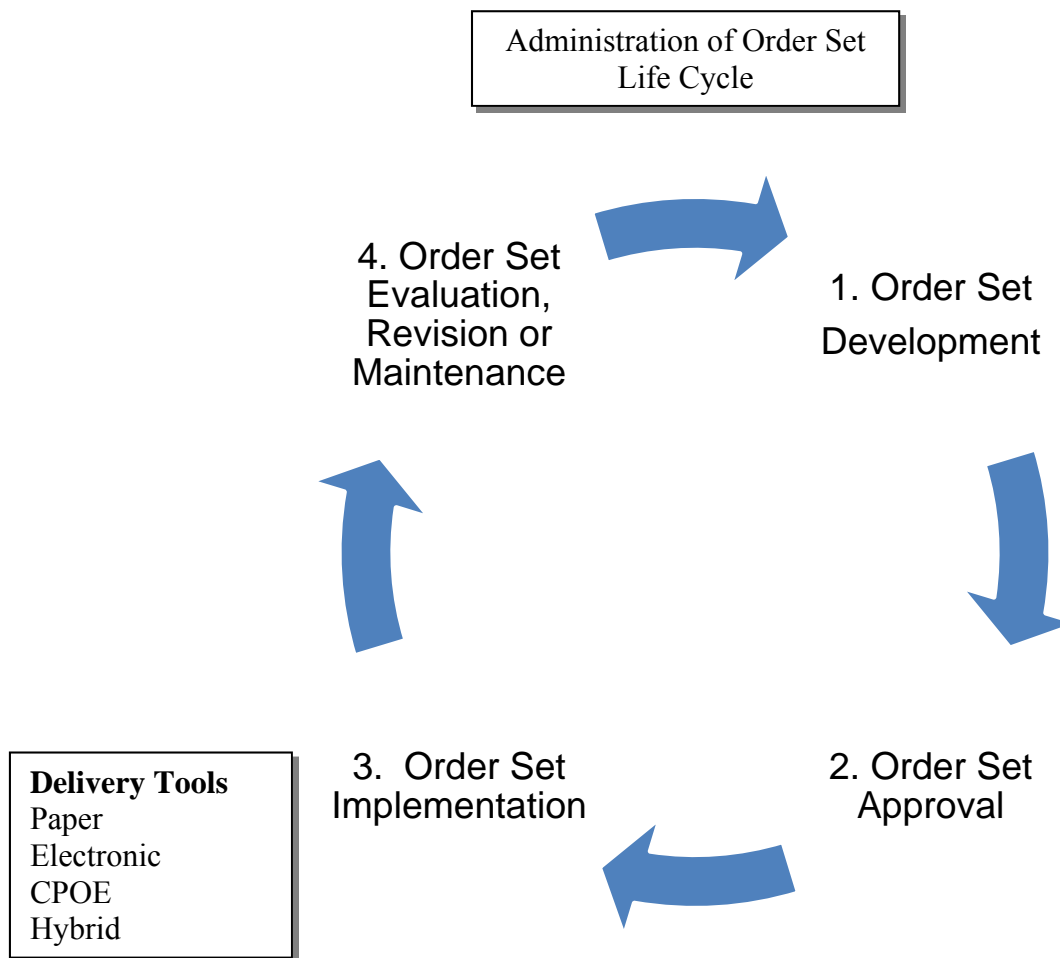
The importance of a single (Maynard, 2009), timely (Fear, 2011; 2007), standardized (Ballard et al., 2008; Maynard, 2009; Meleskie & Eby, 2009) process with a vision for the overall goals (Hagland, 2009) cannot be overstated. Life cycle management challenges were encountered in all phases of the process (see Table 18). These theories

are applied to order set administration as well as each of the four phases of life cycle

management.

Table 18 Organizational Approaches: Life Cycle Management Theme

Theory 50: Life Cycle Ease of Use (a)	Theory 51: Life Cycle Ease of Use (b)
→	←
Organizational life cycle management process facilitates development, approval, implementation and maintenance and revision of order set	Organizational life cycle management process is complex or inefficient and does not facilitate development, approval, implementation and maintenance and revision of order set

Administration: The findings related to the administration of the order set life cycle

identified the need for structure behind the life cycle processes to support users as well as

the prospect of identifying opportunities to manage delivery formats and facilitate

adoption (e.g. managing perceived need by targeting most frequently used order sets).

Challenges associated with life cycle management were identified by interview

participants at Site One, where they expressed awareness of confusion and frustration

with a process that encompassed two separate reporting structures (one for clinical

content and the second electronic development). Site Two was working with streamlined

order set management processes incorporating a single approval body and modular

development standards. One participant (p. #03) noted the "huge difference" as a result of

the changes brought with this new process, citing greater speed and ease of use. Despite

complexities and frustrations reported at Site One, it was interesting to note that one of the interview participants (p. #03) from a high perceived need group (e.g. oncology care provider) indicated surprise that some users found the process complex and confusing. This suggests that perceived need and/or frequency of use may have an impact on perceptions of ease of use.

Phase1 Order Set Development: Standardized organizational principles and format were recommended for the development of order sets (Abramson, 2007; Feldbaum, 2009). The challenges of standardization across multiple locations was also discussed (Maynard, 2009). Variations in formularies, lab test availability, and support services (e.g. inter-professional consultants) can impact local adoption. Consultation was the key to addressing local context (Meleskie & Eby, 2009). Feldbaum (2009) also recommended a policy for conflict resolution.

Delivery format also impacted development components of life cycle management. Participants from Site One identified that the CPOE delivery format added complexity to the process because developers worked with both information management builders and professional practice bodies (e.g. medical advisory committee).

Phase 2 Order Set Approval: It was suggested that approval processes be streamlined (i.e., reduced bureaucracy) to allow for rapid processing and efficient use of resources (Fear, 2011; Meleskie & Eby, 2009). The participants from Site One described complex development and approval processes while Site Two described streamlined minimal processes. One participant from Site One (p. #01) suggested that the size and complexity of the organization necessitated the more complex processes. It was notable that this site

had fewer beds and locations than the organization with the more streamlined process, suggesting that size may not be the primary challenge.

Phase 3 Order Set Implementation: Implementation approaches varied based on delivery formats and phase of the order set in the life cycle management process. Implementation was described with order sets as a single concept or as a component in a larger electronic or CPOE implementation. Alternatively, order sets were already established in one of the delivery formats, and the focus of implementation was narrowed to a single order set within one or multiple settings. Both study sites were in established order set environments (e.g. Site One had implemented CPOE in some areas and Site Two was in the process of implementing electronic order sets).

Phase 4 Order Set Evaluation, Maintenance or Revision: Order set maintenance requires regular review, revision, and quality assurance measures (Heffner et al., 2004). The importance of a supporting infrastructure with updates and quality improvement was noted (Ballard et al., 2008). For this reason, the order set life cycle process must be designed with maintenance in mind (Feldbaum, 2009; Hagland, 2010).

Maintaining order set currency is challenging, necessitating a streamlined process (Abramson, 2007), as was echoed by participants from both study sites.

4.2.6 Behaviorist Approaches

Behaviorist approaches are founded on theories related to conditioning and controlling behavior by use of external stimuli before or after the desired change. Strategies such as providing feedback, giving reminders and providing incentives or sanctions would be employed (Grol & Grimshaw, 1999) (see Table 19).

Table 19 Behaviorist Approaches

Theory 52: Targeted Behaviour can be Achieved with Accountability Strategies in Place	Theory53: Behaviourist Approaches	Theory 54: Behaviourist Approaches but Poor Supports for Change	Theory 55: Behaviourist Approaches Ineffective
Behaviourist approaches provide feedback, accountabilities and/or incentives	Behaviourist approaches are provided and lead to appropriate behaviors or do not lead to appropriate behaviors	Behaviourist approaches provided but supports not in place for change to be implemented	Behaviourist approaches provided but behavior not monitored for impact (e.g., policy implemented but not audited for impact)
Theory 56: Behaviourist Approaches Follow Through			
Effective behaviourist approaches adopted but not followed through (e.g. accountability not enforced nor incentives provided)			

Feedback about order set use provided to the users was proposed to facilitate order set adoption and adherence to processes (Abramson, 2007; Ahmann & Maynard, 2008; Maynard, 2009; Starmer & Waitman, 2006). Ellerbeck et al. (2006) suggested data feedback to users but also noted that this feedback can result in a negative impact if the feedback occurs in absence of systems to support change. Ahmann and Maynard (2008) recommended a focus on audits in early implementation phases to monitor for non-adherence and evaluation of the identified outliers. This was intended to determine if the

variation was specific for an individual or characteristic of a specific group or the whole.

Deviations might be occurring for valid reasons that need to be addressed. A participant

from Site One (p. #05) indicated that the only feedback provided to prescribers was of the

immediate type (e.g. when there were impacts to process because a component of an

order set was incomplete). A participant from Site Two related that there had been some

discussion about the use of behavioural approaches, but the resource intensive component

of chart audits had not seen this initiative move forward.

Behaviorist Approaches Perceived Ease of Use/Usefulness Theme
The perceived need (usefulness) of an order set impacted the perceived ease of use. This

perception of need may also have limited the identified degree of challenges or barriers

associated with the use of those order sets (see Table 20).

Specific prescriber groups were identified with differing perceptions related to the need

for order sets. For example, oncology groups have the need to write very complex sets of

orders to support patient care. The clinical decision support available within order sets, as

well as the inclusiveness of potential content, can facilitate prescribers' perception of

need to complete the ordering process. Prescribers who were providing care in a context

with routine practices and minimal variation of patient outcomes often need to complete

order sets with minimum variation in content (e.g. post-operative knee replacement

orders). Prepared order sets that document this recurring process requirement saved time

and improved provider workload and workflows in turn improving perceptions of ease of

use of an order set.

Table 20 Behaviorist Approaches: Perceived Ease of Use/Usefulness Theme

Theory 57: Targeted Behaviour Achieved with Incentive Strategies in Place (a)	Theory 58: Incentives Impact Perceived Need	Theory 59: Perceived Need Impacts on Perceived Ease of Use/Usefulness Care Complexity	Theory 60: Perceived Need Impacts on Perceived Ease of Use/Usefulness Time Saving
→	→	→	→
Behaviourist approaches provide feedback, accountabilities and/or incentives	Incentive can impact adoption	Managing order complexity can be facilitated with order set use.	Time can be saved with use of order sets e.g. care with minimal variation in clinical outcomes (e.g. routine surgical procedures)
Theory 61: Perceived Need Impacted by Patient Complexity	Theory 62: Perceived Need Impacts on Perceived Ease of Use/Usefulness		
←	→		
Order sets not flexible enough to manage patient complexity (multiple co-morbidities/high risk outcomes)	Modular format facilitates ease of use for patients with multiple co-morbities		

Within other contexts, patient complexity and the limited flexibility of a pre-defined order set made it challenging to complete the ordering process. In attempts to address patient complexity, the application of modular subsets, or orders, to a general admission order set was suggested in order to avoid repeated orders to manage multiple disease-specific needs. For example, a general admission order set could include smoking cessation and adult immunization while modules that address co-morbidities such as hypertension and diabetes could be added. The above findings demonstrate that some

groups can be predicted to have a greater perceived need and also that some strategies

can be used to target this user trait to facilitate order set adoption.

Behaviorist Approaches Perceived Ease of Use/Usefulness Learning Theme

There were also some role-based perspectives impacting perceptions of order set

usefulness and adoption (see Table 21).

Table 21 Behaviorist Approaches: Perceived Ease of Use/Usefulness Learning Theme

Theory 63: Targeted Behaviour Achieved with Incentive Strategies in Place (b)	Theory 64: Perceived Need Impacts Resident Learning (a)	Theory 65: Perceived Need Impacts on Resident Learning (b)
Behaviourist approaches provide feedback, accountabilities and/or incentives	Perceived by residents or inexperienced care providers to support learning	Perceived by experienced users to be an impediment to learning for resident or inexperience users

It was noted in the papers (Asaro et al., 2005) as well as by some participants that order

sets and their content can be viewed as a teaching tool for new and inexperienced care

providers. This view was questioned by some more experienced providers who suggested

that order sets impeded new user learning. The perception of some more experienced

providers was that the "checklist" format did not allow or support the development of

critical thinking for inexperienced clinicians. These conflicting views demonstrate the

variance in priorities for the adoption of order sets. It was stated by one participant (p.

#08) that the first priority of the order set tool was to provide the best quality care. The

use of order sets changes the experience of learning. Order sets can inform evidence-

based practice, but critical thinking still remains essential.

Behaviorist Approaches Perceived Ease of Use/Usefulness Empowerment Theme

Another role-based perspective identified was associated with nurses and allied health

workers. Some nurses and allied health care providers (both experienced and less

experienced) on an individual or group basis were noted to feel empowered by having

some confidence that order sets provided an evidence-based practice standard of care.

They were more likely to engage prescribers in discussion about ordering practices, using

the order sets to leverage their credibility (see Table 22).

Table 22 Behaviorist Approaches: Perceived Ease of Use/Usefulness Empowerment Theme

Theory 66: Targeted Behaviour Achieved with Incentive Strategies in Place (b)	Theory 67: Valid Tool That Facilitates Evidence Based Practice	Theory 68: Nurses and Allied Care Providers Advocate for Prescriber Use
Behaviourist approaches provide feedback, accountabilities and/or incentives	Some nurses and allied care providers feel more empowered to engage prescribers in discussion with order set use and evidence-based practice care	Availability of order sets communicated to new residents and use advocated by care providers

Behaviorist Approaches Perceived Ease of Use/Usefulness Delivery Format Theme

The ease of use of an order set can impact clinician workflow (Maynard, 2009;

Abramson L, 2007). Reingold and Kulstad (2007) advised a simplified delivery format

for paper order sets to improve adoption (e.g. human factor design for development

addressing workflow and cognitive needs) (see Table 23).

Table 23 Behaviorist Approaches: Perceived Ease of Use/Usefulness Delivery Format Theme

Theory 69: Targeted Behaviour achieved with Incentive Strategies in Place (c)	Theory 70: Ease of Use Supports Workflow – Delivery Format (a)	Theory 71: Ease of Use Supports Workflow – Delivery Format (b)
→	→	←
Behaviourist approaches provide feedback, accountabilities and/or incentives	Facilitate evidence-based practice care and time can be saved with the use of order sets.	Order set ease of use is perceived to impede workflow

In relation to process, although paper was not often referred to as the preferred delivery format, there were benefits mentioned both in the literature and by interview participants (see Table 24).

Table 24 Benefits and Challenges of Paper

Paper	
Benefits	**Challenges**
Greater ease of modification for prescribers	Finding order set when needed
Urgent and time sensitive care facilitated with packages of paper that include all of the appropriate order sets, requisitions, and guideline support	Awareness of all order sets available
	Maintaining stock and storage at the front line
	Ability to maintain currency
	Cost of waste when change leads to discarding current stock
	Cost of printing

It was noted in the review papers (Asaro et al., 2005) and by participants that despite challenges the electronic formats were preferred over paper (see Table 25).

Table 25 Benefits and Challenges of Electronic

Electronic	
Benefits	**Challenges**
Despite challenges, electronic formats preferred over paper	Require a computer login and navigation process
Ease and efficiency of managing changes in content	CPOE changes need to wait for database rolls
Patient safety: improved readability and access to decision supports	Not all electronic benefits available in all settings
	Managing hybrid environment during transition to fully electronic environment
	Increased complexity and reduced flexibility
	Alert fatigue

4.2.7 Coercive Approaches

Coercive approaches are intended for use to implement change habits and routines that may be fixed and require external stimulus to achieve change. Pressure and control in the form of policy, financial consequences, or regulation may facilitate the change process based on learning theories and negative consequences. The coercive approach was the least frequently identified but may have been in place without acknowledgement or awareness by the users. For example, policies or accreditation standards that are already in place may be impacting order set adoption by some users (see Table 26).

Table 26 Coercive Approaches

Theory 72: Organizational Policies	Theory 73: Organizational Policies in Place	Theory 74: Organizational Policies Absent	Theory 75: Organizational Policies Enforcement
Exert power and control for user compliance with use	Policies and standards defining order set use are in place	Policies and standards are not in place	Policies and standards are in place but not enforced or are not enforceable

Participants from both sites suggested that coercive approaches were not actually used as drivers for order set use; rather, the focus was on encouragement and social influences.

One participant (p. #15) noted that some prescribers wait until they absolutely must before choosing to participate. In the interim, evidence-based practice committees promote care improvement to achieve a critical mass of users. Other participants noted that there really was no opportunity to use coercive approaches when there were no audit capabilities to identify outliers. Policies are often in place but are primarily related to development and maintenance, not order set use. Accreditation standards may be in place defining evidence-based practice, but as one participant (p. #16) noted, they are difficult to impose in the current physician management model where physicians are not employees of the organization.

4.2.8 Summary

The seven approaches and foundational theories of action identified by Grol and Grimshaw (1999) were applied to the findings of this realist review. Although the approaches can overlap, all findings were sorted to one of the seven approaches. As theory chains were developed, some varied themes within the approaches were also identified. That is to say, although the theme fit within the approach and associated foundational theory, the outcomes of the actions followed a variation in the path along the theory chain. These theme enhancements identified within some of the approaches afforded greater insight to facilitate effective order set adoption.

Epidemiological approaches were directed towards the users (stakeholder engagement) and the order sets (quality of content) that can be a key in addressing the attitudes within the context where the order set(s) is/are being introduced.

Stakeholder engagement was mentioned frequently as a key foundational approach to order set adoption. In some contexts, the engagement may have already taken place

outside of the project or organization and potentially impacted the resource intensity needs for specific contexts. Engagement was also useful in identifying and addressing some of the gaps in evidence-based care practices, impacting attitudes and informing pre-implementation marketing strategies to improve attitudes towards adoption.

The availability of resources at the point of care to demonstrate evidence-based practice quality embedded in order sets was noted to be important. Maintaining the currency of that content was identified as challenging and demonstrated the requirements for sustained monitoring and resource supports.

Educational approaches were also directed to order set users. Focus varied depending on the content of the education (e.g. order set content and purpose versus order set delivery tool skills development) and user characteristics (e.g. some individuals did not have the desire to be engaged in the content, some roles required one on one engagement). Some strategies to enhance user receptiveness to the education were recognized, such as just-in-time education and a one-on-one approach with physicians.

Marketing approaches were directed to users. These approaches also reflected the phase of order set life cycle process (i.e. the message changes related to the phase of the process). Good communication structures that reached the front lines were essential; the most commonly reported barrier to use was lack of awareness. Pre-implementation strategies informed by stakeholder engagement were suggested to be directed at user identification of quality problems, introducing the perceived need for change. Interestingly, it was identified that, while larger contexts required a more extensive marketing strategy, in the pre-implementation and implementation phases the internal

informal infrastructures often meant that sustainability needs were minimized, and the reverse was true in smaller settings.

Social influence approaches demonstrated the need for order set adoption to be addressed at all levels (e.g. departmental, organizational, national) and the potential impacts of formal and informal influences. These informal influences can be harnessed for positive impacts but must also be monitored because they can drive negative outcomes. It was noted that smaller organizations were often more challenged to have identified physician champions and that additional challenges may be encountered with leadership changes (i.e. when new leaders did not support order set processes).

Organizational approaches were focused on creating a context to support adoption. Human, process, and physical resources were deployed to influence adoption, and a lack of resources would negatively influence adoption. One of the interview participants noted that support is often strong during the implementation phase but sustainability of support is often more limited and challenging. A key theme within this approach was the management of the life cycle process as well as the phases within it.

Behaviorist approaches involved the use of external stimuli (e.g. feedback, incentives) to achieve the desired adoption behavior. These approaches incorporated both 'carrot' (perceived ease of use/usefulness) and 'stick' (auditing and feedback) types of actions. Incentives such as the structure of the order set, which can facilitate or impede the clinician workflow, impacted adoption. Perceived ease of use was seen to impact perceptions of usefulness, and usefulness impacted perceived ease of use and incentives for use. Awareness of attitudes related to order sets as a learning tool and/or as a tool to

empower clinicians to engage in evidence-based care discussion was also identified as a potential incentive tool to manage and facilitate adoption.

External stimuli in the form of feedback loops were often limited. It was identified that use of this type of approach early in the process can help identify challenges, support quality improvement, and facilitate adoption. Effective use of this approach often required resource-intensive data collection through manual audits.

Coercive approaches were rarely mentioned, and the term coercive was rejected by some interview participants. When defined in the context of Grol and Grimshaw (1999) as accreditation guidelines, organizational policies or incentives, the concept was reconsidered and acknowledged. Policies for order sets were more often associated with development and maintenance and not directed at adoption.

Some challenges similar to those associated with behaviorist approaches (e.g. audit and feedback capabilities) were discussed as well as the limitations intrinsic in the current management structures (i.e., physicians not employees of the organization).

All approaches and themes identified in the framework contributed to adoption. The demonstrated impact of context on the variability of value highlighted the importance and complexity of context. In addition, the focus of approach evolved to reflect the changes that were/are inherent within a complex adaptive system.

Chapter 5 Discussion and Conclusions

5.1 Discussion

This thesis was undertaken to explore some of the approaches that successfully affect causal relationships encountered in different contexts to achieve order set adoption. This discussion chapter will review the key findings from the review that include the variables of evolving factors to explore and address in the planning, initiation and sustainability of order set adoption; recognition of the complex adaptive environment; the need for a centralized order set management structure; the benefits and challenges of the different delivery formats; and the need for feedback loops to monitor outliers and challenges. The approaches and themes will be reviewed with an emphasis on findings. Conclusions will be provided. A comment on the realist review as a research method will be offered. Limitations and opportunities for future exploration will also be presented.

The identified approaches and themes included the following:

- o Epidemiological approaches
  - Stakeholder engagement theme
  - Quality of content theme
- o Educational approaches
- o Marketing approaches
  - Awareness pre-implementation theme
  - Awareness implementation theme
  - Awareness sustainability theme
- o Social influence approaches
- o Organizational approaches

- Leadership and resource management theme

- Life cycle management theme

- Behaviorist approaches

  - Perceived ease of use and usefulness theme

  - Ease of Use – Learning tool theme

  - Ease of Use – Empowerment theme

  - Ease of Use – Delivery format theme

- Coercive approaches

While all seven approaches are useful in order set adoption, some were less useful and/or dynamic for various reasons. For example, the coercive approach was the least frequently identified and least frequently applied. It was also noted that there are limited supports in place to facilitate effective use of this approach. The educational approach is most important in the context of skills development related to electronic implementations. The social influence approaches have the potential to impact adoption in both positive and negative ways and should be monitored. The four remaining approaches demonstrated broad, foundational and dynamic applications.

The choice of approaches and themes to support order set adoption must be tailored to context. **Context is viewed through three lenses**. The **three phases of order sets** is the first view and incorporates the pre-implementation phase, implementation, and sustainability. Within each of these phases, the second view for contextual assessment would reflect **patient characteristics, user characteristics and order set characteristics**. The third view is a more holistic view that reflects **time passing**.

5.1.1 Key Findings

1. The assessment of context impacts the choice of which approaches and themes of

    action to employ. Each of the three order set phases (pre-implementation,

    implementation, sustainability) will be reviewed. Within each of the phases, patient,

    user, and order set characteristics must be considered. The theories' comprehensive

    details provide for detailed assessment points and consideration. These identified

    variables can then be addressed with approaches and themes that facilitate adoption

    and mitigate risk for project goals.

    Contextual Characteristics

    Patient characteristics can influence order set adoption. Some characteristics such as a

    medical patient with multiple co-morbidities can present challenges to clinician

    workflow when using an order set. Other patient characteristics such as complex

    standardized care needs (e.g. oncology) or high volume routine surgical care needs

    can facilitate clinician workflow when order sets are used. Although patient

    characteristics cannot be manipulated, they must be recognized and leveraged or

    managed.

    User characteristics can also influence order set adoption. Some user roles have been

    identified to be more receptive to order set use than others, and some are supported by

    order set use (e.g. empowerment for nurses and allied health care providers, provision

    of comprehensive prompts for order writers to manage care). Some users are less

    receptive to the use of order sets, citing concerns about impacts to the learning

    environment for order writers. Actions can be directed to users and impact user

    receptiveness to adoption.

Order set characteristics must also be assessed. The quality of content and the ability

of users to verify that content (e.g. references at the point of care) impact users'

decision to adopt order sets. The ease of use of the order set, the usefulness of the

order set, and the ease of development and implementation of order sets impact

adoption. Actions can be directed to order set characteristics to influence order set

users' adoption.

Pre-Implementation

The pre-implementation phase is an opportunity to explore approaches and themes

that can be used to leverage contextual characteristics. The scope of the order set

adoption project was shown to be important to consider when determining effective

approaches. It was strongly demonstrated in the literature and with the interview

participants that the **epidemiological approach** stakeholder engagement theme chain

of theories (theories1, 2, 3, 4, 5, 6, 7) were foundational and target user characteristics

by enhancing awareness (t1) and engagement, which leads to participation and

ownership (t2). Application of this theme becomes increasingly complex as the scope

of the implementation expands with increasing opportunities, where engagement

attempts may be rejected (t3 and t4), or engagement may be accepted but users feel

rejected (t5), or some users may feel overlooked (t6). Awareness of related

engagement at all levels that may have been undertaken by others can also impact the

degree of importance for this theme and the resources needed to support it (t7).

As already identified, the **marketing approaches** pre-implementation theme theory

chain describes potential actions to target user awareness and facilitate adoption (t21,

22, 23, 24, 25, 26, 27). The targeting of patient, user or order set characteristics

known to facilitate implementation could dictate a targeted initial order set implementation (t21 and t22). Alternatively, pre-implementation marketing could be focused on raising awareness of existing gaps in care (e.g. timely awareness of best practice standards at the point of care), influencing a user desire for change (t23 and t24).

Additional insights about user characteristics may have been gained through the stakeholder engagement and have the potential to inform **behaviorist approaches** to facilitate adoption**.** For example, the perceived ease of use/usefulness theme theory chain (t57, 58, 59, 60, 61, 62 and t69, 70, 71) suggests that incentives can impact adoption (t57 and t58). If order sets can facilitate the management of patient complexity or save time (t59 and t60), adoption will be enhanced. If the order sets are not flexible enough to manage patient complexity, perhaps they could be modified to provide incentives for use (t61 and t62). Alternatively, support for the order set delivery format that supports user workflows could provide incentives for use (t69, 70, 71).

Implementation

For the implementation phase, order set characteristics can be leveraged with multiple approaches. From the foundational perspective, the **organizational approach** leadership and resource support theme theory chain (t45, 46, 47, 48, 49) is essential to implementation. If the resources are not made available (t46, 47, 48), that will negatively impact adoption. From a broader perspective of the order set life cycle **organizational approaches** life cycle management theme theory chain (t50, 51), ease of use of the process can impact the availability and sustainability of order sets.

For the individual order set or order set library, the **epidemiological approach** quality of content theme theory chain (t8, 9, 10, 11, 12, 13, 14) is an important approach to demonstrate the order set quality with relevant, broadly accepted references for content (t11,12,13). It is also important to recognize that some users are researchers and may be leading evidence development, impacting user views of best practice (t14).

Marketing approaches implementation theme theory chain (t28, 29, 30, 31, 32) demonstrates the importance of reaching all users (t29) and the use of word of mouth (t30) to facilitate awareness with respected messengers (t31).

The **behaviorist approach** theory chain (t52, 53, 54, 55, 56) can facilitate the implementation phase with feedback for users (t52 and 53) if accountability standards and supports are in place (t54, 55, 56).

Sustainability

The **marketing approach** sustainability theme theory chain (t33, 34, 35, 36, 37, 38) will facilitate management of ongoing user awareness when order set practice changes (t34), when there is staff turnover (t35), or when order sets are used infrequently (t38). It should be recognized that larger units are more likely to have informal structures in place that will facilitate awareness with more limited need for this type of support (t36 and t37).

The **behaviorist approach** theory chain (t52, 53, 54, 55, 56) can also facilitate the sustainability phase with feedback for users (t52 and 53) if the accountability standards and supports have been put in place (t54, 55, 56).

Table 27 below demonstrates the assessment process for planning and choosing

adoption strategies using the phase of order set and contextual characteristics.

Beginning assessment on the left, you will determine the phase of the order set. If you

are exploring pre-implementation, you will see on the extreme right of the table that

there are three potential types of approaches that might best support this phase. You

might engage one or all of them. The focus or choice of approaches may vary

depending on the middle column.

Table 27 Assessment of Two Perspectives

Phase of Order Set	Contextual Characteristics	Interventions to Consider
Assessment moves from left to right		
Pre Implementation	Patient Characteristics	Epidemiological Marketing Behaviorist
Implementation	Order Set Characteristics	Organizational Epidemiological Marketing Behaviorist
Sustainability	User Characteristics	Marketing Behaviorist

For example, through the review process, it has been identified that patient

characteristics such as complex care needs have the potential to impact adoption.

However, complex care needs might be related to cancer care, where users rely on

order sets to support the complex decision-making needed to provide best practice care.

 By adding this lens or perspective to the decision making, the potential interventions

would be different. For example, pre-implementation marketing would need limited

consideration if the patient complexity is due to cancer care needs because research

shows that users find that order sets support the complex decision-making required to
manage care in this area. More resources may be needed to support a marketing
strategy directed at the complex care needs for a patient with multiple co-morbidities.
Marketing might begin with strategies that would drive order set users to identify
potential gaps in care for this population and enhance awareness of how an order set
might support those gaps.

The graphic, or gears, in Figure 5 below demonstrate the interaction between these
components. That is to say, appropriate assessment is required for the intervention gear
to effect change.

Figure 5 Assessment Two Perspectives
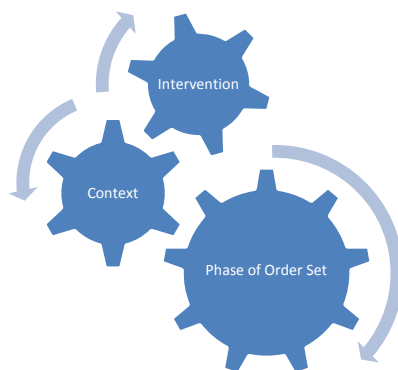
2. An additional challenge is presented by the complex adaptive environment of the
   clinical setting and the need for ongoing reassessment and adoption of approaches. The
   context is constantly changing; there are staff changes, champion changes, and
   competing resource initiatives. Evidence is constantly evolving with new and better
   practice recommendations. Changes may occur in the context that are unrelated to the
   order sets but may still have significant impacts on order set goals. Goals may be
   reached but new elements in the context can reverse those successes. The approaches

and themes employed towards order set adoption produce additional complexity and can result in intended or unintended positive or negative consequences. If the consequences are positive, these new insights may need to be shared. If the unintended outcomes are negative, then interventions may be required to reinforce goals. In addition, with the passing of time, the phases of the order set adoption life cycle changes and action needs are altered as well. Even the phases of the life cycle are dynamic within themselves. This necessitates the third and holistic view of context that is **time passing**.

The approaches and themes theory chains can be used to facilitate understanding and identify the source of negative outcomes in certain settings when other settings have experienced positive outcomes or when outcomes were positive but transition to negative. The theories that were identified by the interview participants may be most helpful; some examples are the **marketing approach** sustainability theme theories recognizing changes in the target audience (e.g. due to staff turnover) (t35and t36) or certain order sets not being used frequently enough for users to recall resource availability when the opportunity for use arises (t38). Within the **social influence approaches**, the interview participants identified that smaller settings within the organization are less likely to have champions in place and that changes in formal and informal leaders can bring new or conflicting attitudes (t43 and t44). The **organizational approach** leadership and resource support theme theories identify that limitations in resources may impact some areas more than others or that recognition for resources was higher during implementation phases (t48 and t49). The **behaviorist** approach perceived ease of use/usefulness learning themes may be impacted by conflict related to use of order sets for new learners (t65). Assessment of context is ongoing.

Failure to monitor actions and behavior outcomes can result in missed opportunities to

facilitate goal achievement. Identification of outliers could be effectively achieved by

ongoing assessment of context and implementation of insightful actions.

In Figure 6 below, the gears of the first two perspectives or lenses of assessment have

been inserted into the centre of the circle of arrows that are intended to represent the

third lens and the constant evolution of context as time passes.

The review has demonstrated intended and unintended consequences of interventions in

the context where they have been employed. Changes in context may be unrelated to

order sets. For example, new staff may be unaware or new leadership may disagree.

The order sets themselves transition through phases. For example, an order set may no

longer reflect current practice and require maintenance.

An example from the review is the finding that clinical contexts that are smaller have

more limited structures in place to support communication with staff turnovers so,

although the smaller groups are easier to initiate, they are more likely to require an

ongoing marketing strategy to support staff awareness as time passes and staff turns

over.

Figure 6 Assessment Loop

Context Assessed/
Reasssessed

Approaches,
Themes,
Implemented/Re-
implemented/
Modified

Intervention

Context

Phase of Order Set

Context changes
due to unrelated
contextual
elements

Context changes
as a result of
intended and
unintended
consequences

Arrows indicate time passing
through phases of the
Assessment Loop

Context changes
with passing of
time
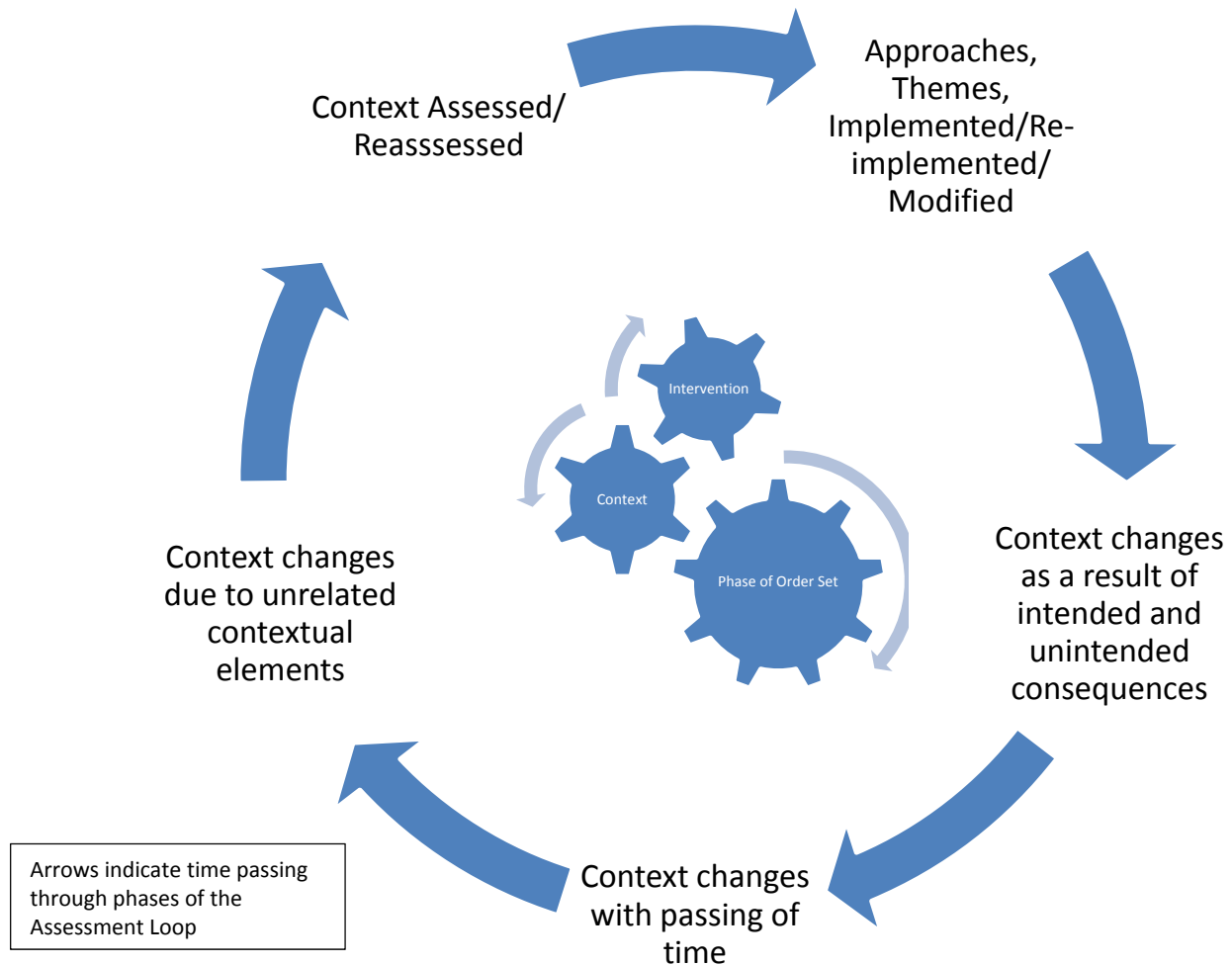
3. Organizations should strive to reduce barriers and confusion around all stages of the

order set life cycle to support adoption and facilitate expansion. **Organizational**

approaches life cycle management theme ease of use theories (t50 and t51) were

identified in the literature, and impacts were clarified with the interview participants,

where one organization had initiated a more centralized and streamlined process and the other had not.

Life cycle management should be centralized, with clearly defined and streamlined processes to support each of the four phases. A management structure is needed to define goals, oversee the process, and effectively manage resources. Vendor solutions that offer access to evidence-based order sets are available. These order sets require due diligence review for each organization but would eliminate the need to start at the beginning for each order set (i.e. duplicate work across multiple organizations). The participant interview organization using a centralized streamlined process employed a vendor solution identified as an order set collaborative that offered evidence-based order sets, sharing of member order sets, and a template for order set life cycle management. These solutions have the potential to save resources and improve adoption.

4. **Behaviorist approach** ease of use delivery format themes (t69, 70, 71) demonstrated that the various order set delivery formats (paper, electronic, CPOE) each present benefits and challenges to adoption. It was clear from interview participants that one of the bigger challenges is the processes needed to support hybrid environments. The hybrid environment is often a component of the transition to one of the electronic formats. The significant impact of electronic implementation on clinician workflow and the likelihood of an interim hybrid environment suggest the importance of introducing order sets prior to this type of intervention and the importance of awareness of resource needs to support this complex stage of transition.

5. **Behaviorist approach** theories (t 52, 53, 54, 55, 56) and coercive approach (t75) distinguish that monitoring and employment of feedback loops is resource intensive, and it was noted to be a challenge by interview participants. Identification of variation in adoption rates provides prospects to address unanticipated challenges such as the need for order set revision, education, process management or behavior management. To achieve long term goals for order set adoption, this review suggests that an important recommendation for software builders and developers is the need for user-friendly tools to audit order set use. These tools will be critical to manage quality improvement and achieve goals for evidence-based practice care.

5.1.2 Approaches and Themes

The use of the theoretical framework of approaches allowed for a systematic review of findings interpreted through an action perspective. The seven approaches, and the identified themes within them, categorized the focus of actions that may be applied to achieve order set adoption. The actions of the approaches were directed to order set patient characteristics, user characteristics, order set characteristics, and other order set contexts (i.e. scope, phase, passing time), with each contributing and providing value in unique ways. The identified themes within the approaches contributed in a similar manner to the main approach but with a more distinctive focus.

Four of the approaches demonstrated broader utility. These approaches were also more frequently mentioned in the literature that was rated of higher quality. Some approaches and themes were only identified by interview participants. The identification of these additional approaches and themes will provide administrators and policymakers with

greater insight into outcomes as well as additional opportunities to potentially identify and manage risks.

The examination of the approaches and themes demonstrated the multiple contexts for consideration. For example, the pre-implementation phase requires different actions and supports than the sustainability phase (e.g. marketing approaches and themes). The breadth of the order set context also requires consideration. An administrator overseeing an order set strategy at the organizational level must consider the unit and departmental context as well as the different organizational contexts. For example, the approaches and themes suggested that smaller facilities within the multi-location organizations could be less likely to have an on-site champion (social influence approaches).

To make effective use of the identified approaches, the three views of context must be assessed and monitored. Based on this assessment, some of the various approaches can be implemented (some of them pre-emptively). Implementation in the complex social system necessitates regular and ongoing cycles of contextual assessment and implementation, re-implementation, or revision of approaches, as shown in Figure 5.

5.2 Conclusions

Achieving order set adoption in the complex adaptive system of the hospital setting is challenging. This review identifies that adoption is a living process that requires central administration and on-going monitoring. This will support effective and efficient management of resources to achieve and sustain defined goals. All of the approaches and themes to support adoption can be effective tools for order set adoption and quality improvement.

The phase of order set life cycle, patient, user and order set characteristics must be regularly assessed and reviewed to determine effective use of resources within each context. Adjustments of actions with use of the described theory chains to achieve adoption are needed to meet the constantly changing contextual requirements.

Order set development is a resource-intensive component of the process that can be supported with the use of vendor software solutions, with vendors offering evidence-based order sets. The order set collaborative described by interview respondents offered evidence-based order sets and order set sharing and also supported the development of a streamlined (reduced bureaucracy) and centralized administrative process that afforded support for users to enhance adoption.

Technology can offer some enhancements in the form of delivery tools but at the same time introduces new and complex challenges for development and implementation. Electronic tools are the preferred delivery format for order sets, but current software limitations create challenges at the point of care where users function with a hybrid delivery format.

Ongoing software development is needed to improve delivery formats as well as incorporate effective tools to allow for continuous quality improvement supports. As technology matures, developers must strive to incorporate tools that facilitate resource-intensive challenges in managing and sustaining feedback loops to achieve needed quality improvement and sustainability strategies.

5.3 Strengths of the Study

The main strength of the study is the interpretive focus in examining the research question. Summative reviews provide insights into what works, but the realist review

approach examines what works, when it works, or why an intervention works. The insights of summative studies are essential to managers and policymakers, but the contextual details provided from the broader focus are important as well.

5.4 Realist Review

The aim of this review was to explore the mechanisms of action that support, contradict or modify the identified theories behind order set adoption and determine more refined theories of some of the causal relationships encountered. In pursuit of this goal, the realist review methodology was employed. The benefits of employing this method were reinforced in the data collection process that demonstrated variations in order set adoption despite similarities of approaches and challenges to disentangle the effects of actions from contexts (Bero et al., 1998; Grol, 2001).

Although the realist review methodology demonstrated value in addressing this research question, not all components of the review proved equally useful. All of the papers in the review were assessed for quality using the Ammenwerth Assessment Tool (Ammenwerth et al., 2003), though this assessment did not ultimately have a meaningful impact on findings (see Appendix N), as indicated by Pawson et al. (2004). The Ammenwerth Assessment Tool assesses the quality of the research process. Data collected from the paper may have been descriptive content related to the actions applied towards order set adoption and not the results of the research process. The assessment of the paper based on the quality of research method criteria did not necessarily assess the quality of this data.

However, the quality assessment did demonstrate consistency with the findings of this review that the four primary approaches discussed have broad and foundational use.

These approaches were discussed in the literature of better quality as well as mentioned more frequently through all three levels of the quality-rated literature.

An additional strength of the realist review methodology is demonstrated in Appendix N. Although the interview participants informed and indicated agreement with all of the theory chains developed, some of the themes and associated chain of theories were identified only through participant interviews (i.e. not identified in the literature review), resulting in more comprehensive review findings.

5.5 Limitations of the Study

There are several important limitations of the study to be acknowledged. First, the single reviewer limits assessment of the depth of objectivity of the findings. Second, the snowball sampling approach used for study participant recruiting has the potential to result in bias. Additionally, although all participants engaged in both pre and post-interviews, the target of 10 participants from each organization was not achieved.

5.6 Future Work

This work is foundational to identify factors important to success for order set adoption as organizations transition to the electronic format. Comprehensive exploration of the individual action approaches as they occur within varied contexts could support project managers, administrators, and policy development at all levels. Further insights may be gained from knowledge development in the areas of educational impacts of order sets for learners, their overall impact on care, contexts best suited for order set support, best processes/structures for order sets, and/or roles in supporting patient and family-centered inter-professional care.

Further work is also needed to facilitate the implementation of current findings. Results could potentially be shared through peer-reviewed publications and conference presentations. Knowledge transfer could also be supported with the development of assessment support tools and/or decision trees to assist managers with successful order set implementation and effective use of resources.

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Appendix A Definitions

Clinical Decision Support (CDS)

Clinical Decision Support Systems are "active knowledge systems which use two or more items of patient data to generate case-specific advice" (Wyatt & Spiegelhalter, 1991).

Clinical Guidelines or Clinical Protocols

The standard definition of clinical practice guidelines (CPGs) is that of "systematically developed statements to assist practitioners and patient decisions about appropriate health care for specific circumstances" (Field & Lohr, 1990)

Clinical Pathways

Clinical Pathways are structured, inter-professional plans of care designed to support the implementation of clinical guidelines. They provide detailed guidance for each stage in the management of a patient's care over a given time period and include progress and outcomes details. Synonyms: Integrated Care Pathways, Multidisciplinary Pathways of Care, Pathways of Care, Care Maps, Collaborative Care Pathways (Benson, 2005).

Complex Adaptive Social System

Complex Adaptive Social Systems include people with freedom to act in ways that are not always predictable. Their actions are interconnected in such a way that change for one individual changes the system as a whole (Minai, Braha, & Bar-Yam, 2010).

Complex Intervention

Complex interventions are built up from a number of components, which may act both independently and interdependently. The components usually include behaviors, parameters of behaviors (e.g. frequency, timing), and methods of organizing and delivering those behaviors. (May, Mair, Dowrick, & Finch, 2007).

Computerized Provider Order Entry (CPOE)

Computerized Provider Order Entry (CPOE) (also sometimes referred to as Computerized Physician Order Entry) refers to any system in which clinicians directly enter medication orders (and, increasingly, diagnostics and procedures) into a computer system, which then transmits the order directly to the pharmacy.

Corollary Orders

Corollary Orders are related to order sets. They are orders triggered as a consequence of another order. For example, frequent coagulation testing is required for patients receiving warfarin (Coumadin ®) (Hirsh, Dalen, & Guyatt, 2001).

Evidence Based Practice (EBP)

EBP is explicit and judicious use of current best evidence in making decisions about the care of the individual patient by integrating individual clinical expertise with the best available external clinical evidence from systematic research (Sackett, Rosenburg, Muir Gray, Haynes & Rishcardson, 1996)

Order Set Collaborative

An order set collaborative is a membership-based order set vendor solution that enables healthcare organizations to work with and share order sets with other healthcare organizations. The vendor also offers support and tools to plan and implement organizational order set projects. (PatientOrderSets, 2013)

Appendix B
Sample Standardized Order Set

Emergency Department (ED) High Risk Transient Ischemic Attack Post-Diagnosis Confirmation Order Set (Adult)	

Consults:

☐ Neurology (*for patients with less than 50% stenosis and has high-risk clinical features and fax referral to Stroke Prevention Clinic, SPC, 613-548-2537*)

☐ Vascular Surgery (*for patients to be seen in ED with greater than 50% stenosis in the internal carotid artery*)

Diagnostic Imaging

☐ Echocardiogram (*if specifically indicated in ED*)

Anticoagulation
For patients with atrial fibrillation and no contraindications

☐ Dabigatran 150 mg PO bid (*in patients under 75 years of age*) (*limited use code 431*)

☐ Dabigatran 110 mg PO bid (*in patients over 75 years of age or older*) (*limited use code 431*)

☐ Warfarin 5 mg PO daily

Antiplatelets
For patients in whom anticoagulation is not indicated

☐ Enteric coated acetylsalicylic acid 160 mg PO once in ED
THEN Enteric coated acetylsalicylic acid 81 mg PO daily

OR

☐ Clopidogrel 300 mg PO once in ED
THEN Clopidogrel 75 mg PO daily (*limited use code 411*)

OR

☐ Dipyridamole XR 200 mg / acetylsalicylic acid 25 mg 1 capsule PO bid (*limited use code 349*)

OR

☐ Enteric coated acetylsalicylic acid 160 mg PO once in ED
THEN Enteric coated acetylsalicylic acid 81 mg PO daily
AND Clopidogrel 300 mg PO once in ED
THEN Clopidogrel 75 mg PO daily (*limited use code 411*)

Pharmacy Use Only:

Reviewed by: ____

Entered by: ____

Checked by: ____

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(Kingston General Hospital, 2012)

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Appendix C Excerpt Care Pathway Stroke Prevention Clinic

This Collaborative Care Plan is intended as a guide only. Each patient is an individual and treatment may be modified according to the individual patient's needs and the particular circumstances.

Inclusion Criteria:
- Definite or suspected TIA
- Stroke

Exclusion Criteria:
- TIA diagnosis has been ruled out & appropriate follow-up arranged.
- Diagnosis, management, and /or follow-up for cerebral aneurysm, subarachnoid hemorrhage, AV malformation, subdural hemorrhage, traumatic intracranial hemorrhage
- (Patients will be followed in Neurosurgery and /or Cerebrovascular Disease (CVD) clinics)

Classification	High Likelihood of Stroke/TIA	Low Likelihood of Stroke/TIA
Definition	Patients who present **within 7 days of sudden onset:** • unilateral motor weakness, and/or • unilateral **profound** paresthesia/anesthesia, and/or • amaurosis fugax or hemianopia, and/or • speech or language difficulties have a high risk of recurrent stroke/TIA. High risk symptoms typically are **sudden in onset and reach peak severity within a few seconds**. It is unusual for the *first stroke/TIA symptom* to take more than 10 minutes to evolve fully.	Low risk symptoms include: • isolated dizziness or vertigo with no lateropulsion and no other deficit, • vague sensory disturbance with no other lateralizing deficit, • confusion or memory impairment. It is useful to ascertain the **evolution** of the symptoms. Low risk symptoms may be acute or sudden in onset, but typically take **more than 10 minutes to reach peak severity.** Low risk symptoms may also migrate (e.g. patchy numbness which moves over the course of a few minutes) or fluctuate rapidly.

(Heart and Stroke Foundation of Ontario, (2012).

Appendix D
Relevance Assessment Tool

Relevance	Notes
Does the paper contribute to the scope of the synthesis? Do the theories fit with the developing explanations?	
If not is a re-examination of the review question required? (Following the logic of analytic induction the working hypotheses driving the review may need to be adjusted for scope.)	

Appendix E Quality and Validity Assessment Tool

Quality and Validity Assessment

Author(s)

Document Title

Document Type: Research, Quantitative; Research Qualitative; Systematic Review; Viewpoint; White Paper; Gray Literature

Publication Date

Theoretical Framework:

    Qualitative Research: Ethnography, Phenomenology, Grounded Theory, Participatory Action Research,

    Other_____

    Quantitative Research

Relevant Theory Addressed: 1. _____
                           2. _____
                           3. _____

Methodological Soundness

What are the inferences made in the primary literature?

General Criteria	-	-/+	+	Notes
Do the authors have a prior track				

General Criteria	-	-/+	+	Notes
record or reputation in research on this topic?				
Is the number of the authors adequate for the content of the paper?				
Is the journal in which the paper has been published a peer-reviewed journal with expertise in paper's topic				
Are the institutions funding the research, and other contributors, credited?				
Are any potential conflicts of interests indicated?				
Background and Motivation				
Is the relevance of the paper made clear?				
Is the motivation of the work in context with previous research?				

Purpose of the Paper	-	-/+	+	Notes
Are the aims of the paper and the research questions presented clearly and unambiguously?				
Do the aims of the research questions make sense in the context of the given topic?				

Method and Approach	-	-/+	+	Notes
Is the chosen method and approach presented clearly and unambiguously?				
Is the given information sufficient to reproduce the method or approach?				
Is the chosen method and approach placed in context with other possible methods and approaches?				

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Method and Approach	-	-/+	+	Notes
Is it explained why this specific method and approach was chosen over others?				
Is the method and approach suited to answer the research questions?				

Presentation of Results	-	-/+	+	Notes
Are the results presented clearly and unambiguously?				
Is it clear how, and from where the results have been derived?				
Are objective results and subjective interpretations distinguished clearly?				
Do the results answer the initial research questions?				

Discussion	-	-/+	+	Notes
Is the discussion been formulated clearly and unambiguously?				
Are facts, conclusions and opinions been separated clearly?				
Are own results critically assessed?				
Have negative data or apparently contradictory results been discussed or explained?				
Have the limitations of the method and results been discussed?				
Are the results discussed in the context of other recent research?				
Is the significance of the results discussed?				
Has the generalization of the results been discussed?				

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Conclusion	-	-/+	+	Notes
Does the conclusion contain a short statement of findings and conclusions?				
Can the conclusions really be derived from the presented results?				
Have new and important aspects of the work been emphasized?				
Are the implications for future research discussed?				

Additional Criteria for Specific Types of Papers

Additional Criteria for Empirical Investigations	-	-/+	+	Notes
Is the chosen study design clear?				
Is the chosen study design adequate to answer the study questions?				
Is the sampling strategy clear and appropriate?				
Is the control group clear and appropriate?				
Is the intervention clear?				
Are the outcome measures clear and appropriate?				
Is the intervention clear?				
Are the outcome measures clear and appropriate?				
Are data collection and analysis methods clear?				
Are data collection and analysis methods adequate?				
Have sufficient amounts of raw data been presented?				
Can the study be repeated based on the given facts?				

Additional Criteria for Qualitative Research Articles	-	-/+	+	Notes
Is the theoretical framework clear and appropriate?				
Are the methods of fieldwork clear and appropriate?				
Is the sampling strategy clear and appropriate?				
Are the qualitative data collection and analysis methods clear and appropriate?				
Is original raw data sufficiently presented?				
Is the reliability and validity of the results sufficiently addressed?				
Is discussed whether the results can be generalized?				

Additional Criteria for Methodological Articles	-	-/+	+	Notes
Is it clear why a new methodology (model, framework, technique) is necessary?				
Is the development and formulation of the new method clear and reproducible?				
Are mathematical formulas adequately explained?				
Can other researchers, based on the particular paper, reuse the methods?				
Has the method been validated in a real application?				

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Additional Criteria for Application Reports	-	-/+	+	Notes
Have the objectives of the system (technical system, application, procedure) been made clear?				
Is it clear which problem the system should solve?				
Have the overall architecture and the user functions of the system been presented in sufficient detail?				
Is the environment in which the system is being developed or tested addressed in sufficient detail?				
Has the system been used in a realistic (clinical) environment?				
Have the experiences and effects of the system been derived in a systematic way?				
Have performances and utilization measures been presented?				
Have the effects been compared with the initial design objectives of the system?				
Is the application or approach still being used in routine?				

Additional Criteria for Systematic Reviews	-	-/+	+	Notes
Is the area of review clearly defined?				
Has locating, selecting and extracting papers for review been defined clearly and reproducibly?				
Are the included papers current?				
Is the review based on a careful, international and longitudinal analysis of the available literature				

Additional Criteria for Systematic Reviews	-	-/+	+	Notes
Does the review possess adequate depth and diversity?				
Have interesting conclusions and perspectives been presented and discussed?				
Is the discussion of different findings well-balanced?				

Additional Criteria for Seminal and Viewpoint Papers	-	-/+	+	Notes
Is the paper based on long-term theoretical and practical experiences in a given area?				
Do the authors have a clear thesis or opinion?				
Are the presented opinions reasonable and interesting to others?				
Is it clear how the paper relates to prior research?				
Are the facts presented correctly?				
Does the article promote discussion and present initiatives?				

Qualitative Assessment

Additional Criteria for Quantitative Papers (Garg et al., 2005)
Method of Allocation to Study Groups *(Random 2: Quasi-random 1: Selected Concurrent Controls 0)* Unit of Allocation *(Cluster 2: Physician 1: Patient 0)*

Presence of baseline differences between groups that were potentially linked to study outcomes *[Observational Studies] (no differences or stat adjustments 2: differences present and no stat adjustment 1: not reported 0)*
Objectivity of Outcome (Objective or subjective with blinded assessment
2: subjective with no blinding but clearly defined assessment criteria 1: subjective with no blinding and poorly defined 0)
Completeness of Follow up for the appropriate unit of analysis
 (>90% 2: 80-90% 1: <80% 0)

Score Total

Adapted from *Developing and evaluating criteria to help reviewers of biomedical informatics manuscripts* (Ammenwerth et al., 2003)

Appendix F
Data Abstraction Tool

Title/Author(s)
Literature Type
Quality
Objective
Context
Interventions
Findings

Appendix G
Semi-Structured Interviews

Draft Pre Review Questions (Clinicians)   **Date:** _____

Subject Number: _____   **Organization: A   B**

Role: Physician   Nurse   Pharmacist   Other

1. How are order sets viewed (attitude) by you and your colleagues?

2. Does this attitude vary by professional groups?
   a. Individuals?
   b. Order Set (e.g. admission order sets versus preventative care order sets)?
   c. Order Set delivery format (e.g. paper versus CPOE)?

3. What is the order set delivery format in your organization?

4. Do you have experience with different order set deliver formats (e.g. paper versus CPOE)?
   a. What was the different order set delivery format?
   b. Was that different experience with in your current organization?
   c. If not, what type of organization was it (e.g. tertiary, community etc.)?

5. Do you have a preferred order set delivery format?

6. What are some of the process challenges that you associate with order set adoption?

7. What factors do you feel might enhance order set adoption?

8. What, in your experience, have been the most effective interventions to support and enhance order set adoption?

9. Do you know other nurses, physicians, pharmacists or administrators in your organization that might take a few minutes to participate in this study?
   a. Name
   b. Role
   c. Contact info

Thank you for your time and participation

Draft Pre-Review Questions (Administrators)

Date: _____   **Subject Number:** _____   **Organization: A   B**

1. What number of order sets are available for use in your institution?

2. Are your order sets well used and what does that mean in your organization?

3. How are order sets viewed (attitude) by you and your clinicians?

4. Does this attitude vary by professional groups?
    a. Individuals?
    b. Order Set (e.g. admission order sets versus preventative care order sets)?
    c. Order Set delivery format (e.g. paper versus CPOE)?

5. What is the order set delivery format in your organization?

6. Do you have experience with different order set delivery formats (e.g. paper versus CPOE)?

7. Do you have a preferred order set delivery format?
    a. What was the different order set delivery format?
    b. Was that different experience with in your current organization?
    c. If not, what type of organization was it (e.g. tertiary, community etc.)?

8. Do you have a preferred order set delivery format?

9. What are some of the process challenges that you associate with order set adoption?

10. What factors do you feel might enhance order set adoption?

11. What, in your experience, have been the most effective interventions to support and enhance order set adoption?

12. Do you know other nurses, physicians, pharmacists or administrators in your organization that might take a few minutes to participate in this study?
    a. Name
    b. Role
    c. Contact info

Thank you for your time and participation

Appendix H
Overview of Approaches and Themes Follow-up Interview
(Approaches and Themes often parallel or overlap)

1. Epidemiological approaches - decision making is by cognitive choice
    a. Stakeholder engagement - leads to awareness, participation and feelings of ownership
    b. Tool validity - Quality of content

2. Educational approaches – Individuals have an intrinsic desire/motivation to grow and expand professional competence

3. Marketing approaches – Awareness and understanding will lead to use
    Communication
    Product or service of interest
    a. Awareness pre-implementation
    b. Awareness implementation
    c. Awareness sustainability

4. Social influence approaches – Learning and changing is achieved as a result of interaction in social networks

5. Organizational approaches – Resource Support
    a. Leadership and resource support
    b. Life cycle management

6. Behaviorist approaches – Targeted behavior can be achieved with accountability strategies in place
    a. Perceived ease of use and usefulness
    b. Ease of Use – Learning tool
    c. Ease of Use – Empowerment
    d. Ease of Use – Delivery format

7. Coercive approaches – Excerpt power and control for user compliance with use

Appendix I Literature General Data Extraction

Papers Quantitative

Author /Date Quality Assessment Score	Participant and Sample Size	Design and Intervention used if present	Outcome/Statistical Analysis	Findings

Fleming, NS. Ogola, G. Ballard, DJ. (2009)
 	
9
	Leased, affiliate and short stay hospitals
	
	Electronic format via physician portal as well as CPOE at 1 site
	
	Patients *n*=4,454
		Retrospective Audit
		
		Impact of standardized order sets for adult pneumonia
			- Following risk adjustment, difference in core measures compliance retained:
			  - relative risk 95% confidence interval (C.I.) 1.08 [1.03, 1.12]
			  - in hospital mortality and 30 day mortality reductions both approached significance (hazard ratios [95% C.I.] of 0.73 [0.51, 1.02] and 0.79 [0.62, 1.00], respectively
			- Mean (standard error) benefits of order set use in in-hospital mortality and costs were estimated at 1.67 (0.62) % and $383 (207).
			- Incremental cost effectiveness ration point estimate was $22,882 per life saved
			- Order set use varied significantly by month *(p<.001)*: use increased from 35% I March 2006 to 76% in August 2008-
				Significant variations in use between hospitals
				
				No significant variation in order set use by age, sex or race
				
				Unadjusted analysis -significant reduction in in-hospital mortality, 30 day mortality and direct cost

Ballard, DJ. Ogola, G. Fleming, NS, Heck, D. Gunderson, J. Mehta, R. Khetan, R. Kerr, JD. (2008)
 	
7
	Integrated healthcare system in northern Texas
	
	Electronic Order Sets
	
	Patients *n*=3,301
		18 month retrospective audit
		
		Examine order set use by: hospital, discharge month, severity of illness, risk of mortality for pneumonia
			- Significant association between order set use and:
			  o APR DRG severity of illness (*p<0.01*)
			  o APR DRG risk of mortality (*p<0.01*)
			- No significant association seen using the Greenfield co-morbidity score (*p=0.42*)
			- For first pneumonia admissions between Mar 06 and Sept 07 comparison of use for:
			  - standardized order set 27% to 82% (*p<0.01*);
			  - no order set use 51% to 18%
			  - personal order set use 22% to 0%
				Order set use increased 55% over 19 months
				
				Sicker patients were less likely to receive order set

Author /Date Quality Assessment Score	Participant and Sample Size	Design and Intervention used if present	Outcome/Statistical Analysis	Findings
			- Despite system wide promotion variation in use across organizations range from 43% to 91% ($p<0.01$) - Significant variation in order set use by age ($p=0.01$) but not sex or race	
Munasinghe, RL. Arsene, C. Abraham, TK. Zidan, M. Siddiqui, M. (2011) 7	404 bed hospital CPOE Implementation	Pre Post Time Series Study Introducing modular sub sets of orders	- The number of electronic order sets used each month increased from 349 in July 2008 to 1711 in October 2009 - Number of new nested medicine admission order sets increased from 74 per month to 1476 per month during this period ($p=0.023$)	Integration of disease specific order subset into single general admission order set significantly improved overall adoption
McAlearney, AS. Chisolm, D. Veneris, S. Rich, D. Kelleher, K. (2006) 7	328 bed children's hospital CPOE Delivery Format	Retrospective Chart Audit CPOE Delivery Format	- When order set was used significant number of orders -within the set used as well as across a number of order types - Uses most always included orders for medications; nursing; diet and activity - Trends in order set utilization also varied by condition: only the asthma order set - Unlike demographic characteristics patients clinical conditions were strongly associated with physicians decisions to use order sets - Cases of asthma and appendectomy admissions to units that admit large numbers of patients with that given condition were more likely to result in order set utilization; informal conversation suggest that this association may be driven by the attending physicians on the units who serve as strong proponents for use.	
Ali, NA. Mekhjian, HS. Kuehn, PL. Bentley, TD. Kumar, R. Ferketich, AK. Hoffmann, SP. (2005)	Academic Critical Care Unit CPOE Pre $n=36$ Post $n=55$	Retrospective Pre Post Review modified vendor based system	- Significant increase in the amount of patient care delivered though revised orders - Vasoactive and sedation volume of orders statistical significant decrease ($p< .01$) when adjusted for length of stay for duration of drug	System modifications improved workflow and efficiency

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Author /Date Quality Assessment Score	Participant and Sample Size	Design and Intervention used if present	Outcome/Statistical Analysis	Findings
6			use - Significant difference in order volume per patient favouring increased efficiency post (*p*<..01) - Length of Stay - no significant difference possibly indicating patients of similar states of illness	
Khajouei, K.. Peek, N. Wierenga, PC. Kersten, MJ. Jaspers, MW. (2010) 6	18 bed oncology unit in academic medical center CPOE Trial Physicians *n*=10	CPOE Trial Scenario	- Mouse clicks and keystrokes varied from physician to physician ranging from 16 to 72 (median 26) in ordering with predefined order sets, whereas in ordering without order sets it ranged from 98 to 416 (median 161). - The excess number of keystrokes was significantly lower in ordering with predefined order sets (*p*<0.01).	There were not significant differences in the average number of mouse clicks and keystrokes between the two groups of participants (*p*>0.05)
Cheekati, V. Osburne, RC. Jameson, KA. Cook, CB. (2009) 6	460 bed teaching hospital Physicians *n*=66 Response rate 77%	Perceptions of resident physicians about management of inpatient hyperglycemia Survey Published Tool (Mayo Clinic Inpatient Diabetes Attitude Survey)	- 54% were not at all familiar with insulin pump orders - 23% unaware of policy - 17% somewhat familiar - 6 % were very familiar	Lack of knowledge about insulin treatment was most commonly cited barrier. First steps to and standardizing may be to make certain clinicians are familiar with policies that in place.
Asaro, PV. Sheldahl, AL. Char, DM. (2005) 5	Emergency Department of a University Hospital Residents *n*=51 Attending *n*=30 Survey Response Rates Pre ED Residents 35%	Use of available CPOE functionality in a commercial emergency department information system to deliver guideline knowledge Retrospective Chart	- Only 4th phase significant impact on practice being guided (e.g. use of beta blockers)	Survey data indicated openness to decision support, at least by lesser experienced physicians. Guideline-consistent CPOE order sets alone failed o improve adherence to

Author /Date Quality Assessment Score	Participant and Sample Size	Design and Intervention used if present	Outcome/Statistical Analysis	Findings
	Pre Attending 20% Post ED Residents 50% Post Attending 37%	Audit and Survey of Physicians Pre Post(x4 weekly) CPOE		clinical practice guidelines
Ellerbeck, EF. Bhimaraj, A. Hall, S. (2006) 5	Hospitals in Kansas Hospitals *n*=44	Survey Impact of organizational infrastructure on beta blocker and aspirin therapy for acute MI	- Hospitals vary widely. More likely to receive: aspirin if on emergency order sets odds ratio (OR) 1.57, 95% confidence interval (CI) 1.01-2.48% - Beta blockers on admission or discharge if included in an emergency protocol or pathway OR 2.14, 95% CI 1.25-3.77 and OR 3.5, 955 CI 1.14-14.38	Hospitals varied widely in inclusion of aspirin and beta-blockers in order sets. Physician champion a factor
Cook, CB. McNaughton, DA. Braddy, CM. Jameson, KA. Roust LR. Smith, SA. Roberts, DL. Thomas, SL. Hull, BP. (2007) 4	200 bed tertiary care center Physicians *n*=70 Response Rate 74%	Attitudes about perceived barriers to management hyperglycemia Survey of physicians Self-developed tool	- Pre Order Set – 10.9% Post Order Set 4-12 months - 32.3% - Post Order Set 14-15 months - 51.5%	Lack of knowledge about insulin treatment options was the most commonly cited barrier to ideal management
O'Connor, C. Adhikari, NKJ. DeCaire, K. Fredrich, JO. (2009) 4	750 bed community hospital Proportion of medical admissions receiving DVT prophylaxis Pre *n*=113 Post *n*=291 Post (2) *n*=108	Pre Post (x2) Retrospective Chart Audit Paper	- Pre Order Set – 10.9% Post Order Set 4-12 months - 32.3% - Post Order Set 14-15 months - 51.5%	Broad impact of order sets and minimal organizational resources for implementation suggests order set may have wide applicability as a clinical decision support tool
Reingold, S. Kulstad, E. (2007)	Emergency Department 695 bed suburban tertiary care hospital	Impact of human factor design elements on congestive heart failure	- Pre – 9% - Post – 31% (*p*<0.001) - Post – 60% (*p*<0.001)	Attention to human factor design elements significantly improved

Author /Date Quality Assessment Score	Participant and Sample Size	Design and Intervention used if present	Outcome/Statistical Analysis	Findings
4	Pre *n*=87 Post (3) *n*=84	order set use Retrospective Chart Audit	- Post – 72% (*p*<0.001)` - There was no variation in order set usage based on patient acuity, age or gender.	utilization of order sets and compliance with guidelines
Heffner, J. Brower, K. Ellis, R. Brown, S. (2004) 2	596 bed academic medical center and 110 bed community hospital Electronic order set system	Retrospective Audit Quality Review - Literature Report	- 220 order sets have been developed by physician groups without an institutional request - Hits to portal increased by about 4-5000 over 18 months	Demonstrated willingness to develop and use order sets and support tools
Formea, CM. Picha, AF. Griffin, MG. Schaller, JA. and Lee, MR. (2010) 1	The Mayo Clinic Center for Translational Science Activities (CTSA) clinical research unit (CRU) - integrative inpatient outpatient and mobile research program 1,100 bed, tertiary care academic health care system System users *n*=59 56% response rate	Case Report and post implementation satisfaction survey using convenience sample	- Survey reflected positive feedback	Successful design and implementation of electronic application with the ability to create medication order templates to generate participant specific medication order sets
Peshek, SC. Cuber, K. Gleespen, L. (2010) 1	2 facilities more than 800 combined bed	Paper to CPOE Case Report and Retrospective Chart Audit	- Order set compliance in paper 37% - Post CPOE 70-83% - Critical Care sedation protocol for ventilator patients 12% in paper 89% in CPOE - Standardized sliding scale insulin even with educational in paper 5% CPOE 93% - 40.5 % increase in clinical best practices	There is a constant demand for new and more complicated interactive order sets
Starmer, J. Waitman, LR. (2006)	2 Site 864 Bed University Medical Center	Five Year Retrospective Audit of Order Set Use CPOE delivery format	- Inpatient ordering patterns: Mean percent of orders from order sets between Jan 2004 and Dec 2005 is 62.5% with SD of 5.3%; Prior to	Orders from order sets have accounted for more than 60% of all hospital

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Author /Date Quality Assessment Score	Participant and Sample Size	Design and Intervention used if present	Outcome/Statistical Analysis	Findings
1			Jan 2004 40.7% SD 3.9% - ED ordering patterns - April 2004 mean per cent order sets 61.6% SD 1.6% - In past 2 years - Order sets accounted for more than 60% of all hospital and ED orders	and ED orders

Papers Qualitative

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
Ahmann A. and Maynard, G. (2008)	Discussion Paper A	Design elements and implementation strategies to increase acceptance and improved patient safety (Insulin Infusion Protocols)	Not Stated	- Building a Team - multidisciplinary steering committee - Uniform standards - Supporting infrastructure - Clinical and administrative stakeholders from key departments - Identify and examine all current orders. - Address burden of change - Identify and address barriers - Agreement on the goal (e.g. glycemic target) - Metrics - Communication - Some algorithms work better in paper format - Challenge to maintain currency - Different patient populations different requirements. - Local Factors - Well-grounded in reliability principles - Nursing education should include rationale, and case based instruction on utilization Ongoing education and review for /updates - For broader implementation choose less restricted target

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
				- Follow up with focused audits
Bobb, A. Payne, T. & Gross P. (2007)	Discussion Paper A		All	- Use not mandatory - Limited transferability of order sets between organizations – - While paper based order sets have limitations that CPOE can overcome; CPOE also has some significant limitations. - Organization standards required and clinical review processes to maintain currency - Private clinician order sets not recommended
Feldbaum, J. (2009)	Viewpoint B	Physician consultant specializing in clinical transformation	Electronic and CPOE	- Conversion of personal paper order sets to electronic not recommended - Standardized order sets can pit physician against physician - Good governance required - Broad stakeholder engagement - a pre-existing sprit of collaboration or hostility among constituencies is the best predictor of outcome on consensus. - Clinicians must create, edit gain consensus and approve order sets - Remind physicians that order sets do not replace clinical judgement - Electronic orders should be configured to conform to a hierarchy of rules, standards and principles - Formal policy and procedure for the creation, adaption maintenance and review. Don't forget a policy for conflict resolution - Design with maintenance in mind. - Standard naming conventions, single lexicon - Policies before build - Minimize click and scrolling - Uniform policy for pre-selected orders - Start with highest volume order sets and highest priority - Consider organizational culture when purchasing order sets. - There is no plug and play when purchasing order sets
Fratino, LM. Daniel, DA. Cohen, KJ. Chen, AR. (2009)	Case Study B	Division of Pediatric Oncology at Johns Hopkins	Not Stated	- Multidisciplinary group of physicians, nursing, and pharmacy - Education plan for order set content to include all prescribers - Concurrent with staff education patient and family education

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
		Lean Sigma approach to introduce pre-chemotherapy hydration protocol in two in-patient units n=45 patients (consecutive)		
Hoffman, J. Baker, D. Howard,S. Laver, J. Shenep, J.(2011)	Case Report B	Pediatric Oncology Order forms for chemotherapy as part of a clinical trial Safety comparison of the CPOE and paper systems using the proactive risk assessment technique	CPOE Implementation	- Organizational commitment and leadership: appropriate resources - Implementation approach: iIntense, formal process redesign; use of proactive risk assessment tools (e.g., Failure Modes and Effects Analysis); sequential implementation - Implementation techniques; engagement all disciplines - Advanced software functionality to allow continuous review of the order set and regiment even after completion - Training and support - Down time planning - Increasingly customized alerts that make the system safer
Maynard, GA. (2009)	Editorial Viewpoint B	Order sets that promote VTE prophylaxis	Any Format	- Properly constructed they are easy to use, and can save time - Modular design allows the specific components to be incorporated into all appropriate admission and transfer orders - Periodic audit and feedback and computerized decision support - Real time identification of outliers with proactive intervention - The foundation for improvement must be in place - Administrative buy in, even in the face of occasional medical staff.
Meleskie, J. Eby, D. (2009)	Case Report B	Alignment and standardization or order sets in 11 hospitals at 3 hospital corporations Adoption: initial 40% across all sites; more	Paper	- One standardized development and approval process for all 11 hospitals - One standardized modular format for order sets - Existing order sets adapted to the new format - Overlapping and personalized order sets were eliminated - Challenges: change management; obtaining consensus; multiple sites - practicality of meeting; adapting a generic order set to become standardized at multiple sites; turf protection – unexpected

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
		that 80% in some sites in first 6 month		(largely from the secondary centre)
Perkins, J. Ambroson, R. Kinsey, K. (2008)	Case Report B	802-bed acute care, not-for-profit hospital son three campuses Cardiac telemetry unit Goal: improve use of Standardized Diabetes Order Sets and effect on patient outcomes	Paper	- Order Set usage rates increased to 75% - Decreased blood glucose readings greater than 180 mg/dL - Six Sigma methodology was helpful in engaging team - Clinicians patients and families became more engaged and more aware of target goals for blood glucose levels - Increased communication interprofessionally
Pollack, AH. Eisenberg, MA. Del Beccaro MA. (2007)	Case Report B	Pediatric Specialty Care Unit Describe the development, design, implementation and first 6 months of order set utilization Ambulatory Seattle Children's multiple subspecialty practices	CPOE Implementation	- Order set utilization paralleled clinic specific patient volume - Top 5 plans (1.5% of total plans) were orders 28.8% of the time - Top three plans all generic, clinic specific but not disease specific - 26% of plans were individually ordered 0.9% times - Lessons learned: Need to identify departmental clinician contacts ; develop structural standardization of content and display; multidisciplinary review by ancillary diagnostic services ; rapid post implementation modifications and enhancements ; and balance between too many highly specialized order sets and more generic, simplified order sets that facilitate a high volume, short encounter
Rosenal, T. Fantin, L. Sinnarajah, A. Gregson, D. Mageau, A. Rich, T. Pattullo, A. Jamieson, P. Kraft, S. Robert, J. Ross, S. (2009)	Urban Academic Health Region B	Three urban adult care sites totalling 2000 beds After CPOE implementation spike in single blood culture collection	Post CPOE Implementation	- Timely electronic person and time stamped structured allows robust analysis - Design requires periodic evaluation - Analysis is necessary to identify unintended consequences and confirm benefits - Design insufficient to solve all CDS challenges: leadership, education, review of best practice and policy and communication - The rapidity with which ordering behaviour can be changed is critical in a complex environment where standards of care may change quickly - Effective cross department coordination of CDS development is

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
				important - Well-designed order sets should result in improved care and outcomes and reduce the workload
Starmer, J., Lorenzi, N. Wright Pinson, C. (2006)	Case Report B	Two Site 864 Bed University Medical Center Electronic use monitoring tool providing feedback to clinical teams	CPOE	- Monitor order set to manage use - Address teaching for rotating residents - Eliminate order sets not being used - Monitor frequency of use to promote use; address non use; identify common deviations to determine potential interventions and monitor effectiveness of interventions - Ultimate goal real time feedback
Abramson and Smith (2007)	Case Report C	328 bed hospital with 8 satellite facilities	Not Stated	- Involve users in development - Word-smithing important to make certain achieves intent - Not just word processing - changes must be reflected across the organization in MARs, formulary etc. - Purchased or shared order sets still require due diligence - Physician champion needed to manage physician non compliance - Interprofessional communication essential
Anonymous 1(2009)	Case Report C	245 bed hospital Implement hyperthermia program	Paper format	- Some success attributed to nurse involvement in the planning of implementation and education also added clinical perspective to development - Pre implementation communication among teams key to success
Anonymous 2 (2010)	Case Report C	Not for profit network physicians and hospitals	Not Stated	- Vendor purchased product allowed broad clinician consensus quickly - Virtual teams created system wide
Fear, F. (2011)	Case Report C	154 hospital and 7 satellite locations Resource for development Wolters Kluwer Health	CPOE	- Formal governance policy - Senior administrative support clinical and administrative - Champions - Strategy for which order sets first:top 25 diagnosis related groups and core measures within the organization - Interprofessional development order set development team including reps from quality improvement and risk management - Customizable templates enable rapid draft development

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
				- Virtual tools and user friendly dashboards for faster more efficient review and approval and enhanced project management - Easy access to trusted clinical content - Auto alerts when changes are made to support best practice - Ability to quickly provide updates across multiple order set - Solution deployed 6 weeks ahead of CPOE
Giuse, NB. Williams, AM. Giuse, DA. (2010)	Case Report C	Knowledge Management Consultants		- Interprofessional - knowledge information specialists participate: synthesis evidence from primary literature
Hagland, M. (2009)	Interviews C	5 hospital 2,060 bed health system	CPOE	- Advantage going into CPOE already had strong well define process for order set creation - CPOE must be integrated into the quality and workflow of the care delivery model that your organization has - Multidisciplinary stakeholder based project - MD was CIO at the time - Must be implemented to improve care delivery not just automate - Challenging part is sustaining change
Hagland , M. (2010)	Interviews C	3 hospital health systems Vendor Order Sets	CPOE	- Interprofessional development - Use of vendor order set product facilitated physician buy in. - Different roles have different needs - Needs bigger challenge than attitudes - Not always evidence available to support order - Some workload moves to physician role - Standardization increased load for physician to identify unique patient needs
Hagland, M. (2011)	Interviews C	Multiple organizations	CPOE	- Use of vendor order sets speeded up development phase - Governance is critical - Make sure to make that leadership group multidisciplinary - Have a sense of overall goals in mind - Work out a deliberate process for evidence based development - Formal workable communication plan - Establish a system of enterprise wide processes

Author/Date	Literature Type/Design Method/ Sample Size	Context	Order Set Delivery Format	Outcomes
				- Define standardization process and the maintenance process - Interprofessional development but will still be push back. Will be iterative process - User friendly catalogue of order sets

Appendix J Literature Order Set Data Extraction

Reference Author/ Date/Type	Interventions/Relevance
Fleming, NS. Ogola, G. Ballard, DJ. (2009) Follow-up Study to Ballard et al. *n*=4,454	<u>Marketing Approaches</u> High profile awareness campaign presented to the best care committee and available to frontline care providers through the intranet <u>Educational Approaches</u> Just in time training provided to nursing units at some acute care hospitals; academic detailing at physician level <u>Social Influence Approaches</u> Physician champions who were identified as highly
Ballard, DJ. Ogola, G. Fleming, NS, Heck, D. Gunderson, J. Mehta, R. Khetan, R. Kerr, JD. (2008) Observational Study	<u>Epidemiological Approaches</u> **Stakeholder Engagement** – Interprofessional, broad, team ownership and autonomy; system level groups in which stakeholders play role in the development process. <u>Educational Approaches</u> Significant learning curve <u>Marketing Approaches</u> Good communication structure needed Comment in paper – wide variation in organizational use likely reflects variability in physician leadership and buy in to implementation and use (potentially impacting factors such as: Degree to which front line users were exposed to awareness campaign And differences from one hospital to another in the training provided for nursing units) <u>Social Influence Approaches</u> Physician champions, senior support from all stakeholder groups <u>Behaviorist Approaches</u> **Ease of Use - Workflow -** Addition of default care co-ordination consults and a formatting change **Ease of Use – Perceived Need** - Focus on most necessary order sets by Diagnosis Related Group (DRG) data – particularly patient volumes and the Institute of Medicine 20 priority areas.

Reference Author/ Date/Type	Interventions/Relevance
	<u>Organizational Approaches</u> **Life Cycle Management** – Supporting infrastructure, annual updates, quality improvement (QI)
Munasinghe, RL. Arsene, C. Abraham, TK. Zidan, M. Siddiqui, M. (2011) Pre Post Time Series Study	<u>Behaviorist Approaches</u> **Ease of Use – Workflow -** Balance between ensuring the medical order set is complete but not over burdening the user with an overwhelming choice of sections to address all eventualities; modular subset ; general admission order set to include the most commonly needed orders; avoid repeating orders in the disease specific subsets - common co-morbidities such as hypertension, diabetes; use of nested order subsets for community acquired pneumonia (CAP), stroke and end stage renal did not increase to the same extent as for the other diagnosis
McAlearney, AS. Chisolm, D. Veneris, S. Rich, D. Kelleher, K. (2006b) Retrospective Chart Audit CPOE Delivery Format	<u>Education Approaches</u> Training for attending physicians who are required to consult with residents who enter orders should stress importance of being aware of available order sets and the value of recommending <u>Marketing Approaches</u> Admit through emergency department (ED) and use of off service bed impacted order set use; appendectomy started high but showed significant but small negative trend over study period; trend was largely driven by drop in use in July and August; may have been attributable to the arrival of new residents <u>Behaviorist Approaches</u> **Ease of Use – Workflow** – multiple co-morbidities decrease use <u>Organizational Approaches</u> **Life Cycle Management** - Designers consider system level alerts based on a patients admission diagnosis and not on the patient's location that remind ordering physicians that there is and available order set when they begin entering order
Khajouei, K. Peek, N. Wierenga, PC. Kersten, MJ. Jaspers, MW. (2010)	<u>Behaviorist Approaches</u> **Ease of Use Workflow -** Use of predefine order sets imposes less cognitive and physical demands on users than the use of single orders: minimize number of actions needed to finalize orders; streamline the medication ordering process; guide physicians better through the different steps, reducing the chance of human errors More usability problems of high severity when medications ordered without order so order sets also seem to reduce the chance of encounter of severe usability flaws decreasing the cognitive effort they have to expend to recover from these design flaws

Reference Author/ Date/Type	Interventions/Relevance
Cheekati, V. Osburne, RC. Jameson, KA. Cook, CB. (2009)	Marketing Approaches Need for awareness and communication but does not describe how to achieve
Asaro, PV. Sheldahl, AL. Char, DM. (2005)	Epidemiological Approaches **Stakeholder Engagement –** Conceptual view of decision support viewed as potentially useful rather than finding current functionality helpful Social Influence Approaches "Cook Book" medicine, in academic setting attending attitude trickledown effect Behavioral Approaches **Ease of Use – Delivery Format** – Low order set use in paper format, adoption of CPOE related to computer experience; use improved over time in CPOE format; CPOE preferred over paper despite limitations in ability to build into the vendor system **Perceived Need - Role** – Resident (new learner) versus experienced attending (perceived need); also note impact on learning
Ellerbeck, EF. Bhimaraj, A. Hall, S. (2006)	Social Influence Approaches Physician leadership "Smaller hospitals much less likely to have implemented standardized order sets and less likely to have identified physician champion." Behaviorist Approaches Data feedback suggested but other studies suggest can have negative impact if feedback occurs in absence of systems support.
Cook, CB. McNaughton, DA. Braddy, CM. Jameson, KA. Roust LR. Smith, SA. Roberts, DL. Thomas, SL. Hull, BP. (2007)	Marketing Approaches Most commonly reported barrier was lack of knowledge about appropriate regimens and how to use them.
O'Connor, C. Adhikari, NKJ. DeCaire, K. Fredrich, JO. (2009)	Epidemiological Approaches **Stakeholder Engagement** – none Organizational Approaches

Reference Author/ Date/Type	Interventions/Relevance
	Life Cycle Management – website developed to facilitate timely reordering Educational Approaches No educations Marketing Approaches Physicians notified by email when order sets became available; minimal implementation strategy but use still increases with time.
Reingold, S. Kulstad, E. (2007) Retrospective Chart Audit Pre *n*=87 Three audits Post *n*=84	**Pre Result Interventions** Epidemiological Approaches **Stakeholder Engagement** – Design primarily by cardiology Behaviorist Approaches **Ease of Use - Workflow** – Jointly developed order sets single page, much detail with good effect Social Influence Approaches Initial implementation with poor impact national and local experts give lectures to department with memos from QI chair with reminders to use order sets with minimal impact on use **Post Result Interventions** Epidemiological Approaches **Stakeholder Engagement -** Jointly prepared by cardiology and ED Behaviorist Approaches **Ease of Use -Delivery Format** – Reduced complexity of paper delivery format
Heffner, J. Brower, K. Ellis, R. Brown, S. (2004)	Behaviorist Approaches **Ease of Use – Workflow -** On-screen completion; free text orders indicating spaces for additional orders; decision support tools that guide clinicians toward a specific order option; information material that informs clinicians about method of ordering, information related to the underlying health condition, precautions, reminders and alerts Marketing Approaches Periodic e-mails and announcements at faculty meetings

Reference Author/ Date/Type	Interventions/Relevance
	Organizational Approaches Well maintained computer network throughout inpatient outpatient and academic settings with off campus password protects access Sufficient numbers of computers, monitors and printers in clinical areas **Life Cycle Management -** Forms committee restructured to include pharmacists and process experts from hospital quality and safety program; standard template developed;-developers required to submit proposed forms to the forms committee for review revision and approval before posting; orders for specific condition unique to a specialty required signature of relevant department chair; Internet based Delphi technique that formed consensus among pharmacists and physician experts on pneumonia care Approved forms were published on the Web site in portable document format (pdf); changes in drugs or practice allow quick recall and revision Coercive Approaches No policies to enforce use
Formea, CM. Picha, AF. Griffin, MG. Schaller, JA. and Lee, MR. (2010)	Epidemiological Approaches **Stakeholder Engagement -** Key users, group members, and institutional committees identified and included a clinical research unit (CRU) informatics specialist, CRU nursing staff, CRU nursing education specialist, infections disease specialists, pharmacists, institutional medication safety pharmacists, members of research groups and institutional oversight committees Educational Approaches Targeted application training for research groups, nursing and IDS pharmacists Behaviorist Approaches **Ease of Use Workflow -** User friendly application: build an application that could be easily learned and used Organizational Approaches **Life Cycle Management -** Order Set Protocol Approval Group (OSPAG); Lean process: involve key institutional groups to streamline the review, approval, and amendment process for efficient use of resources; comply with institutional medication order writing standards and create new standards for research scenarios where previously clinical medication order writing standards were unable to address research needs; formalized review process; develop a standardized method for medication order review and approval by clinical research user groups and institutional oversight committees (electronic tracking to govern the template); version control: provide the ability to track edits;

Reference Author/ Date/Type	Interventions/Relevance
	controlled access: implement role based access to the medical informatics application; phased approach, pilot testing
Peshek, SC. Cuber, K. Gleespen, L. (2010)	Epidemiological Approaches **Stakeholder Engagement** – broad Social Influence Approaches Strong physician leadership Behaviorist Approaches Rules **Ease of Use** – minimize alerts; the more comfortable users are with the system the more they request new order sets Organizational Approaches limitation or resources for creation and testing (two way interface GE Centricity to Eclipsys) **Life Cycle Management** – development for CPOE began with paper order sets in existence**;** nursing super user group to support life cycle Educational Approaches Physician lead physician education, education programs Marketing Approaches Nurses super user meetings; -physicians monthly appearances at departmental meeting ; -pharmacists through in-service; written materials and staff meetings; medical safety coordinator and lead quality and clinical -analysts attend meetings and speak in person;-on telephone and in clinical and technology areas
Starmer, J. Waitman, LR. (2006)	Behaviorist Approaches **Ease of Use - Workflow -** Use of CPOE order sets increased over time.

Qualitative Literature

Author/Date	Interventions/Relevance
Ahmann AJ. and Maynard, G. (2008)	Epidemiological Approaches **Stakeholder Engagement – S**takeholder engagement - interprofessional, development team most knowledgeable stakeholders Organizational Approaches Leadership Support – administrative, institutional identify infrastructure needed and work required volume of work, resources needed **Life Cycle Managemen**t – Development and implementation – starting with a less aggressive target can be good politics standardized organizational format and care strategy Behaviorist Approaches Feedback - benefit of outcomes – negative impact on patients e.g. finger sticks Focused audits in early implementation phases; look for non-adherence and deviations evaluated according to the patterns identified e.g. variation in application may be specific for an individual or group or the whole; may point to gaps in education or attitudes; may deviate because find it ineffective unsafe or impractical for certain situations or specific patients. Ongoing review process to identify issues to be addressed with permanent solutions. Revisions require supplementary education and rapid and wide dissemination Periodic retraining continue to achieve optimal results and safety. **Ease of Use - Quality of Content** - Fear of hypoglycaemia, limitations of current empirical evidence; quality of content **Ease of Use - Workflow** – Practice and workflow, flexible content for decisions support, ability to respond to changes in practice; manage complexity – improve automation and control refinements come at a cost of increased complexity. Social Influence Approaches Champions - focused experts management teams Attitudes - Culture or state of experience related to new implementation
Bobb, AM. Payne, TH. and Gross PA. (2007)	Epidemiologic Approaches **Ease of Use – Quality of Content** – Currency Behaviorist Approaches **Ease of Use - Delivery Format** - Paper limitations that CPOE can overcome

Author/Date	Interventions/Relevance
Ali, NA. Mekhjian, HS. Kuehn, PL. Bentley, TD. Kumar, R. Ferketich, AK. Hoffmann, SP. (2005)	<u>Behaviorist Approaches</u> **Ease of Use - Workflow**– Improve efficiency of workflow, decrease order volume
Feldbaum, J. (2009)	<u>Epidemiological Approaches</u> **Stakeholder Engagement** - Broad <u>Behaviorist Approaches</u> **Ease of Use - Workflow** - Minimize click and scrolling **Ease of Use – Perceived Need – Workflow -** Start with highest volume order sets and highest priority <u>Organizational Approaches</u> **Life Cycle Management** – Formal policy and procedures for creation adoption, maintenance and review of order sets. Policy for conflict resolution. Design with maintenance in mind. Principles and standards from which all order sets are designed. Use naming conventions, single lexicon, Policies before build. Uniform policy for pre-selected orders
Fratino, LM. Daniel, DA. Cohen, KJ. Chen, AR. (2009)	<u>Epidemiological Approaches</u> **Stakeholder Engagement** - Multidisciplinary group of physicians, nursing, and pharmacy <u>Educational Approaches</u> **Education** – Staff, patients and families <u>Organizational Approaches</u> **Life Cycle Management** - Lean Sigma approach to QI
Hoffman, J., Baker, D., Howard, S., Laver, J., & Shenep, J (2011)	<u>Epidemiological Approaches</u> **Stakeholder Engagement –** Across all professions; principal investigator and/or senior attending physicians final approval of content <u>Educational Approaches</u> **Education** – Inclusion of training staff in process redesign; extensive round the clock go live support <u>Social Influence Approaches</u> **Leadership** – Organizational and departmental commitment and leadership; appropriate resources for process redesign and safe implementation

Author/Date	Interventions/Relevance
	Behaviorist Approaches **Ease of Use** – **Delivery Format**– Standardized; some software functionality flexible so that process does not always have to adjust to software but software can adjust to process; advance software functionality to allow continuous review of the order set and regiment even after completion of the orders and to sequence orders based on an anchoring order; filter alerts to avoid alert fatigue and maintain effective function and reduce impact on workflow Organizational Approaches **Life Cycle Management** – Use of proactive risk assessment tools e.g. Failure Modes and Effects Analysis; sequential implementation rather than big bang; appropriate downtime processes
Maynard, GA.(2009)	Educational Approaches **Education** - The foundation for improvement must be in place e.g. education programs, guidelines Organizational Approaches **Organizations Support** - Administrative buy in is priority, commitment to support standardization even in the face of occasional medical staff resistance; willingness to examine and redesign processes; culture of shared purpose, cooperation, and high expectations between the medical staff and the administration is more important than extensive resources; an institutional commitment to standardization **Life Cycle Management -** A plug and play modular order set design Behaviorist Approaches Periodic audit and feedback; favour a method that involves real time identification of outliers (i.e., patients without prophylaxis who have some VTE risk or provide feedback to providers on their performance proactive intervention applied to outliers who are not on appropriate prophylaxis **Ease of Use -** If constructed properly is easy to use and save the clinician time; VTE prevention order set to be incorporated into all appropriate admission and transfer orders and works well in paper and electronic format Coercive Approaches Institutional mandates for the use can be very effective strategy
Meleskie, J. Eby, D. (2009)	Epidemiological Approaches **Stakeholder Engagement** – Broad (electronic communication across sites)

Author/Date	Interventions/Relevance
	Quality of Content - Questions about what constitutes evidence and lack of empirical based evidence especially when it did not fit with local practice; turf protection (unexpected) largely from the secondary centre, nursing and pharmacy defended turf or level of care Educational Approaches Multiple venues **-** in-service, newsletter, memos Social Influence Approaches Physician reps engage physician groups, advocacy from administration Marketing Approaches Voluntary use and ability to stroke out default orders if desired or add orders Behaviorist Approaches **Ease of Use - Life Cycle Management** - Rapid cycle response team; one standardized development and approval process, standardized modular format; grant Order Set Committee final decisions; adapting a generic order set to become standardized at multiple sites problematic due to variations in formularies, lab test availability and support services such as inter professional consultations (emphasizes the importance of local context in the adoption of generic order sets and useful practice)

Author/Date	Interventions/Relevance
Perkins, J. Ambroson, R. Kinsey, K. (2008)	<u>Epidemiological Approaches</u> **Stakeholder Engagement** – Broad <u>Educational Approaches</u> Diabetes education <u>Marketing Approaches</u> Enhanced awareness <u>Social Influence Approaches</u> Respected lecturers <u>Behaviorist Approaches</u> **Ease of use** – Find paper orders, reduce visual complexity of the paper form <u>Organizational Approaches</u> **Life Cycle Management- I**ntervention application and monitoring; standardize practice
Pollack, AH. Eisenberg, MA. Del Beccaro MA. (2007)	<u>Epidemiological Approaches</u> **Stakeholder Engagement** – Broad; identify clinician contacts to develop and review order sets; multidisciplinary review by ancillary diagnostic services <u>Behaviorist Approaches</u> **Ease of Use** - Structural standardization of content and display <u>Organizational Approaches</u> **Life Cycle Management** - Rapid post implementation changes; balance between too many highly specialized order sets and more generic simplified; paralleled clinic specific patient volume Top 5 plans (1.5% of total number of plans) were orders 28.8% of the time Top 3 plans were generic, clinic specific but not disease specific plans 26% of plans were individually ordered 0.9% times
Rosenal, T. Fantin, L. Sinnarajah, A. Gregson, D. Mageau, A. Rich, T. Pattullo, A. Jamieson, P. Kraft, S.	<u>Marketing Approaches</u> Memo of best practice, review policy; different units different communication

Author/Date	Interventions/Relevance
Robert, J. Ross, S. (2009)	Behaviorist Approaches **Ease of Use** - Quality of order set format (easier to do wrong thing e.g. 1 click versus 2 clicks) Organizational Approaches Effective cross-departmental coordination of CDS development is important **Life Cycle Management** – Analysis to identify unintended consequences; design requires periodic evaluation
Starmer, J. Lorenzi, N. Wright Pinson, C. (2006)	Epidemiological Approaches **Quality of Content -** Evidence links available for key evidence Marketing Approaches Non-emergency department (ED) physicians rotated through ED had lower levels of compliance than expected. Changes in resident orientation and the way attending work with residents improved compliance Behaviourist Approaches Report generated infrequently used or not recently updated distributed to clinical teams and 50% of the order sets identified were retired. Usage report distributed to increase use Organizational Approaches **Life Cycle Management** - Order set tracking tool identified order set in conflict with an evidence based order set; competing order set eliminated

Appendix K Metrics

Author	Order Set Characteristics	Patient Characteristics	User Characteristics	Patterns of Use	Organizational Trends
(Ballard et al., 2008) (Level A)		*Severity of Illness* Less use with greater APR DRG severity of illness ($p<0.01$) and APR DRG risk of mortality ($p<0.01$) No significant relation to Greenfield co-morbidity ($p=0.42$)			Variation in use between hospitals with a range from 43% to 91% ($p<0.01$).
(Fleming et al., 2009) (Level A)		*Demographic* No significant variation by age; sex; race		Significant increase in use by month from 35% to 76% ($p<0.001$) over 29 months.	Variation in use between hospitals with a range from 43% to 91% ($p<0.01$).
(McAlearney et al., 2006) (Level A)	Number of order used within an order set ≥ 10	*Severity of Illness* More than one co-morbidity were significantly less likely to have order sets used (OR= 0.20, 95% CI 0.09-0.50) (OR=0.32, 95% CI 0.12-87) *Demographic* No significant variation in order set use by patient insurance (Commercial, Medicaid, Other/Self); age; race *Diagnosis* Varied by condition ($x2 = 339.2$, $p<0.001$) with asthma highest 88.1%, appendectomy 79.4% and a community acquired pneumonia 21.1%. *Location of Admission* Appendectomy order set - only admitting unit statistically significant factor. (CO 3.44, 95% CI 1.45-8.14) - emergency department admission more likely to have the use than admitted non-emergency - (81% versus 58%) Asthma order set - use on the regular unit greatest predictor for use (OR =12.2, 95% CI1.4-6.7)		Asthma order set use started high and increased over time ($z = -3.02$, one sided $p=0.001$); Appendectomy order sets started high but showed a significant but small negative trend ($z=2.10$, once sided $p=0.018$) Community Acquired Pneumonia order set use relatively low at implementation and no evidence of increased use over time ($z=0.626$, one sided $p=0.266$)	

Author	Order Set Characteristics	Patient Characteristics	User Characteristics	Patterns of Use	Organizational Trends
		- emergency department admission more likely to have the use than admitted non-emergency -71% versus 89% *Time of Admission* <u>Asthma</u> order set -increased weekend use over weekday use (OR=3.0, 95% CI1.4-6.7). -not a factor in the <u>Community Acquired Pneumonia</u> order set. -time of day for the admission e.g., 0700 hours to 1900 hours versus 1900 hours to 0700 hours was not a factor of order set use for any of the order sets reviewed.			
(Munasinghe et al., 2011) (Level A),				Monthly increase order set use from 349 to 1711 over a 16 month Number of newly implemented nested order sets increased from 74 per month to 1476 per month (*p*=0.023).	
(Khajouei et al., 2010) (Level B)	Mouse clicks and key strokes by physician and order set versus random orders				
(Reingold & Kulstad, 2007) (Level B)		*Severity of Illness* No difference in use of order sets in relation to patient acuity *Demographic* No significant variation by age; sex		Pre/post (x3) CPOE Pre – 9% [95% confidence interval CI = 5% to 17%; *p*<0.001]). Post 2– 60% (*p*<0.001); Post 3 – 72% (*p*<0.001) (95% confidence interval CI = 52% to 82%).	

Author	Order Set Characteristics	Patient Characteristics	User Characteristics	Patterns of Use	Organizational Trends
(O'Connor et al., 2009) (Level B),				Use increased over time (paper) Post 10.9% to 32.3 % over 4-12 months 51.5% 14-15 months	
(Cheekati et al., 2009) (Level B)			Most commonly cited barrier to use was lack of knowledge about order set subject matter		
(Asaro et al., 2005) (Level B)			Survey data indicate openness to use decision support tools, at least by lesser experienced physicians		
(Starmer & Waitman, 2006) (Level C),				CPOE Pre/post Pre -40.7% SD 3.9%. Post - 62.5% SD of 5.3%.	
(Peshek et al., 2010) (Level C)				Pre/post CPOE Pre-37% Post 70-83%.	
(Heffner et al., 2004) (Level C),				Post portal implement -usage increased 4-5000 over 18 months.	

Appendix L
Table of Grol and Grimshaw Theoretical Approaches

Theoretical Perspectives	Driver	Focus	Aim	Contribution/Value	Activities	Lessons
Epidemiologic Approaches **Derived from decision making theories e.g. rational choice Or cognitive choice (TPB)**	Consider humans to be rational who make decisions balancing rational arguments about costs, harms and preferences	Rational aspects of behavior	Evidence should be sound and convincing Procedures should be explicit and rigorous	Emphasis on sound rationale for change as well as summary of the available evidence		Develop sound and credible Message or product
Educational Approaches	internal striving for professional competence, an intrinsic motivation to grow	Focus on intrinsic motivation	Give the target group the feeling that they own the change process	link QI activities to the actual problems and experiences of care providers	Promote learning from experience Problem based learning Small group interactive learning Local consensus process	Involve target group to discuss needs and experience Ownership of product
Marketing Approaches **Innovative theories, communication theories, health promotion theories and social marketing theories**	Assume that there are different sub groups in the target audience (e.g. early adopters, late adopters	Development and marketing of attractive product or message which is adapted to the needs of the target group		Strength of multiple channels lies in emphasizing the need to adapt change proposals to the characteristics of the different target groups of clinicians and in addressing their particular needs and perceived barriers	See changes as step wise process, drawing attention to the message, increasing the understanding of the message, influencing acceptance and maintaining the change Message spread through a variety of	Learn about needs and problems of the target group and adapt innovation

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Theoretical Perspectives	Driver	Focus	Aim	Contribution/Value	Activities	Lessons
					channels	
Behaviourist Approaches	Based on theories about conditioning and controlling behaviour Primarily influenced or reinforced by (external stimuli before or after a specific action)				Approaches are reviewing performance and providing feedback to care providers, giving reminders about specific actions (before or during performance) and providing incentives or sanctions related to specific actions	
Social Influence Approaches	Emphasize that learning and changing is often achieved as a result of the influence of and interactions within social networks.	Opinions, feedback or pressure coming from significant individuals in a social networks Have a substantial impact on whether scientific findings are adopted	Emphasis on professional communication		Use of opinion leaders, outreach visits Academic detailing (in a small group), peer review in small local groups, demonstration of new performance by colleagues. Patient mediated interventions	Use of respected peers, opinion leaders , role models
Organizational Approaches	Different management theories	Do not focus on individual but on creating the necessary conditions for change	Value on emphasis on organizational and structural factors hindering change and in seeing care provision is a series of interrelated actions in which different people depend on each other		Continuous quality improvement, total quality management	Be aware that the barrier is often the setting. Improve teamwork and leadership provide resources and support
Coercive Approaches	Concern pressure and control as a method of implementing change					Some target groups need pressure to change

Theoretical Perspectives	Driver	Focus	Aim	Contribution/Value	Activities	Lessons
						Use regulations and budgets appropriately and carefully to support the change process

Adapted from Evidence-based Implementation of Evidence-Based Medicine (Grol & Grimshaw, 1999)

Appendix M Table of Theories and Associated Findings

Theory	Findings
Theory 1 Communication Stakeholder Engagement and *Theory 2 Feelings of Ownership*	This epidemiological theme is based on the underlying theory that engagement leads to awareness, participation and ownership. It was broadly identified in the literature papers and by interview participants (Abramson L, 2007; Ahmann & Maynard, 2008; Anonymous, 2007; 2009; Ambroson, & Kinsey, 2008; Ballard et al., 2008; Cohen, & Chen, 2009; Fear, 2011; Feldbaum, 2009; Formea, Picha, Griffin, Schaller, & Lee, 2010; Fratino, Daniel, Cohen, & Chen, 2009; Hagland, 2009, 2010, 2011; Hoffman, Baker, Howard, Laver, & Shenep, 2011; Meleskie & Eby, 2009; Perkins, Pollack, Eisenberg, & Del Beccaro, 2007; Reingold & Kulstad, 2007; Peshek et al., 2010; Starmer & Waitman, 2006; 2009).
Theory 3 Engagement Attempts Rejected (a)	Some individuals or professional groups reject attempts for engagement. Some papers and participants identified a lack of enthusiasm for changing usual practice or the consequences of limiting clinical autonomy through standardization (sometime described as "cook book medicine"). Several of the interview participants also described challenges for adoption when order set content included items that were not well established evidence based practice. Another participant (p. #06) noted a stakeholder group who chose not to participate because they perceived the tool they were using better served their needs than order sets could.
Theory 4 Engagement Attempts Rejected (b)	The engagement experience may not have been positive for the stakeholders and feelings of ownership were not developed, perhaps due to tensions between the change agents and the stakeholders. One participant asserted, *"It can very much be a case of who is developing the order set and what they are trying to do" (p. #13).* Alternatively, there may be resistance to externally imposed changes in practice. One paper noted feelings of pride and ownership of some practices creating resistance to change (Meleskie & Eby, 2009).
Theory 5 Feelings of Ownership (a)	At times, engagement was achieved but order set adoption was still unsuccessful. Some of these scenarios required broad order set adoption (e.g. department wide; organization wide) that impacted care provision by providers in alternate settings. This caused challenges with different organizational formularies or different service provider availability. Where possible identification of concerns and addressing feedback was suggested to enhance feelings of ownership and facilitate adoption. Adoption may have been negatively impacted if stakeholders felt that their feedback had not been incorporated (Meleskie & Eby, 2009).
Theory 6 Feelings of Ownership (b):	One paper described an engagement where one stakeholder group was overlooked. In this scenario patients admitted to the hospital through the emergency department were recognized as a potential opportunity for early treatment prior to admission to the in-patient care setting. A group of care providers from the admission setting developed order sets focused on initiating care within the emergency department. The developers neglected to engage care providers from the emergency department in the development process (Reingold & Kulstad, 2007). Similarly a participant (p. 01) described an order set challenged by a provider group and exploration of the challenge revealed that although the order set called for consultation with that provider group, the group had not been engaged in the development. Once engaged, the group agreed that the order set was appropriate and once recognized as part of the process the order set adoption no longer encountered barriers.
Theory 7 Adoption despite	Stakeholder engagement was the dominant action undertaken to support order set adoption and Reinhold et al. (2007) indicated

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Theory	Findings
No Direct Engagement:	improved adoption after the action of engagement was undertaken. Alternatively, one paper demonstrated success with limited stakeholder engagement (O'Connor et al., 2009). This implementation only employed a marketing approach (emailing prescribers to notify them of availability of the order set) and life cycle management support (implementing processes to facilitate re-order management) with no stakeholder engagement. Characteristics of the order set and the setting could have accounted for the discrepancy of the results as the contents of this order set were driven by initiatives incorporating practices into national accreditation standards. Similarly, one participant (p. #16) working within the stroke management context commented that implementation of order sets in the neurological stroke setting went very smoothly as standards were being driven at a national level. This may suggest that engagement has taken place at another level outside of the direct order set implementation process.
Theory 8 Cognitive Choice and Theory 9 Order Sets are a Valid Tool (a)	This approach is founded on the epidemiological theory that prescribers will make the decision to use a tool if it provides benefits. In addressing this variable, the actions were focused on the quality of the order set content and users' perceived ease of use and/or usefulness of the order set.
Theory 10 Order Sets are a Valid Tool (b)	Both interview participants and the review papers identified scenarios where the concept of order sets was not viewed as a valued clinical tool. One participant (p. #16) stated that within her organization the "cook book" reference was heard in the past but, prescribers had moved away from that and were now more accepting of the order sets as valid clinical tools.
Theory 11 Order Sets are a Valid Tool (c)	When the concept of the order sets was accepted as a valid tool, one challenge identified was the ability to confirm the content as evidence based practice at the point of care. The availability for references embedded in the order set (or direct links to the references) was suggested to assist decision making for the prescriber and was viewed as a significant enabler to facilitate confident adoption of the order set (Abramson, 2007; Fear, 2011; Giuse, Williams, & Giuse, 2010; Starmer & Waitman, 2006). Several papers identified the improved ease of use when order sets were directly linked to the supporting evidence (Abramson L, 2007; Anonymous, 2009; Fear, 2011; Starmer & Waitman, 2006).
Theory 12 Order Sets are a Valid Tool (d)	Asaro et al. (Asaro et al., 2005) noted that the concept of order sets may be viewed in a positive light but challenges associated with the functionality of current versions available were not. For example, the presented order set may not have been current with respect to evidence based practice standards. Maintaining currency of order set content (reflecting current published evidence based research) was frequently noted as a challenge in the review papers (Abramson, 2007; Ballard et al., 2008), and by participants. One participant indicated, *"We do really well at implementation but resources to support maintenance are often limited or lacking"* (p. #06). To address this limitation there was a need for human resources to provide ongoing evidence review and order set updating as well as maintaining awareness of changes at the point of care. Alternatively, new tools may need to be implemented to support the order set management process (e.g. implementation of templates for order set development). Another participant (p. #07) noted that as an organization they were often more aware of changes in medication practices than other practice updates such as lab or diagnostic testing practice. It was suggested that policies were needed to support regular review.
Theory 13 Order Sets are a Valid Tool but Question Available Research	The perceived quality of evidence available for evidence based practice also impacted the perceived quality of the order set content (Meleskie & Eby, 2009). Questions about availability of empirically based evidence and what constituted evidence, i.e. sufficient volume and/ or quality of evidence, impacted order set adoption. Hagland (2010) suggested that, *"…only about 20 percent of what*

Theory	Findings
	we [health care practitioners] do has evidence" (page 2). Much of practice is based on consensus rather than evidence. This challenge resulted in order sets where some of the content was agreed to be evidence based but other components were not. This became particularly controversial when proposed evidence conflicted with opinions and/or values of local practice. For example, one study participant (p. #01) related a controversy where different professional colleges recommend conflicting evidence based practice strategies. Alternatively, the values of a context might change. Another participant (p. #12) noted conflict experienced around established practices embedded in order sets when the leadership of the department changed and introduced new perspectives. One participant described a strategy that pre-dated order sets but limited this type of challenge. It involved a weekly team meeting to review practice. This exercise was initiated to address challenges experienced by residents when staff chose to practice in contrasting ways. This process was reported to limit conflicts related to consensus based content.
Theory 14 Order Sets are a Valid Tool but Research in Progress	One challenge (p. #17) was associated with large teaching centres where prescribers were involved in, or aware of, leading edge research or theories that they wanted to incorporate into daily practice. Although quality practice guidelines and order sets are intended to bring current evidence based practice and research to the front line some front line users are at the leading edge of that research and/or exploration of alternative new theories.
Theme 15 Desire to Grow	Educational themes are directed to individual desire to grow. It was noted that the initial steps or foundation for change must be in place with the availability of education programs, guidelines and protocols etc. (Anonymous, 2009; Ballard et al., 2008; Cheekati et al., 2009; Cook et al., 2007; Fleming et al., 2009; McAlearney et al., 2006; O'Connor et al., 2009). The content, timing, selection of educators, venue, and strategy were all mentioned as contributing factors to adoption. One paper suggested that education include patients and families as well (Fratino et al., 2009).
Theory 16 Motivation	Targeted (Formea et al., 2010), just in time training was suggested (Fleming et al., 2009). It was proposed that the impact of just in time supports can be enhanced by learner desire to grow to manage impending change.
Theory 17 Education Method	A number of educational strategies were also described such as use of multiple venues, in-service, packages, newsletters and memos (Anonymous, 2009; Meleskie & Eby, 2009). One on one education was noted as necessary on some occasions (e.g. physicians) (Anonymous, 2009; Peshek et al., 2010), and physician led physician training was recommended (Peshek et al., 2010). Starmer and Waitman (2006) noted that when non-emergency department physicians rotated through the emergency department there was lower compliance with use of the orders sets. Changes to the resident orientation improved use. McAlearney et al. (2006) suggested that attending physicians stress to residents awareness of the order sets and recommendation of use.
Theory 18 Education Content Validity (b)	There were several different areas of education focus noted. Some education was directed to the subject matter (e.g. diabetes management) of the order set with the objective of facilitating or enhancing order set use. (Perkins et al., 2008). Interview participants suggested that there was very little overall rejection of education around order sets themselves. More often the focus was related to the content of the order set and once concerns were addressed reception was positive.
Theory 19 Targeted Stakeholders Non-Receptive	It was noted by a participant from Site Two (p. #12) that some senior physicians declined education on order sets and new electronic tools suggesting that it should be directed to the resident staff. These senior staff did not often write orders and the task most often fell to residents in this department. As part of the follow up interview this participant also shared that these same senior staff were receptive to information related to new order sets and new order set content facilitating the process of sharing the

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Theory	Findings
	information and encouraging use of the order sets. Different components and strategies for education were reviewed with some demonstrating positive effects associated with the intervention. Contrasting this finding was evidence that adoption can occur in some contexts without education. O'Connor et al. (2009), provided no education for his paper order sets yet identified adoption and increased use.
Theory 20 Education Content Validity (b)	Interestingly, one participant (p. #16) shared that an educational event had the unintentional impact serving as a marketing tool. An organizational multisite educational broadcast that incorporated mention of an associated order sets resulted in follow-up request for access to the order sets.
Theory 21 Identify Product or Service of Interest	Marketing approaches are founded on innovation and communication theories. The focus is directed towards the development of an attractive product or message that is adapted to the target group. The approach is presented in multiple formats (e.g. person to person, networks of professionals, media). The broadness of the intervention types facilitates capturing a broad range of target individuals and groups (Grol & Grimshaw, 1999). Marketing planning can include pre implementation strategies, implementation strategies and sustainability and enhancement of use strategies.
Theory 22: Target Product or Service of Interest, *Theory 23: Perceived Need (a),* *Theory 24: Perceived Need (b) and* *Theory 25: Perceived Need Lacking*	Pre-Implementation marketing theories were directed towards creating a culture of interest or desire for change. Attention is drawn to what is relevant. Perceived need will influence desire for change. The desire for change will increase reception to marketing message. Within the papers some strategies described for identifying a product of interest were to focus on the top 25 diagnosis related groups (DRG) or the highest patient volumes to begin order set development and implementation (Ballard et al., 2008; Fear, 2011; Feldbaum, 2009). It was also suggested that starting with a less aggressive target can be good politics (Ahmann & Maynard, 2008).
Theory 26 Create Perceived Need (a) and Theory 27 Create Perceived Need (b)	One of the interview participants indicated that in hindsight a campaign before order set implementation directed at identifying quality problems and introducing a perceived need for change might have facilitated engagement and receptiveness to messages.
Theory 28 Communication Leads to Awareness	Cook et al. (2007), reported that the most commonly reported barrier to adoption was lack of awareness. Good communication structures that reach to the front lines were identified as essential (Ballard et al., 2008; Cheekati et al., 2009; Hagland, 2009). Fleming et al. (2009), describe a high profile awareness campaign presented to the best care committees and available to frontline care providers through the organization's intranet. Other papers describe email notices (O'Connor et al., 2009) , with periodic email reminders, announcements at faculty meetings, nurses super user meetings, physicians monthly appearances at departmental meetings, in-services and written materials (Heffner et al., 2004). Some described designated bed medical safety co-ordinators and quality analysts attending meetings to speak and targeted telephone or on-site clinical area conversations (Peshek et al., 2010).
Theory 29 Message Does Not Reach Target	It was also noted by the participants (p. #15) that implementation across sites was "huge" and must incorporate repeated education and reinforcement with multilevel support and engagement.
Theory 30 Communication	Participants noted that the biggest challenge was bringing the first site on board. Individuals from the first implementation

Theory	Findings
of Availability and Advantages	locations who rotated throughout the organization facilitated the process with word of mouth marketing.
Theory 31 Communication Message Effective but Does Not Reach Target Audience	Ballard et al. (Ballard et al., 2008), reported wide variation in organizational order set use following a high profile awareness campaign. It was suggested that variation may have been a reflection in variability of physician leadership and buy-in. This had the potential to impact on the degree to which front line users were aware and differences in training between organizational sites. Rosenal et al. (2009), suggests the use of consistent messaging when different messengers engage with different units.
Theory 32 Communication Effective but Order Sets Not Available	The impact of limitations in the infrastructure was also noted by some interview participants. At the time of implementation there were challenges with insufficient computers or printers and challenges with routing of order sets to appropriate printers.
Theory 33 Communication (b)	Descriptions of marketing in the papers included periodic emails and announcements at faculty meetings (Heffner et al., 2004), nurse super user meetings, monthly physician appearances at departmental meetings, pharmacists in-service, written material and staff meetings, medical safety coordinator and lead quality and clinical analysts attending meetings and speaking in person, on telephone and in clinical and technology areas (Peshek et al., 2010).
Theory 34 Product Change	Participants noted that sustaining awareness was a constant challenge.
Theory 35 Message Communicated but Target Changed	Staff changes and resident rotations also add to the complexity by creating a constantly changing target audience.
Theory 36 Message Re-Communicated Formal and Informal Structures	During the review it was identified that there are formal and informal marketing strategies that are developed or evolve to sustain awareness and use of order sets. The context for order sets varied broadly. It was identified (p. #02) in many contexts that nurses are often managing the communication of awareness of order sets and in particular strong nursing practitioner representation in an area was suggested to see more consistent use of order sets. Nursing often supports the marketing process but is not the best resource in all contexts. In some cases a senior resident acts as the primary source of communicating awareness. In still other contexts it is a function of the group (e.g. peer awareness) that facilitates use. It was noted that contrary to marketing for implementation the marketing for sustaining use was often more effectively achieved in the larger contexts than the smaller closed settings. It was suggested that this could be the result of more formal structures in the larger contexts (e.g. senior resident, junior resident).
Theory 37 Message Facilitated by Frequency of Use and *Theory 38 Message Not Facilitated by Frequency of Use*	Awareness can also be impacted by the number of order sets used. For example, in a particular unit the admission orders would be used frequently and the awareness of the availability of the order set would be high. Other order sets might be available to support care that is needed infrequently or rarely. Awareness and/or remembering that an order set is available to support this care can be more difficult to sustain.
Theory 39 Interaction in Social Networks and	Social influence approaches are founded on the theory that the opinions and feedback from significant individuals within a social network impact behaviors. The focus of these types of approaches is based on learning and changing achieved as a result of

Theory	Findings
Theory 40 Formal and Informal Leaders	influence and interactions with others. This strategy is supported by professional communication (Grol & Grimshaw, 1999).
Theory 41 Formal and Informal Leaders All Levels	The importance of champions at all levels including respected physician champions to engage physicians was frequently mentioned in the literature (Abramson L, 2007; Ahmann & Maynard, 2008; Ellerbeck, Bhimaraj, & Hall, 2006; Fear, 2011; Fleming et al., 2009; Maynard, 2009; Peshek et al., 2010; Reingold & Kulstad, 2007). Meleskie and Eby (2009), advised using physicians to engage physician groups. Social influences were identified in a number of papers. Several papers described the use of respected lecturers (national and local experts) to engage users (Perkins et al., 2008).
Theory 42 Formal and Informal Leaders Attitude	Formal and informal leaders provide conflicting messages Social influences can provide both positive and negative impacts. Asaro et al. (2005) noted that attending physician attitudes can have a trickledown effect that was not always positive.
Theory 43 Formal and Informal Leaders Availability	Ellerbeck et al. (2006), noted that "smaller hospitals" were much less likely to have implemented standardized order sets and less likely to have identified physician champions.
Theory 44 Formal and Informal Leaders Turnover	One participant (p. #01) noted that challenges were encountered in one unit when the formal leadership changed and did not support the order sets in use.
Theory 45 Leadership and Resource Support	Maynard (2009), noted the importance for the commitment to support standardization even in the face of occasional resistance from medical staff.
Theory 46 Leadership Support	The importance of solid order set governance at all levels (senior organizational and departmental leadership, front line champions; professional practice leadership) (Fear, 2011; Hagland, 2009; Peshek et al., 2010), plan with appropriate resources (physical, financial and human) for process redesign, standardization and safe implementation (Abramson, 2007; Hoffman et al., 2011; Meleskie & Eby, 2009) were mentioned in the literature (Hoffman et al., 2011), but not discussed extensively.
Theory 47, 48, 49 Resource Support (a, b, c):	In the electronic formats the need for well-maintained computer networks and sufficient numbers of computers, monitors and printers in clinical areas was noted as key to adoption success (Heffner et al., 2004). One participant (p. #13) indicated that in early stages there was some initial lack of computers but as the organization moved forward on a larger informatics project these challenges were addressed as part of that work with more and faster computers being installed. The bigger challenge was noted to be the maintenance component relating to human resources needed to support regular best practice review and corresponding order set updates. Another participant (p. #13) noted that when the project was going live, standardization was a big component that was well supported with 24 hour tech support, computer and printer availability etc. , but now it is primarily related to maintenance (e.g. order set changes, moving printers and updating technology). Other participants noted that the sustainability is challenged by the human resource limitations (time and work prioritization) impact for ongoing development and maintenance of current evidence based practice order sets.
*Theory 50, 51 Life Cycle Ease of Use (a,b) *applied to order set life cycle administration and*	*Administration:* The life cycle process was frequently mentioned in the literature papers (Anonymous, 2009; Fear, 2011; Feldbaum, 2010; Fratino et al., 2009; Hagland, 2009; Heffner et al., 2004; Maynard, 2009; Pollack et al., 2007;). The importance of a single (Maynard, 2009), timely (Anonymous, 2007; Fear, 2011), standardized (Ballard et al., 2008; Maynard, 2009; Meleskie & Eby, 2009), process with a vision for the overall goals (Hagland, 2009) cannot be over stated. The findings related to the administration

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Theory	Findings
the four phases of order set life cycle management	of the order set life cycle identified the need for structure behind the life cycle processes to support users as well as the prospect of identifying opportunities to manage delivery formats and facilitate adoption (e.g. managing perceived need by targeting most frequently used order sets).
	Challenges associated with life cycle management were identified by interview participants at Site One where they expressed awareness of confusion and frustration with a process that encompassed two separate reporting structures (one for clinical content and the second electronic development). Site Two was working with streamlined order set management processes incorporating a single approval body and modular development standards. One participant (p. #03) noted the "huge difference" as a result of the changes brought with this new process citing greater speed and ease of use. The process was noted to be clear and easy to manage resolving the challenges that previously took months to resolve. Another comment shared was that in the past order sets could to take 6 to 12 months to develop with evidence based practice changes occurring within the development time span.
	Despite complexities and frustrations noted at Site One, it was interesting to note that one of the interview participants (p. #03) from a high perceived need group (e.g. oncology care provider) indicated surprise that some users found the process complex and confusing. This suggests that perceived need and/or frequency of use may have impacted on perceptions of ease of use.
	Phase1 Order Set Development: Standardized organizational principles and format were recommended for the development of order sets (Abramson, 2007; Feldbaum, 2009). This included the standardization of orders (e.g. eliminating competing or conflicting orders and standardizing with evidenced based versions) (Formea et al., 2010; Starmer & Waitman, 2006).
	Customizable templates for rapid draft development (Fear, 2011), naming conventions (Feldbaum, 2009) and modular formats (Anonymous, 2010; Meleskie & Eby, 2009), were all suggested.
	The challenges of standardization across multiple sites was also discussed (Maynard, 2009). Due to variations in formularies, lab test availability and support services (e.g. inter professional consultants) there can be impacts on local adoption. Consultation was the key to address local context (Meleskie & Eby, 2009). The use of virtual tools and user friendly dashboards were endorsed to facilitate development and approval (Fear, 2011). Feldbaum (2009) also recommended a policy for conflict resolution.
	Delivery format also impacted development components of life cycle management. Participants from Site One identified that the CPOE delivery format added complexity to the process as developers worked with both information management builders and professional practice bodies (e.g. medical advisory committee). The impacts of functioning in a hybrid CPOE/paper environment has meant that some content is prepared and built into the CPOE system while other content must be formatted on paper. A separate paper order set that incorporates the content of both the CPOE and paper hybrid format is also needed to manage the potential for computer down time.
	Electronic order set formats required similar but additional considerations. For example, Hoffman et al. (Hoffman et al., 2011) indicated the importance of incorporating computer down time processes into the planning.
	Phase 2 Order Set Approval: It was suggested that approval processes be streamlined (reduced bureaucracy) to allow for rapid processing and efficient use of resources (Fear, 2011; Meleskie & Eby, 2009). A central approval body was recommended and advised to include research groups, pharmacists, process experts, quality and safety experts (Formea et al., 2010). Virtual tools were suggested as a potential means to facilitate the activities (Fear, 2011).
	The participants from Site One described complex development and approval processes while Site Two described streamlined minimal processes. One participant from the Site One (p. #01) suggested that size and complexity of the organization necessitated

Theory	Findings
	the more complex processes. It was notable that this site had fewer beds and sites than the organization with the more streamlined process suggesting that size may not be the primary challenge. *Phase 3 Order Set Implementation:* Implementation approaches varied based on delivery formats and phase of the order set in the life cycle management process. Implementation was described with order sets as a single concept or as a component in a larger electronic or CPOE implementation. Alternatively, order sets were already established in one of the delivery formats and the focus of implementation was narrowed to a single order set within one or multiple settings. Both study sites were in established order set environments (e.g. Site One had implemented CPOE in some areas and Site Two was in the process of implementing electronic order sets). There were several implementation strategies mentioned in the literature but these were usually discussed in the context of early phases of order set projects. It was suggested that order sets be introduced on paper prior to the introduction of electronic support systems (Fear, 2011; Peshek et al., 2010). Phased electronic approaches were also recommended (dependent upon the level of technology penetration in the organization) (Formea et al., 2010; Hoffman et al., 2011). *Phase 4 Order Set Evaluation, Maintenance or Revision:* Order set maintenance requires regular review, revision and quality assurance measures (Heffner et al., 2004). The importance of a supporting infrastructure with updates and quality improvement were noted (Ballard et al., 2008). For this reason the order set life cycle process must be designed with maintenance in mind (Feldbaum, 2009; Hagland, 2010). Maintaining order set currency is challenging necessitating a streamlined process (Abramson, 2007) as was echoed by participants from both study sites. One participant indicated that maintaining currency for medications was done well but less so for lab and diagnostic order sets. There must be the ability to rapidly respond to the need for updates and changes across multiple order sets (Ahmann & Maynard, 2008; Meleskie & Eby, 2009; Pollack et al., 2007), as well as the ability to provide auto alerts to the front line when these changes are made (Fear, 2011). Quality improvement requires the ability to analyze process to identify unintended consequences (Rosenal et al., 2009; Perkins et al., 2008). Ongoing education and feedback for process improvement and evaluation was also suggested. (Anonymous, 2009; Rosenal et al., 2009). One participant from Site One (p. #01) commented on delay challenges when making order set changes in the CPOE format because of the need to wait for system updates that occurred at set time intervals. Another participant from Site One (p. #07) indicated that resources are often adequate for new or development phases but the maintenance phase often entails more limited focus.
Theory 52 Targeted Behaviour can be achieved with Accountability Strategies in Place	Behaviorist approaches are founded on theories related to conditioning and controlling behavior by use of external stimuli before or after the desired change. Strategies such as providing feedback, giving reminders and providing incentives or sanctions would be employed (Grol & Grimshaw, 1999).
Theory53: Behaviourist Approaches	Feedback about order set use provided to the users was proposed to facilitate order set adoption and adherence to processes (Abramson, 2007; Ahmann & Maynard, 2008; Maynard, 2009; Starmer & Waitman, 2006). Maynard (2009), suggested real time

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Theory	Findings
	proactive intervention applied to outliers who were not providing evidence based practice care e.g. VTE prophylaxis and provision of feedback to prescribers to achieve targeted goals in patient care.
Theory 54: Behaviourist Approaches but Poor Supports for Change	Ellerbeck et al. (2006) suggested data feedback to users but also noted that this feedback can result in a negative impact if the feedback occurs in absence of systems to support change. This was also identified by Ahmann &Maynard (2008), who recommended a focus on audits in early implementation phases to monitor for non-adherence and evaluation of the identified outliers. This was intended to determine if the variation was specific for an individual or characteristic of a specific group or the whole. Deviations might be occurring for valid reasons that need to be addressed. There may be gaps in education related to the order set or the practices being supported by the order set (e.g. VTE prophylaxis). Alternately, variations might be occurring for non-valid reasons; these may need to be addressed with behavioural or organizational approaches.
Theory 55: Behaviourist Approaches Ineffective	A participant from Site One (p. #05) indicated that the only feedback provided to prescribers was of the immediate type (e.g. when there were impacts to process because a component of an order set was incomplete). It was also noted that the structure of the current CPOE system was able to identify that some groups may use the CPOE system more or less than other groups but it did not support the collection of audit information i.e., there was no way to detect where an order had been generated or if it was a component of an order set versus an individually generated order. In some areas manual audits were completed and usually occurred where foundational information to another initiative was necessary. One participant (p. #04) noted that when this information was available, it demonstrated anticipated improvement but was not as great as expected and there was clearly a need for further improvements.
Theory 56: Behaviourist Approaches Follow Through	A Site Two participant related that there had been some discussion about the use of behavioural approaches but the resource intensive component of chart audits had not seen this initiative move forward. Another participant (p. #17) indicated that although the electronic order set system did not currently support user audits beyond site access (e.g. not at the user or departmental level) the pharmacy system allowed for the tracking of orders and was utilized in a limited capacity (e.g. for the purposes of monitoring overuse of expensive antibiotics).
Theory 57 Targeted Behaviour can be achieved with Incentive Strategies in Place (a) and Theory 58 Incentives Impact Perceived Need:	Hagland (2010) stated that the bigger adoption challenge with order sets was related to clinician needs rather than attitudes. The perceived need (usefulness) of an order set impacted the perceived ease of use. Asaro et al. (2005), noted that residents or new learners identified a greater perceived need than more experienced attending staff. This perception of need may also have limited the identified degree of challenges or barriers associated with the use of those order sets.
Theory 59 Perceived Need Impacts on Perceived Ease of Use/Usefulness Care Complexity	Specific prescriber groups were identified with differing perceptions related to the need for order sets. For example, oncology groups have the need to write very complex sets of orders to support patient care. The clinical decision support available within order sets, as well as the inclusiveness of potential content, can facilitate prescribers' perception of need to complete the ordering process. One participant (p. #03) within this prescriber group expressed surprise that there may be groups who did not experience similar need for order sets.
Theory 60 Perceived Need Impacts on Perceived	Prescribers who were providing care in a context with routine practices and minimal variation of patient outcomes often need to complete order sets with minimum variation in content (e.g. post-operative knee replacement orders). Prepared order sets that

Theory	Findings
Ease of Use/Usefulness Time Saving	document this recurring process requirement saved time and improved provider workload and workflows in turn improving perceptions of ease of use of an order set.
Theory 61 Perceived Need Impacted by Patient Complexity	Within other contexts patient complexity and the limited flexibility of a pre-defined order set made it challenging to complete the ordering process. This occurred in scenarios where patients had multiple co-morbidities and/or high risk outcomes (e.g. medical patients, critical care patients) (Ballard et al., 2008; McAlearney et al., 2006). Munasinghe et al. (2011), identified that many medical patients with more than one diagnosis at the time of admission required the selection of several different order sets to manage care. When multiple order sets were used for this purpose the prescriber was required to review the content and delete/exclude duplicate orders that were already prescribed by completion of the initial order set (Munasinghe et al., 2011). This type of challenge impacted prescribers' perceptions of the ease of use/usefulness for an order set and resulted in decreased or poor order set use.
Theory 62 Perceived Need Impacts on Perceived Ease of Use/Usefulness	In attempts to address patient complexity the literature papers (Munasinghe et al., 2011), and participants identified strategies to manage this potential barrier. The application of modular subsets or orders to a general admission order set was suggested to avoid repeated orders to manage multiple disease specific needs. For example, a general admission order set could include smoking cessation and adult immunization while modules that address co-morbidities such as hypertension and diabetes could be added. Several participants described similar strategies to improve order set flexibility. For example, critical care settings employed intervention specific order sets such as those to address hypothermia, intra-aortic balloon pump management and anticoagulation and insulin infusions. The above findings demonstrate that some groups can be predicted to have a greater perceived need and also that some strategies can be used to target this user trait to facilitate order set adoption.
Theory 63 Targeted Behaviour can be Achieved with Incentive Strategies in Place (a) and Theory 64: Perceived Need Impacts on Resident Learning (a)	It was noted in the papers (Asaro et al., 2005), as well as by some participants that order sets and the content can be viewed as a teaching tool for new and inexperienced care providers.
Theory 65 Perceived Need Impacts on Resident Learning (b)	The view of use as a resident learning tool was questioned by some more experienced providers who suggested that order sets impeded new user learning. The perception of some more experienced providers was that the "check list" format did not allow or support the development of critical thinking for inexperienced clinicians. One participant shared that a department within their organization developed order sets that required a decision for each potential order in the order set (e.g. there were no default or automatic orders). Each potential order within the set was required to be checked to be implemented. Alternatively, another participant related that one surgeon requested that all orders within one procedural order set be automatically checked or defaulted. The proposal being that there were minimal variations in need related to the procedure and default orders would facilitate workflows. A third participant asserted that order sets were "more about getting it done", rather than intention to provide a learning environment. These conflicting views demonstrate the variance in priorities for the adoption of order sets. It was stated by one participant (p. #08) that the first priority of the order set tool was to provide the best quality care. The use of order sets changes the

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Theory	Findings
	experience of learning. They inform evidence based practice but critical thinking remains essential. It was stated that there was no evidence that learning was improved without the use of order sets, "Is it better to get lost with a map than without?"
Theory 66 Targeted Behaviour can be achieved with Incentive Strategies in Place (b) and Theory 67 Valid Tool That Facilitates Evidence Based Practice:	Another role based perspective identified (p. #01) was associated with nurses and allied health workers. Some nurses and allied health care providers (both experienced and less experienced providers) on an individual or group basis were noted to feel empowered having some confidence that order sets provided an evidence based practice standard of care.
Theory 68 Nurses and Allied Care Providers Advocate for Prescriber Use:	They were more likely to engage prescribers in discussion about ordering practices using the order sets to leverage their credibility. It was also shared by several participants that adopted order sets facilitated general discussion among providers related to prescribing practices. For example, an order to administer a medication by a naso-gastric tube to a post-operative patient resulted in discussion when providers pointed out that although the medication was an important component for care patients were not always admitted with the naso-gastric tube in place to complete the administration. Discussion ensued to address the contradiction. Order sets have thereby precipitated more open dialogue about process.
Theory 69 Targeted Behaviour Achieved with Incentive Strategies in Place (c), Theory 70 Ease of Use Supports Workflow - Delivery Format (a) and Theory 71 Ease of Use Supports Workflow – Delivery Format (b)	The ease of use of an order set can impact clinician workflow (Maynard, 2009; Abramson L, 2007). Reingold and Kulstad (2007) advised a simplified delivery format for paper order sets to improve adoption (e.g. human factor design for development addressing workflow and cognitive needs). In relation to process, although paper was not often referred to as the preferred delivery format, there were benefits mentioned both in the literature and by interview participants. There was greater ease of modification for prescribers when using a paper format. Both electronic formats require a computer log in and navigation process. As one participant (p. #07) alluded, an electronic format cannot improve on the ease of checking off tick boxes with a pen on a piece of paper and signing your name. Other participants (p. #16) described process challenges where the paper format better facilitated workflow. Scenarios that required urgent and time sensitive care have been facilitated with packages of paper that include all of the appropriate order sets, requisitions, and guideline support. While these associated documents can be made available in some electronic formats, the paper process had proved to be more efficient to date. With those noted benefits aside, many challenges with the paper format were noted. Some prescribers described challenges with finding the order set needed (Anonymous, 2009; Perkins et al., 2008), finding multiple pages of an order set and awareness of the variety of order sets available. Challenges noted by order set administrators included maintaining stock and storage at the front line, the ability to maintain currency (e.g. finding and discarding outdated order sets, cost of waste when changes are made and pre-printed versions discarded, printing and storage costs and costs of no carbon required (NCR) copy paper (needed to share multiple copies of the order set with multiple provider groups). It was noted in the papers (Asaro et al., 2005), and by participants that despite challenges, the electronic formats were preferred over paper.

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	The electronic and CPOE format offered patient safety advantages such as readability and facilitated access to decision support (Khajouei et al., 2010). They also had the ability to overcome some of the challenges associated with paper order sets (Bobb, Payne, & Gross, 2007). Order set administrators noted the reduced costs versus paper management and the improved ease and efficiency of managing changes in content. Benefits noted in the papers (Hagland, 2009; 2011; Khajouei et al., 2010), were not available in all settings. In some circumstances limitations were related to software constraints and in others linked to complexities of working in a hybrid environment. For example, one participant (p. #06) noted that despite a CPOE format, the organization struggled to keep prescribers aware and provide easy access to appropriate order sets. Although there was a searchable database, it was not user friendly. In addition, the structure of the information system required changes to the software when the user changed roles (e.g. a resident moving from medicine to surgery setting). If the user neglected to notify the information management team they would continue to be directed to order sets appropriate to the previous role. While the appropriate order sets for the new role could be searched the process was challenging. The ability to make changes to order sets was greatly facilitated by electronic systems. The assumption with electronic formats was that there would be the ability to make one change that translated into an equivalent change among all relevant order sets. While this was often possible, one participant from Site One (p. #05) noted that changes often had to wait for quarterly computer data base rolls or system updates. Participants from Site Two reported the greatest ease for managing this type of change. One participant commented on the significant challenges of transitioning to an electronic or CPOE format with the need to function in a hybrid environment. The complexity adds considerable risk for process management. Electronic order sets could be completed on screen or, in a hybrid environment, printed for completion. They included opportunities for free text orders, supporting information related to methods of ordering medication or interventions, decision support tools to guide prescribers and reminders and alerts (Heffner et al., 2004). Once completed, the information could be relayed electronically to other departments. Challenges identified by participants included the system limitations impacting flexibility to choose individual modules and lack of prompts or links to additional order sets. Additional challenges cited by participants were related to infrastructure resources (e.g. enough computers, enough printers, routing computers to appropriate printers, and log on processes). It was noted that the implementation of CPOE can help to overcome some of the constraints of paper (Bobb et al., 2007). It was also reported that CPOE was preferred despite its own limitations (e.g. need for computer sign on, need to wait for data base roles to make changes). In contrast, Ahmann and Maynard (2008), cautioned that improved automation and control refinements come at a cost of increased complexity. The papers supported that order sets (as opposed to single orders) in the CPOE system imposed less cognitive and physical demands on users (Khajouei et al., 2010). A well-developed CPOE system should improve efficiency of workflow, minimize clicking and scrolling and decrease order volume (Ali et al., 2005; Feldbaum, 2009). Hagland (2010) suggested that the transition to CPOE means the shift of some workload to the physician group. The importance of design to facilitate clinician workflows was noted (Fear, 2011). The CPOE delivery format context offered many advantages but was also the most complex to implement. Challenges noted in the papers for the CPOE delivery format included the need to minimize alerts to avoid alert fatigue and

Theory	Findings
	maintain effective workflow (Fear, 2011; Hoffman et al., 2011; McAlearney et al., 2006; Peshek et al., 2010). It was also noted that use of CPOE increased over time. (Asaro et al., 2005; Starmer & Waitman, 2006). Peshek et al. (2010) indicated that the more comfortable users were with the system the more they requested new types of order sets. This suggests that familiarity with electronic systems facilitates ease of use. One participant (p. #14) commented that use of electronic formats was facilitated when users were familiar with working in electronic systems - i.e., areas that had already moved forward with electronic documentation. Another participant stated that familiarity did not always result in evidence based practice noting that, *"There is often the path of least resistance"* (p. #06). This was referring to the fact that prescribers challenged with completing an order will settle for choices that will bring them close to where they were aiming settle for an order that may be satisfactory because the better option was becoming too much trouble. In the paper format they would have written exactly what they wanted.
Theory 72 Organizational Policies	Coercive approaches are intended for use to implement change habits and routines that may be fixed and require external stimulus to achieve change. Pressure and control in the form of policy, financial consequences or regulation may facilitate the change process based on learning theories and negative consequences (see Table 26). The coercive approach was the least frequently identified but may have been in place without acknowledgement or awareness by the users. For example, policies or accreditation standards that are already in place may be impacting order set adoption by some users.
Theory 73 Organizational Policies in Place	It was suggested in the literature papers that institutional mandates or coercive approaches could be a very effective strategy (Maynard, 2009). Fear (2011), described enlisting solid support for order set policies starting with senior medical staff. In contrast, Heffner et al. (2004), indicated that no policies were used to support order set use.
Theory 74 Organizational Policies Absent	Participants from both sites suggested that coercive approaches were not really used as drivers for order set use but rather the focus was on encouragement and social influences. One participant (p. #15) noted that some prescribers wait until they absolutely must before they choose to participate. In the interim evidence based practice committees promote care improvement to achieve a critical mass of users. Another participant suggested that because there is flexibility in the order sets (e.g. don't have to use all orders) there is no real need for a coercive approach.
Theory 75: Organizational Policies Enforcement	Other participants noted that there really was no opportunity to use coercive approaches when there were no audit capabilities to identify outliers. Policies are often in place but primarily related to development and maintenance not order set use. Accreditation standards may be in place defining evidence based practice but as one participant (p. #16) noted they are difficult to impose in the current physician management model where physicians are not employees of the organization. One interview participant (p. #06) from Site One noted that there is often the expectation that the computer will police the process but stated that people must police processes and be accountable. An example presented was that the computer can introduce multiple questions to direct prescribers away from inappropriate use of tests or medications but this ultimately adds to workload which affects patient care. It was also noted within this organization that the hybrid delivery format sets the stage for conflicts when nurses are forced to remind prescribers (usually physicians) who initiate order sets in the CPOE format and neglect to complete the paper components of the same order set.

Appendix N Theory Chain Theories

* Participants confirmed all theories but some theories were only identified by participants
**Framework approach theory

Theory Number	Theory	Theory Component	Literature Quality Level **Number of Papers**		
			Level A	Level B	Level C
Epidemiological Approaches: Stakeholder Engagement Theme					
Theory 1	Communication Stakeholder Engagement and Theory		2	7	12
Theory 2	Feelings of Ownership		2	7	12
Theory 3	Engagement Attempts Rejected (a)		*Participant Identified		
Theory 4	Engagement Attempts Rejected (b)			1	
Theory 5	Feelings of Ownership (a)			1	
Theory 6	Feelings of Ownership (b)			1	
Theory 7	Adoption despite No Direct Engagement			1	
Epidemiological Approaches: Quality of Content Theme					
Theory 8	Cognitive Choice		**Framework		
Theory 9	Order Sets are a Valid Tool (a)				
Theory 10	Order Sets are a Valid Tool (b)			1	3
Theory 11	Order Sets are a Valid Tool (c)			1	3
Theory 12	Order Sets are a Valid Tool (d)			1	3
Theory 13	Order Sets are a Valid Tool but Question Available Research		1	1	1
Theory 14	Order Sets are a Valid Tool but Research in Progress				
Educational Approaches					
Theory 15	Desire to Grow		3	3	1
Theory 16	Motivation		1		1
Theory 17	Education Method			3	5
Theory 18	Education Content Validity			1	

Theory Number	Theory	Theory Component	Literature Quality Level Number of Papers		
			Level A	Level B	Level C
Theory 19	Targeted Stakeholders Non-Receptive		Participant Identified		
Theory 20	Education Content Validity (b)		Participant Identified		
Marketing Approaches: Pre-Implementation Theme					
Theory 21	Identify Product or Service of Interest		Framework		
Theory 22	Target Product or Service of Interest		2		2
Theory 23	Perceived Need (a)		2		2
Theory 24	Perceived Need (b)		2		2
Theory 25	Perceived Need Lacking		2		2
Theory 26	Create Perceived Need (a)		Participant Identified		
Theory 27	Create Perceived Need (b)		Participant Identified		
Marketing Approaches: Implementation Theme					
Theory 28	Communication Leads to Awareness		2	3	1
Theory 29	Message Does Not Reach Target Audience		Participant Identified		
Theory 30	Communication of Availability and Advantages		Participant Identified		
Theory 31	Communication Strategy Effective but Does Not Reach Target Audience		1	1	
Theory 32	Communication Effective but Order Sets Not Available		Participant Identified		
Marketing Approaches: Sustainability Theme					
Theory 33	Communication (b)				2
Theory 34	Product Change		Participant Identified		
Theory 35	Message Communicated but Target Changes		Participant Identified		
Theory 36	Message Re-Communicated Formal and Informal Structures		Participant Identified		
Theory 37	Message Facilitated by Frequency of Use		Participant Identified		
Theory 38	Message Not Facilitated by Frequency of Use		Participant Identified		
Social Influence Approaches					
Theory 39	Interaction in Social Networks		Framework		

Theory Number	Theory	Theory Component	Literature Quality Level Number of Papers		
			Level A	Level B	Level C
Theory 40	Formal and Informal Leaders		Framework		
Theory 41	Formal and Informal Leaders All Levels		1	5	3
Theory 42	Formal and Informal Leaders Attitudes			1	
Theory 43	Formal and Informal Leaders Availability			1	
Theory 44	Formal and Informal Leaders Turnover		Participant Identified		
Organizational Approaches: Leadership and Resource Support Theme					
Theory 45	Leadership and Resource Support			1	
Theory 46	Leadership Support			3	4
Theory 47	Resource Support (a)			1	
Theory 48	Resource Support (b)		Participant Identified		
Theory 49	Resource Support (c)		Participant Identified		
Organizational Approaches: Life Cycle Management Theme					
Theory 50	Ease of Use (a)	Administration	1	7	7
		Development		4	5
		Approval		1	3
		Implementation		1	3
		Maintenance	2	6	5
Theory 51	Ease of Use (b)	Administration	Participant Identified		
		Development		2	1
		Approval	Participant Identified		
		Implementation		1	3
		Maintenance	Participant Identified		
Behaviorist Approaches					
Theory 52	Targeted Behavior achieved with Accountability Strategies in Place		Framework		
Theory 53	Behaviorist Approaches		1	3	2
Theory 54	Behaviorist Approaches but Poor Supports for Change		1	1	

Theory Number	Theory	Theory Component	Literature Quality Level Number of Papers		
			Level A	Level B	Level C
Theory 55	Behaviorist Approaches Ineffective		Participant Identified		
Theory 56	Behaviorist Approaches Follow Through		Participant Identified		
Behaviorist Approaches: Perceived Ease of Use/Usefulness Theme					
Theory 57	Targeted Behaviour achieved with Incentive Strategies in Place (a)		Framework		
Theory 58	Incentives Impact Perceived Need		Framework		
Theory 59	Perceived Need Impacts Perceived Ease of Use/Usefulness Care Complexity		Participant Identified		
Theory 60	Perceived Need Impacts Perceived Ease of Use/Usefulness Time Saving		Participant Identified		
Theory 61	Perceived Need Impacted by Patient Complexity		2	1	
Theory 62	Perceived Need Impacts on Perceived Ease of Use/Usefulness			1	
Behaviorist Approaches: Perceived Ease of Use/Usefulness Learning Theme					
Theory 63	Targeted Behaviour achieved with Incentive Strategies in Place (b)		Participant Identified		
Theory 64	Perceived Need Impacts on Resident Learning (a)			1	
Theory 65	Perceived Need Impacts on Resident Learning (b)		Participant Identified		
Behaviorist Approaches: Perceived Ease of Use/Usefulness Empowerment Theme					
Theory 66	Targeted Behaviour achieved with Incentive Strategies in Place (c)		Participant Identified		
Theory 67	Valid Tool That Facilitates Evidence Based Practice		Participant Identified		
Theory 68	Nurses and Allied Care Providers Advocate for Prescriber Use		Participant Identified		
Behaviorist Approaches: Ease of Use Delivery Format Theme					
Theory 69	Targeted Behaviour achieved with Incentive Strategies in Place (d)		Framework		
Theory 70	Ease of Use Supports Workflow – Delivery Format (a)		3	7	5
Theory 71	Ease of Use Supports Workflow – Delivery Format (b)		1	5	6
Coercive Approaches					
Theory 72	Organizational Policies		Framework		
Theory 73	Organizational Policies in Place			1	2

Theory Number	Theory	Theory Component	Literature Quality Level Number of Papers		
			Level A	Level B	Level C
Theory 74	Organizational Policies Absent		Participant Identified		
Theory 75	Organizational Policies Enforcement		Participant Identified		