Use of Order Sets in Inpatient Computerized Provider Order Entry Systems: A Comparative Analysis of Usage Patterns at Seven Sites

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Abstract

Background—Many computerized provider order entry (CPOE) systems include the ability to create electronic order sets: collections of clinically-related orders grouped by purpose. Order sets promise to make CPOE systems more efficient, improve care quality and increase adherence to evidence-based guidelines. However, the development and implementation of order sets can be expensive and time-consuming and limited literature exists about their utilization.

Methods—Based on analysis of order set usage logs from a diverse purposive sample of seven sites with commercially- and internally-developed inpatient CPOE systems, we developed an original order set classification system. Order sets were categorized across seven non-mutually exclusive axes: admission/discharge/transfer (ADT), perioperative, condition-specific, task-specific, service-specific, convenience, and personal. In addition, 731 unique subtypes were identified within five axes: four in ADT (S=4), three in perioperative, 144 in condition-specific, 513 in task-specific, and 67 in service-specific.

Results—Order sets (n=1,914) were used a total of 676,142 times at the participating sites during a one-year period. ADT and perioperative order sets accounted for 27.6% and 24.2% of usage respectively. Peripartum/labor, chest pain/Acute Coronary Syndrome/Myocardial Infarction and

diabetes order sets accounted for 51.6% of condition-specific usage. Insulin, angiography/ angioplasty and arthroplasty order sets accounted for 19.4% of task-specific usage. Emergency/ trauma, Obstetrics/Gynecology/Labor Delivery and anesthesia accounted for 32.4% of service-specific usage. Overall, the top 20% of order sets accounted for 90.1% of all usage. Additional salient patterns are identified and described.

Conclusion—We observed recurrent patterns in order set usage across multiple sites as well as meaningful variations between sites. Vendors and institutional developers should identify high-value order set types through concrete data analysis in order to optimize the resources devoted to development and implementation.

Keywords

order sets; electronic health records; clinical decision support; computerized physician order entry system

Introduction & Background

Computerized provider order entry (CPOE) with embedded clinical decision support (CDS) has been shown to improve the quality and efficiency of patient care, reduce errors and increase adherence to evidence-based care guidelines (1–5). Many CPOE systems allow for the use of order sets, collections of clinically-related orders grouped together for convenience and efficiency. Order sets may be designed for a wide variety of clinical scenarios including any type of hospital admission (e.g. cardiology admission), condition (e.g. myocardial infarction), symptom (e.g. chest pain), procedure (e.g. angiography), or treatment (e.g. chemotherapy). Such tools have existed in paper form for many years – long before the advent of electronic medical records or CPOE – and continue to be used today (6–8). However, CPOE allows order sets to be deployed more widely and consistently across the hospital setting. For the purpose of this paper, we consider an "order set" to be a collection of orders designed around a specific clinical purpose and intended to be used together. This differs from an "order pick list" which lists related orders that are not designed to be used as a unified group (e.g. a list of antibiotics). A sample electronic admissions order set used at Brigham & Women's Hospital is shown in Figure 1.

The use of order sets has been shown to improve the quality and efficiency of care and increase adherence to evidence-based guidelines (8–13). They accomplish these aims by influencing provider behavior at the point of order entry. Order sets serve a function similar to a checklist, ensuring critical steps are not missed during a given care process. Rather than entering desired orders from memory, providers are presented with a list of orders relevant to the particular clinical scenario.

In addition to preventing steps in a clinical process from being overlooked, order sets also provide tacit decision support based on their content. For example, the use of an "acute myocardial infarction" order set has been shown to increase the probability that a beta blocker is administered (as well as other evidence-based treatments such as aspirin, ACE inhibitors, heparin therapy, tenecteplase and eptifibatide) (7). In an electronic format, such an order set might also 1) ensure that the most effective beta blocker is used (by listing the preferred standard-of-care as the only option, the default selected choice, or first on the list of choices), 2) enable documentation of a contraindication to beta blocker therapy if no beta blocker is chosen and 3) enable more widespread tracking and measurement of the delivery of evidence-based case.

Despite evidence suggesting that order sets may be of value for improving patient care, only limited research exists on order set usage patterns and much current research is focused on

narrow clinical applications (such as the implementation of a single order set for a specific condition). Payne et al (2003) (14) were among the first to conduct a broad investigation of "order configuration entities" that might improve CPOE efficiency and increase provider acceptance of CPOE, including: order dialogs (guided ordering), quick orders (preconfigured orders), order menus (a organizational hierarchy of orders), and order sets (collections of related orders). They found that, although time-consuming and resource-intensive to produce, such entities were valuable tools for accomplishing these goals. In addition, they found that the majority of usage was skewed towards a subset of all implemented content. The investigation was limited to a single site (Veterans Affairs Puget Sound Health Care System, Seattle & Tacoma, WA) and thus our goal in this project was to expand and update these results by examining order set usage across multiple clinical sites.

Given that the development of orders sets is both time- and resource-intensive (14, 15), an improved understanding of order set usage patterns could be of value for both vendors and institutions attempting to develop and implement these tools. Although some automated methods of generating order sets have been proposed (16, 17), order sets are generally designed and implemented using manual processes, with content determined by local governance committees. Researchers and standards developers are also currently exploring ways to share order set content across sites (18, 19). Through automation and content sharing, it may be possible to make the order set a more efficient, cost-effective and widely-used tool.

In order to generate useful order set content, a better understanding of order set usage patterns and identification of "high-value" order sets is needed. Expanding on previous research (20), we developed a basic order set classification scheme to describe the different types currently in use and analyzed order set usage across a purposive sample of seven sites with CPOE. The goal of this project was to identify specific order set usage patterns that could aid clinical sites and vendors in prioritizing development of high-value order sets.

Methods

Sample

We selected a diverse purposive sample of ten clinical sites with computerized order sets and requested information on each site's order set usage in the inpatient setting for a period of one year. This sample was designed to include a geographically diverse mix of small and large, community and academic medical centers with a range of CPOE systems (both self-developed and commercially-developed systems with a mix of vendors), case heterogeneity and patient volume (measured by case-mix index, which represents the average diagnosis related group relative weight for a hospital). Seven sites agreed to participate in the project, two did not have usage data available and one declined to participate due to time constraints. The final sample (n=7) is shown in Table 1 and site characteristics are presented in the results section. Data on staffing, case mix index, discharges, and patient days were based on information provided by American Hospital Directory (28).

Dataset

Order set usage data (for 1,914 total order sets) was obtained from the seven sites. Use of an order set was defined as opening and submitting the order set. It did not matter whether the user activated a single item from an order set or every order in a single set – each counted as one use of an order set. Participating sites were asked to provide anonymized logs of inpatient system-wide order set usage for a full year (including time, date and order set name for each instance of use). Information on unused order sets (order sets with zero uses during the study period) was available at only four sites and thus "zero-use" order sets were

excluded from analysis. One site was able to provide only six months of data due to the system's data storage capabilities. Given that order set usage for this site was largely consistent across the two quarters provided, we doubled the order set use counts in the analysis phase to compensate for the shorter data collection period. All other sites provided a full year of order set data. Start and end dates varied across sites.

Classification of Order Sets

Due to granularity and naming mismatches across sites, it was not possible to conduct a cross-site comparison based on order set name alone. In addition, given the wide variation in order set content and large data set, we believed it would be extremely challenging – and not necessarily fruitful – to analyze order set content directly across sites. Thus, we developed an order set classification scheme in order to 1) provide a method of comparing order set usage across sites with varying naming conventions and order set granularity and 2) create unifying basic categories for a large database of order sets with potentially variable content.

Following qualitative assessment of the collected order set usage data, the following five categories were developed based on order set type as determined by the name of each order set (and, when needed, review of the order set content in a small number of cases):

- **ADT (admissions/discharge/transfer):** Groups of orders related to admission to any hospital service (including general admissions orders), discharge from the hospital or transfer internally or externally. These types of order sets are further divided into subcategories: admission, discharge or transfer.

- **Perioperative (pre-operative/post-operative/unspecified):** Collections of orders related to preparation for surgery or care following surgery (not necessarily specific to a certain procedure) and any surgery-related order sets with a purpose not otherwise specified. These types of order sets are divided into subcategories: pre-operative, post-operative or unspecified (not-otherwise-specified based on order set name).

- **Condition-specific:** Order sets pertaining to a specific diagnosis (e.g. myocardial infarction) or symptom (e.g. abdominal pain). For each condition-specific order set, the related condition was recorded.

- **Task-oriented:** Order sets related to a specific diagnostic (e.g. chest X-ray) or therapeutic procedure (e.g. transfusion) or to administration of a particular medication (e.g. insulin) or other treatment. For each task-specific order set, the related task was recorded.

- **Service-specific:** Order sets related to a specific hospital service (e.g. ICU). For each service-specific order set, the related service was recorded.

In addition, two other categories were identified on the basis of each order set's function and origin:

- **Convenience:** Order sets that catalog laboratory tests, medications or clinical consult orders organized for ordering convenience, but not for any particular clinical purpose. For example, some sites used order sets like "AM Labs" or "Common STAT Labs" that allow common orders to be placed quickly. Unlike regular order sets, users are generally expected to pick only a single or small number of orders from a convenience set, and the convenience set lacks an associated clinical purpose – only some sites had convenience sets, and they were frequently used as workarounds when other mechanisms of organizing orders (e.g. order menus) were not available. As previously mentioned, we do not consider convenience sets to be "true" order sets but define these here for completeness.

- **Personal:** Order sets created or modified for use by an individual or group of practitioners rather than institution-wide committees.

The categories listed above are not mutually exclusive (e.g., a cardiology admission order set would be both "ADT" and "service-specific"). All order sets surveyed fall into at least one category, with many falling into multiple categories. In order to maintain consistency, rules for classification of recurring types of order sets were devised on an ongoing basis and are shown in Appendix A. When an order set was classified into one of the first five categories, specific details (e.g. the condition, task or service) were also recorded.

In order to further compare usage patterns across sites, we also developed an attribute called "order set signature" which combines multiple order set classifications into a single descriptive term. For example, using this strategy, all order sets classified as "ADT (admit)" and "Service-specific (medicine)" can be grouped across sites into the signature "Admit to Medicine." We utilized this attribute to group related order sets across sites and create a list of top signatures.

Data Analysis

Once our list of order set types was finalized, classification of order sets was carried out by study staff (JF). Consensus checks were conducted with the primary author (AW) for a random subset of the order sets, high-use order sets and all those with potentially ambiguous categorization. Additional information was requested from study sites on an as-needed basis when an order set name was ambiguous. All data analysis was carried out in Microsoft Excel and SAS 9.2, including calculation of order set counts and category-specific usage statistics.

Results

Sites

Order set usage data was collected from a diverse sample of sites with CPOE. The characteristics of each of the participating sites, including CPOE system, CPOE install year, order set vendor, location, hospital type, teaching hospital status, number of staffed beds (median: 395, average: 431), case mix index (median: 1.61, average: 1.59), discharges per year (median: 18,384, average: 25,021) and patient-days per year (median: 102,421, average: 129,791), are shown in Table 1. Participating sites included a geographically diverse mix of small and large, academic and community hospitals. Five sites had commercial CPOE systems, while two sites had internally-developed systems.

Order Set Types & Usage

Our data set consisted of 1,914 order sets. These order sets were used a total of 676,142 times in a one year period. Table 1 shows the total number of order sets in use at each site as well as the total number of uses during the study period and the average number of uses per set, per discharge and per bed at each site. Table 2 shows the number of order sets and total order set uses by category for each of the seven sites. Order sets from each site were classified into non-mutually exclusive categories as described above. The total by category and average uses per order set are shown on the right-hand side of Table 2. By count, task-(n=1100) and service-specific (n=956) order sets were the most common, while personal (n=79) order sets were least common. Service-specific order sets contributed the most (53.3%) to overall usage, while personal order sets contributed the least (0.2%). ADT order sets had the highest uses per set (812.5) while personal order sets had the lowest (13.7).

Additional order set usage data is presented in Tables 3a–e. For ADT (Table 3a) and perioperative (Table 3b) order sets, total number, total uses, average uses per set and number of sites with each order set type are shown for each subcategory. Admission order sets were the predominant ADT order set subtype by both count and usage. Post-operative sets were the most common perioperative order set subtype by both count and usage.

For condition-specific (Table 3c), task-specific (Table 3d) and service-specific (Table 3e) order sets, the top ten subcategories are shown by number and use as well as the number of sites with each subtype. The top ten conditions, tasks and services by usage accounted for 75.8%, 37.2%, and 63.9% of usage respectively within each category. The complete lists of all conditions (n=144), tasks (n=513) and services (n=67) by overall usage are available in Appendix B. In addition, 472 convenience order sets and 79 personal order sets were identified, accounting for 29.4% and 0.2% of total usage respectively.

Out of all 1,914 order sets, the top 20% of order sets (383 order sets) by use account for 90.1% of total usage. The cumulative distribution of order set usage by site is shown in Figure 2. The top ten individual order sets by usage (excluding convenience and personal order sets) are shown by site in Table 4a. In addition, the top 20 "order set signatures" (described in the methods section) are shown in Table 4b.

Discussion

We have studied the types and utilization of order sets in a small but diverse sample of hospitals in the United States (US), and learned that at all participating sites, order sets were widely used, although the count and total usage statistics varied drastically. We have dramatically expanded results reported in our previous work (20), which included only a high-level analysis of the top order sets at each site, and data on the cumulative distribution of order set usage. The order set classification scheme, complete review of order set database (n = 1,914) and the extensive category-specific analysis of usage patterns presented in this manuscript are novel findings not previously described.

Our sample was intentionally diverse covering a range of community hospitals and academic medical centers, with a case-mix index (CMI) ranging from 1.12 (a community hospital) to 2.06 (a large academic medical center), a median of 1.61, and an average of 1.59. The CMI is calculated by adding diagnosis-related group (DRG) weight for the hospital's Medicare patients and dividing by the total number of discharges. Medicare, a national health insurance program in the US administered by the federal government, provides health care to individuals older than 65 or to younger individuals with disabilities; Medicare uses DRGs to determine the payment amount for reimbursement according to a patient's diagnosis, procedures performed while in hospital, and other demographic characteristics. Consequently, the CMI takes into account the complexity of the patient's illness and reflects the diversity of the patients treated in a hospital by averaging the DRGs for all patients treated in one fiscal year. For fiscal year 2010, the median CMI for all hospitals in the United States was 1.38, the average was 1.42, with a range of 0.50 to 3.77 (21).

We encountered a large range of order set usage per set, usage per discharge and usage per bed across the seven sites. This may be due in part to differences in the CPOE systems and order set catalogues (the complete library of all order sets) at each site. For example, convenience order sets were especially common at Portland Providence Medical Center (PPMC). In PPMC's CPOE system, order sets are the most efficient mechanism for entering orders, and the PPMC staff have created many convenience sets. In fact, the system has two different constructs for order sets: order outlines (which operate in the Java-based CPOE

front end) and iForms (HTML documents rendered in an external window) – these two constructs are the predominant mode of entry for the system, and the entry of individual orders through non-order set means is less common. However, at other sites, such as Brigham & Women's Hospital, providers seem to rely on other tools in the CPOE for entering individual orders, so convenience orders are uncommon.

In addition, there were notable differences in the granularity of sites' order set catalogues. For example, Faulkner Hospital had only eight ADT order sets covering major hospital services while Massachusetts General Hospital had 58 ADT sets covering a wide range of services as well as specific patient states and procedures. There were also important differences between the order set usage profiles of each site. At some hospitals, ADT order sets predominated while other hospitals appeared to use order sets primarily for convenience ordering. The difference in granularity may reflect differences in each site's order set approach. For example, although all hospitals had the ability to create order sets without needing customization by their vendor, their approach varied. Some hospitals began with model content provided by their EHR vendor or by a commercial order set vendor, while others started from scratch. Further, some allowed users to create personal order sets (a functionality which is generally being phased out in our study sites), while others required departmental sponsorship for order sets. Unfortunately, there is no objective measure regarding the ease or difficulty in creating order sets therefore, we were not able to evaluate this potential confounding factor across organizations. Consequently, we could not distinguish whether the approach to order set creation and modification varied because of the difficulty of this task or due to other reasons.

Overall, much of the variation observed is likely to be due to differences in the clinical information systems (CIS) implemented at each site, local governance practices regarding the use of CIS and differences between the sites themselves (size, patient volume, available services, etc.). Within and across order set categories, we identified several salient usage patterns which are discussed in depth below.

Major Usage Patterns

ADT—The highest usage per set occurred in the ADT category and can be attributed primarily to the use of admissions sets – including generic, service-specific, and condition-specific sets. Usage per ADT set was roughly double the next most frequently used categories. It appears that hospitals get a great amount of utility from these types of order sets, likely because admission is a common occurrence at any large, multi-specialty inpatient facility and requires that many orders be entered at one time. The top order sets by site (Table 4a) and top cross-site order set signatures (Table 4b) also showed a high instance of admissions order sets (including the top order set signature overall, "Admit").

We recommend that, at minimum, a basic admission order set be part of any implementation project. When feasible, additional service-specific admissions sets and condition-specific admission sets should also be developed.

Perioperative—Post-operative order sets were the most common and most frequently used type of perioperative order set, accounting for approximately 73% of total usage within the category. These order sets were often task-specific or service-specific. Pre-operative order sets were also commonly used, and, in some cases, order sets spanned both the pre-operative and post-operative period. We recommend that sites implement a standard pre-operative and post-operative order set and also develop or purchase additional content based on high-volume services and commonly performed procedures.

Condition-Specific—Within the category of condition-specific order sets, we observed that certain common conditions and clinical states dominated overall usage. Peripartum/labor order sets alone accounted for approximately a third of all condition-specific order set usage. The top order sets by site (Table 4a) and top cross-site order set signatures (Table 4b) also showed a high instance of peripartum/labor order sets. Order sets such as those related to cardiac events (Chest Pain/ACS/MI) and thrombotic disease (DVT, VTE and/or PE prophylaxis and treatment) also accounted for a disproportionately large number of uses. Hospitals should prioritize the implementation of order sets related to common conditions and presentations and study their billing and discharge data to determine the highest-value conditions to target.

Task-Specific—Task-specific order sets were by far the most common type of order set in number (1100 total order sets or 57.5%); however, they were used disproportionately less often, accounting for only 31.4% overall, and a large number of task-specific order sets went essentially unused. Thus, it is important that sites work to identify common or especially important tasks for which the development and implementation of order sets is worthwhile.

Based on usage alone, our findings indicate that task-specific order sets may be valuable for frequent procedures or treatments, especially those applicable across conditions and services such as epidural/intrathecal anesthesia, patient-controlled analgesia, electrolyte replacement and blood transfusion. Order sets for common complex surgical procedures such as arthroplasty, angiography and angioplasty were also often used and appear to be supported by order sets based on usage. Sites should create or purchase procedure- and treatment-oriented order sets based on 1) the degree of standardization of the associated task (a more standardized task lends itself more easily to the use of order sets) and 2) the volume of these tasks performed at that particular site. Sites should also identify and implement important task-specific order sets based on other factors such as cost of care and quality and safety initiatives.

Service-Specific—As was the case with condition- and task-specific order sets, a small number of services accounted for a disproportionately large amount of overall usage. The top three services by usage (emergency/trauma, anesthesia and obstetrics and gynecology) accounted for approximately one third of total usage and the top ten services (out of 68) generated over 61% of usage. While sites should develop order sets for all major services, they should preferentially develop order sets targeted to high-volume services, especially the emergency department, obstetrics and gynecology, and anesthesia as applicable. These top services can also be noted frequently in the top order sets by site (Table 4a) and top cross-site order set signatures (Table 4b).

Convenience—We observed a substantial number of convenience order sets: roughly one quarter of the order sets studied fell into this category. However, the instance of convenience orders varied widely across sites. Usage was also highly skewed towards a small minority of order sets: a mere 7.6% of convenience sets account for 80% of usage. The most highly used convenience sets were generally lab or medication pick lists. As previously mentioned, we do not consider convenience sets to be "true" order sets. Convenience sets are generally more akin to pick-lists and are often a workaround when other mechanisms of grouping orders or facilitating the entry of common orders are unavailable. The demand for and use of convenience order sets should be studied to improve the CPOE system as heavy reliance on convenience sets may indicate gaps or deficiencies in the user interface of the system.

Personal—Although many of the sites allowed users to create new order sets or customize existing order sets, personal order sets were uncommon and infrequently used in our study.

This indicates that end users are unlikely to generate their own content, probably due to time constraints and lack of system expertise. While it may be valuable in limited instances to have this functionality available, our results suggest that it is not very likely to be utilized. In fact, several of the sites with personal order sets indicated that they were phasing personal order set capability out, and asking users to substitute standard order sets. We recommend that sites should first research whether personal order sets would be useful in their system and if not, concentrate on developing standard order sets that will be more widely used.

General Patterns—At each of the studied sites, we observed that a small number of order sets accounted for a large proportion of total order set usage (shown in Figure 2). A similar phenomenon was observed with specific categories of order sets as well, as described above. For example, 144 distinct conditions and symptoms were identified within the category of condition-specific order sets. Yet, the top ten accounted for 76% percent of condition-specific order set usage. A similar phenomenon was also observed by Payne et al in their investigation of order configuration entities at VA Puget Sound (14). They found that usage of "order configuration entities" was concentrated in a small number of orders and that 47% of all content went unused during their six-month evaluation period. We have also shown similar patterns for the distribution of medication, problem and laboratory data in an electronic medical record (22).

These findings suggest that sites should attempt to identify high-value order sets before initiating any development and implementation project. Even at the site at which order set use was least concentrated, 80% of total usage came from less than 70 order sets and 95% of usage came from under 175. This indicates that, if thoughtfully chosen, a catalogue of 150–200 order sets may meet the vast majority of a site's order set needs. The top order sets (Table 4a) and top order set signatures (Table 4b) may serve as a valuable starting point for sites wishing to develop or purchase order sets. Data such as service volume, admission and discharge diagnosis frequencies and procedure volume can all be used to inform and tailor the development of a robust order set catalogue, and such data is generally available from departmental or institution-wide billing systems, even for institutions that have not implemented CPOE. Substantial time and resources may be wasted if order sets are developed or purchased without preliminary usage research and a strong implementation plan.

While it is beneficial to focus on order sets that are likely to be used frequently, it is also important to note that "high-value" order sets are not limited only to high-volume sets. Although this investigation focuses on usage statistics, sites may also find it useful to create order sets based on other institutional priorities such as reducing the incidence of adverse events or decreasing the cost of care. Sites should be sure to balance the development and implementation of "high-use" order sets with order sets they believe will be critical for other reasons (even if they are less frequently used).

Implications and Future Directions

Our findings clearly show that order sets are a frequently used tool when available as part of CPOE. Given that order sets can be time- and resource-intensive to create, it is important to focus on those high-volume order sets that will be the most used. Our findings indicate that a small proportion of order sets will ultimately be most employed at any given site. Institutions hoping to implement order sets should work to identify high-value order sets based on local needs and focus their attention and resources on this subset.

We hope that sites planning to implement order sets will use these findings to guide the development or purchase of order set content. For those sites that have not yet implemented any order sets, it may be of value to analyze available discharge and billing data to identify

areas ripe for the application of order sets. Final selection of order sets to be implemented should be tailored based on local priorities, governance practices (23) and available resources. In addition, we hope that those sites that have already implemented order sets will expand these findings based on their own order set usage data and continue to refine their catalogues.

For smaller sites and those with limited resources for developing order sets, it may be of value to purchase content from an established order set vendor rather than developing content "in-house". Such vendor-generated order sets can serve as a good starting point for a local catalogue that can, over time, be customized to suit institutional needs. Vendor-generated order sets may offer an alternative to local development although both can require substantial investments of time and resources.

Another potentially valuable approach to encouraging order set use is to facilitate sharing of validated content. Our data suggests that there are order set types that many sites have in common. As such, it may be possible to develop high-value order sets that can be shared widely and then tailored to local needs. HL7 is developing a standard for representing order sets (18), and, if adopted, this approach may enable wider sharing of content. In fact, many EHR vendors already have electronic libraries where customers can share order set content (24, 25); however, until the HL7 standard work is completed and the standard is adopted, interoperability of order set content across vendors is not possible; additional obstacles to content sharing include security concerns and economic loss to competitors (25), which may especially hinder vendors from creating sharing capabilities. Nonetheless, we believe it would be both technically feasible and highly valuable to create, through multi-site collaboration, a freely available "starter kit" of high-value order sets that could then be tailored to institutional needs and expanded based on local priorities.

Finally, sites looking to implement new order sets need to realize that post-implementation maintenance is crucial as a large corpus of order sets need periodic review. In order to restrict unintended adverse consequences of order sets, systems need content update and information review (26). As important as multidisciplinary collaboration may be during planning stages of new order sets (27), the same cooperation is needed during the maintenance stages. However, if periodic order set review is difficult for a specific site, it may choose not to develop as many start-up order sets.

Limitations

We examined a purposive sample that included only seven hospitals using CPOE. Our sample was designed to be diverse, but it is not random and is not necessarily representative of hospitals in the United States. In particular, our findings may not be generalizable to sites not represented in our sample (e.g. specialty, VA or children's hospitals), though many of the themes and analysis techniques we identify are likely to hold.

Considerable differences in order set naming convention and granularity made it challenging to directly compare order sets across sites. However, we believe that the order set classification scheme described above serves as a useful means of unifying order set data across sites. The designed classification scheme is an original approach that has not been employed before; we have provided the scheme in Appendix A so that other researchers may be able to replicate the results. Furthermore, because only one member of the study team classified the order sets, we were not able to calculate a kappa coefficient. In addition, given the size of our database and the data sites were able to provide, analysis of the specific content of each order set and the usage patterns of individual providers was beyond the scope of this investigation. Differences in order set content and provider order set usage warrant further study, as the extent of homogeneity or heterogeneity of content is likely to

influence the extent to which such content can be shared and individual provider behavior may be relevant to understanding variable order set usage across and within sites. Finally, we were unable to obtain complete information on order sets with zero uses from all sites, so such sets were excluded from our analysis. However, studying such sets could be useful for discerning patterns of order sets that are infrequently used.

Conclusion

We observed important patterns in order set usage across multiple sites as well as meaningful variations between sites. A small number of order sets accounted for the large majority of overall order set usage. Vendors and institutional order set developers should focus on high-value order set types in order to optimize the resources devoted to development and implementation and maximize the value of this important tool.

Acknowledgments

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Summary Table

What is known	Study Contributions
• The use of order sets has been shown to improve the quality and efficiency of care and increase adherence to evidence-based guidelines. • Limited research exists on order set usage patterns and much current research is focused on narrow clinical applications.	• Expanding on previous research(20), we developed a basic order set classification scheme. • Across participating sites, order sets are widely used, although the count and total usage statistics vary drastically. • A small number of order sets accounts for the large majority of overall order set usage.

Research Highlights

- We have developed a unique order set classification scheme.

- Order sets are widely used although usage statistics vary drastically.

- A small number of order sets accounts for the majority of overall order set usage.

Figure 1.
Sample order set from BICS (Brigham Integrated Computing System)
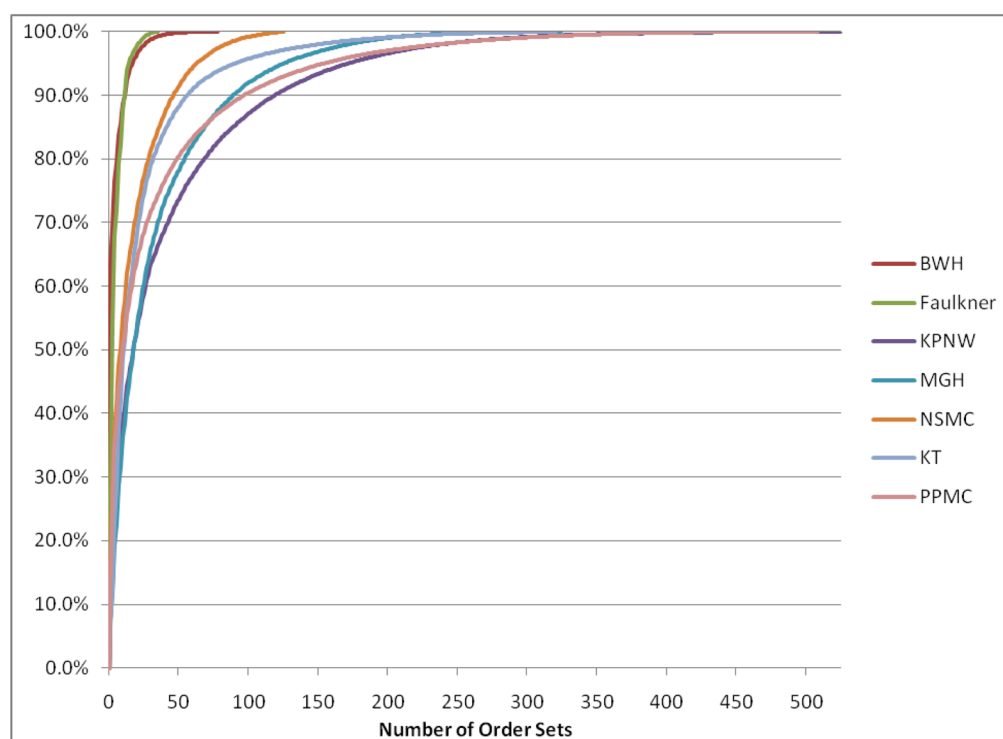
Figure 2.
Cumulative distribution of order set usage by site

Table 1

Site characteristics and order set utilization

Hospital	CPOE System	CPOE Install Year	Order Set Vendor	Location	Type	Teaching Hospital (FTEs)**	Beds**	Case Mix Index**	Discharges**	Patient Days**	Total Order Sets***	Total Order Set Uses	Uses per Set	Uses per Discharge	Uses per Bed
Brigham and Women's Hospital (BWH)	Brigham Integrated Computing System (BICS)*	1993	None	Boston, MA, USA	Academic Med Center	Yes (494)	750	2.06	52,631	268,447	78	26,346	337.7	0.5	35.1
Faulkner Hospital (Faulkner)	MEDITECH MAGIC	2004	None	Boston, MA, USA	Community	Yes (30)	153	1.12	7,558	37,219	35	3,692	105.5	0.5	24.1
Kaiser Sunnyside Medical Center (KPNW)	Epic Systems EpicCare	2008	None	Clackamas, OR, USA	Community	Yes (23)	271	1.61	17,686	67,022	524	115,703	220.8	6.5	427.0
Massachusetts General Hospital (MGH)	Physician Order Entry (POE)*	1994	None	Boston, MA, USA	Academic Med Center	Yes (597)	907	1.89	46,593	284,299	324	254,983	787.0	5.5	281.1
Memorial Hermann Katy Hospital (KT)	Cerner PowerChart	2006	Zynx§	Katy, TX, USA	Community	No	127	1.39	12,252	38,825	320	22,594	70.6	1.8	177.9
NSMC Union Hospital (NSMC)	Siemens INVISION	2005	None	Lynn, MA, USA	Community	Yes (31)	414	1.42	18,384	102,421	125	38,170	305.4	2.1	92.2
Providence Portland Med Center (PPMC)	McKesson Horizon Expert Orders	2005	Zynx§	Portland, OR, USA	Community	Yes (30)	395	1.66	20,040	110,303	508	214,654	422.5	10.7	543.4

*
Self-developed system

**
Based on current data from the American Hospital Directory (http://ahd.com)

***
Excludes order sets with zero uses

§ A vendor of evidence-based order sets, clinical decision support rules, and quality measures (29). It is one of many vendors that specializes in the area of order sets.

NSMC – North Shore Medical Center

CPOE - Computerized provider order entry

FTE – Full Time Equivalent (house staff)

Table 2

Order set usage by category

Order Set Category*	BWH Order Sets (Total Uses)	Faulkner Order Sets (Total Uses)	KPNW Order Sets (Total Uses)	MGH Order Sets (Total Uses)	KT Order Sets (Total Uses)	NSMC Order Sets (Total Uses)	PPMC Order Sets (Total Uses)	Total Order Sets	Total Uses	Total Uses/Set
ADT	29 (20,339)	8 (1,354)	48 (18,154)	58 (109,450)	48 (6,351)	20 (19,256)	19 (11,982)	230 (12.0%)	186,885 (27.6%)	**812.5**
Perioperative	26 (1,170)	15 (290)	148 (32,982)	155 (117,551)	30 (6,010)	23 (4,180)	10 (781)	407 (21.3%)	163,565 (24.2%)	**401.9**
Condition	24 (4,130)	1 (134)	211 (34,653)	82 (34,544)	191 (7,792)	17 (2,472)	55 (11,352)	581 (30.5%)	95,077 (14.1%)	**163.6**
Task	45 (4,765)	24 (934)	298 (50,454)	179 (70,850)	98 (4,850)	76 (14,392)	380 (66,078)	1100 (57.5%)	212,323 (31.4%)	**193.0**
Service	20 (3,308)	7 (631)	410 (89,032)	281 (212,458)	144 (18,399)	58 (23,544)	36 (13,255)	956 (49.9%)	360,627 (53.3%)	**377.2**
Convenience	2 (11)	2 (1,283)	43 (19,888)	8 (4,124)	40 (4,976)	42 (11,210)	335 (157,399)	472 (24.7%)	198,891 (29.4%)	**421.4**
Personal	2 (8)	3 (33)	53 (377)	12 (156)	0 (0)	0 (0)	9 (510)	79 (4.1%)	1,084 (0.2%)	**13.7**

*
Categories are non-mutually exclusive

BWH – Brigham and Women's Hospital

KPNW - Kaiser Sunnyside Medical Center

MGH – Massachusetts General Hospital

KT - Memorial Hermann Katy Hospital

NSMC – North Shore Medical Center Union Hospital

PPMC – Providence Portland Medical Center

Table 3a

Order set number and usage: ADT

Top Order Sets	Count	Uses	Uses Per Set	Sites with Order Set Type
Admit	209 (90.8%)	181,166 (96.9%)	871.0	7
Discharge	14 (6.1%)	5,140 (2.8%)	367.1	2
Transfer	6 (2.6%)	521 (0.3%)	86.8	4
Other	1 (0.4%)	55 (<0.1%)	55	1

Table 3b

Order set number and usage: perioperative

Top Order Sets	Count	Uses	Uses Per Set	Sites with Order Set Type
Pre-operative	90 (22.1%)	23,502 (14.3%)	261.1	6
Post-operative	262 (64.4%)	119,222 (72.9%)	455.0	7
Unspecified	55 (13.5%)	20,841 (12.7%)	378.9	7

Table 3c

Order set number and usage: condition (top ten)

Top Order Sets By Usage	Uses*	Uses/Set	# Sites with Order Set Type	Top Order Sets By % of Total Usage	Average % of Overall Usage	Uses/Set	# Sites with Order Set Type
Peripartum/Labor	31,247 (32.9%)	600.9	5	Peripartum/Labor	4.8%	600.9	5
Chest Pain/ACS/MI	11,035 (11.6%)	356.0	6	Chest Pain/ACS/MI	1.8%	356.0	6
Diabetes **	6,724 (7.1%)	3362.0	2	Abdominal/Flank Pain/GI Complaint	1.3%	643.7	3
Abdominal/Flank Pain/GI Complaint	6,437 (6.8%)	643.7	3	Diabetes **	0.8%	3362.0	2
DVT, VTE and/or PE	5,392 (5.7%)	173.9	6	Cardiac Complaint **	0.7%	514.5	1
Hypoglycemia **	3,192 (3.4%)	1064	3	Stroke/TIA	0.6%	70.9	6
Stroke/TIA	2,270 (2.4%)	70.9	6	DVT, VTE and/or PE	0.5%	173.9	6
Burn/Smoke Inhalation	1,985 (2.1%)	248.1	3	Pneumonia	0.4%	48.3	6
Pneumonia	1,882 (2.0%)	48.3	6	Respiratory Complaint (RDS, Distress, Virus)	0.3%	190.5	4
AAA **	1,862 (2.0%)	465.5	2	Neurological Complaint **	0.3%	487.0	1

*
With percent of category-specific total usage

**
Based on < 5 individual order sets

ACS – Acute Coronary Syndrome

MI – Myocardial Infarction

GI – Gastro-Intestinal

DVT – Deep Venous Thrombosis

VTE – Venous Thromboembolism

PE – Pulmonary Embolus

TIA – Transient Ischemic Attack

AAA – Abdominal Aortic Aneurysm

RDS – Respiratory Distress Syndrome

Table 3d

Order set number and usage: task (top ten)

Top Order Sets By Usage	Uses*	Uses/Set	# Sites with Order Set Type	Top Order Sets By % of Total Usage	Average % of Overall Usage	Uses/Set	# Sites with Order Set Type
Insulin	17,568 (8.3%)	532.4	6	Insulin	2.1%	532.4	6
Angiography/Angioplasty	15,401 (7.2%)	394.9	4	Angiography/Angioplasty	2.0%	394.9	4
Arthroplasty	8,322 (3.9%)	489.5	6	Epidural/Intrathecal	1.7%	347.4	5
Epidural/Intrathecal	7,295 (3.4%)	347.4	5	Detox **	1.5%	126.0	2
Electrolyte Replacement	6,877 (3.2%)	343.9	5	Patient-Controlled Analgesia	1.3%	425.0	5
Patient-Controlled Analgesia	5,100 (2.4%)	425.0	5	Arthroplasty	0.9%	489.5	6
Blood Transfusion	5,014 (2.4%)	557.1	5	Albuterol & Ipratropium **	0.9%	49.0	1
Heparin	4,153 (2.0%)	207.7	4	Circumcision **	0.7%	374.7	3
Craniotomy **	4,116 (1.9%)	823.2	3	Heparin	0.6%	207.7	4
Thoracic Surgery **	3,915 (1.8%)	1957.5	2	Total Parenteral Nutrition **	0.6%	155.8	4

*
With percent of category-specific total usage

**
Based on < 5 individual order sets

Table 3e

Order set number and usage: service (top ten)

Top Order Sets By Usage	Uses*	Uses/Set	# Sites with Order Set Type	Top Order Sets By % of Total Usage	Average % of Overall Usage	Uses/Set	# Sites with Order Set Type
Emergency/Trauma	48,258 (13.4%)	258.1	4	Emergency/Trauma	7.6%	258.1	4
Obstetrics & Gynecology/Labor & Delivery	36,639 (10.2%)	516.0	5	Anesthesia	6.2%	649.1	4
Anesthesia	31,807 (8.8%)	649.1	4	Obstetrics & Gynecology/Labor & Delivery	5.7%	516.0	5
Orthopedic Surgery	24,148 (6.7%)	575.0	5	Newborn Nursery	2.5%	836.9	3
Hospitalist	16,960 (4.7%)	1,211.4	2	ICU	2.5%	104.8	6
Cardiac Surgery	14,579 (4.0%)	857.6	3	Cardiology	2.4%	581.5	4
Cardiology	14,538 (4.0%)	581.5	4	Medicine	2.4%	1,266.4	2
Pediatrics	13,508 (3.7%)	314.1	4	Orthopedic Surgery	2.0%	575.0	5
Neurosurgery	13,133 (3.6%)	938.1	3	Hospitalist	1.7%	1,211.4	2
Gynecological Surgery	9,197 (2.6%)	306.6	3	Surgery	1.5%	132.4	4

*
With percent of category-specific total usage

Table 4a

Top ten order sets by site based on total usage [*]

Rank	BWH	Faulkner	KPNW	MGH	KT	NSMC	PPMC
1	Basic Admissions (ADT)	Medicine Admission (ADT, Service)	Diabetes Management (Condition, Task, Service)	Standard Admission (ADT)	Anesthesia Post-Op – PACU (Perioperative, Service)	Medicine Admission (ADT, Service)	Hospitalist Admission (ADT, Service)
2	Patient-Controlled Analgesia (Task)	Addiction Recovery (Task)	PACU Post-Op (Perioperative, Service)	Anesthesia Same Day Surgical Unit (Perioperative, Service)	OB/GYN Triage (Service)	Cardiology Admission (ADT, Service)	Insulin Correction (Task)
3	Post-Partum (Condition, Service)	Admit to Surgery (ADT, Service)	Standard Admission (ADT)	Labor, Birth and Recovery Admission (ADT, Condition, Service)	Anesthesia Pre-Op (Perioperative, Service)	Albuterol & Ipratropium (Task)	Guidelines for Hypoglycemia (Condition)
4	Post-Cardiac Catheterization/Intervention (Perioperative, Task)	Parenteral Nutrition (Task)	Standard Pre-Op (Perioperative)	Post-Op Cardiac Surgery ICU (Perioperative, Service)	Anesthesia Labor Epidurals (Task, Condition, Service)	Newborn Admission (ADT, Service)	Deep Vein Thrombosis Prophylaxis (Condition)
5	Routine Admit Post-Cardiac Catheterization (ADT, Task)	Rule-Out Myocardial Infarction (Condition)	Patient-Controlled Analgesia (Task)	Neurology Admission (ADT, Service)	Gastrointestinal Complaint – ED (Condition, Service)	Obstetrics Admission (ADT, Service)	Blood Product Transfusion (Task)
6	Labor Admission Template (ADT, Condition, Service)	Addiction Recovery – Opiates (Task)	Expedited Admission - ED (ADT, Service)	Post-Op Same Day Surgical Unity (Perioperative, Service)	Neonatal Circumcision (Task)	Psych Admission (ADT, Service)	Oxygen Ordering (Task)
7	Admit – Ischemia Pathway (ADT, Condition)	Endoscopy (Task)	Chest Pain - ED (Condition, Service)	Orthopedic Surgery Post-Op (Perioperative, Service)	Cardiac Complaint (ED) (Condition, Service)	ICU Admission (ADT, Service)	Universal Respiratory Therapy Protocol (Task)
8	Post-Partum (New) (Condition, Service)	Medicine Admission – Psych (ADT, Service)	Blood Transfusion (Task)	Pediatrics Admission (ADT, Service)	Intrathecal/Epidural Narcotics (Anesthesia) (Task, Service)	Post-Partum – Vaginal Birth (Condition, Service)	Echocardiogram Orders (Task)
9	Stroke Admission (ADT, Condition)	Hemodialysis (Task)	Abdominal Flank Pain - ED (Condition, Service)	Medical ICU Admission (ADT, Service)	Neurological Complaint – ED (Condition, Service)	Pediatric Admission (ADT, Service)	Potassium IV Replacement (Task)
10	Insulin Protocol (Task)	ICU Admission (ADT, Service)	Chest Pain – Possible Cardiac – ED (Condition, Service)	Post-Op – General (Perioperative)	GBS Prophylaxis (Condition)	Transitional Care Unit Admission (ADT, Service)	Admission (ADT)
Count By Category:	ADT = 5 Perioperative = 1 Condition = 5 Task = 4 Service = 3	ADT = 4 Perioperative = 0 Condition = 1 Task = 5 Service = 4	ADT = 2 Perioperative = 2 Condition = 4 Task = 3 Service = 6	ADT = 5 Perioperative = 5 Condition = 1 Task = 0 Service = 8	ADT = 0 Perioperative = 2 Condition = 4 Task = 3 Service = 7	ADT = 7 Perioperative = 0 Condition = 1 Task = 1 Service = 8	ADT = 2 Perioperative = 0 Condition = 2 Task = 5 Service = 1

[*]
Excluding convenience and personal sets

BWH – Brigham and Women's Hospital

KPNW - Kaiser Sunnyside Medical Center

MGH – Massachusetts General Hospital

KT - Memorial Hermann Katy Hospital

NSMC – North Shore Medical Center Union Hospital

PPMC – Providence Portland Medical Center

Table 4b

Top 20 order set signatures * overall based by percent of total usage

Order Set Signature	Average Percent of Total Usage	# Sites with Order Set Signature
Admit	16.2%	7
Post-Operative, Anesthesia Service	3.0%	3
Admit to Medicine Service **	2.3%	1
Peripartum/Labor, Labor & Delivery/Obstetrics & Gynecology Services +	1.8%	4
Admit to Cardiology Service **	1.7%	4
Admit to Labor & Delivery/Obstetrics & Gynecology Services *+	1.6%	3
Pre-Operative, Anesthesia	1.5%	2
Drug and Alcohol Detox Protocols **	1.4%	1
Abdominal/Flank Pain/GI Complaint, Emergency/Trauma Service	1.3%	3
Admit, Peripartum/Delivery, Labor & Delivery/Obstetrics & Gynecology Services **+	1.3%	3
Admit to Psychiatry Service **	1.2%	4
Admit to Pediatric Service **	1.0%	2
Chest Pain/ACS/MI Evaluation and Management ^	1.0%	5
Patient-Controlled Analgesia	0.9%	3
Epidural/Intrathecal for Peripartum/Labor, Anesthesia Service	0.9%	3
Insulin for Diabetes, Hospitalist Service **#	0.8%	1
Insulin (General)#	0.8%	4
Admit to ICU	0.8%	4
Chest Pain/ACS/MI, Emergency/Trauma Service ^	0.7%	3
Admit to Emergency/Trauma	0.7%	3

*
For definition of "order set signature," see Classification of Order Sets subsection of the Methods.

**
Based on < 5 individual order sets.

^
These order sets fell into two related but distinct signatures. The first group includes chest pain evaluation and management order sets designed for hospital-wide use and the second group includes those specific to the emergency/trauma service.

These order sets fell into two related but distinct signatures. The first group includes insulin order sets designed for diabetes management within the hospitalist service while the second group includes insulin order sets for broader clinical use hospital-wide.

+ The granularity and content of OB/GYN order sets varied considerably and fell into three related but distinct signatures. The first group includes peripartum care not related to hospital admission, the second includes admission to L&D and OB/GYN services not related to peripartum conditions, and the third includes admission to the hospital for peripartum conditions.

GI – Gastro-Intestinal

ACS – Acute Coronary Syndrome

MI – Myocardial Infarction

ICU – Intensive Care Unit

Appendix A

Description of classification rules applied to order sets

Order Set Description	ADT	Perioperative	Condition	Task	Service	Convenience	Personal
Treatment for specific condition			X	X			
Treatment protocol/adviser				X			
Single drug "order set"				X		X	
Single lab "order set"				X			
Single procedure				X			
Specific medication/lab/order				X		X	
Non-specific medication/lab/order						X	
Non-specific list of medications						X	
Non-specific list of labs						X	
Serial labs/medications				X			
Specific surgery		X		X			
Condition-specific workup/treatment			X				
Condition-specific prophylaxis			X				
Birth, labor/delivery, newborn			X				
Admit to Service A from Service B					X		
Common orders (specific task/treatment)				X		X	
Common orders (non-specific task/treatment)						X	
Discharge (specific task) order						X	
Any calculator				X			
Surgery with condition specified		X	X	X			
Surgery without condition specified		X		X			
Invasive interventional radiology		X		X			
Invasive non-diagnostic procedure		X		X			
Invasive diagnostic procedure				X			
Multiple medication/labs over time				X			
Chemotherapy for specific cancer			X	X			
Chemotherapy				X			

Order Set Description	ADT	Perioperative	Condition	Task	Service	Convenience	Personal
Consults						X	
Admission orders	X						
Research involving medication			X				X
Research involving procedure				X			X
Notify						X	
Medication load and maintenance				X			

Appendix B-1

Order set number and usage: condition (n = 144)

Condition	Total Uses	Count	% By Use	Cumulative %
Peripartum/Labor	31247	52	32.88	32.88
Chest Pain/ACS/MI	11035	31	11.61	44.5
Diabetes	6724	2	7.08	51.57
Abdominal/Flank Pain/GI Complaint	6437	10	6.77	58.35
DVT, VTE and/or PE	5392	31	5.67	64.02
Hypoglycemia	3192	3	3.36	67.38
Stroke/TIA	2270	32	2.39	69.77
Burn/Smoke Inhalation	1985	8	2.09	71.86
Pneumonia	1882	39	1.98	73.84
Abdominal Aortic Aneurysm	1862	4	1.96	75.8
Drug Addiction	1358	4	1.43	77.23
Contrast-Induced Nephropathy	1271	2	1.34	78.57
Respiratory Complaint (RDS, Distress, Virus)	1143	6	1.2	79.77
Bronchospasm/Asthma/COPD	1098	20	1.16	80.93
CHF/Heart Failure	1051	11	1.11	82.03
Cardiac complaint	1029	2	1.08	83.11
Cellulitis	900	7	0.95	84.06
Sepsis	822	12	0.87	84.93
GI bleed	747	16	0.79	85.71
Bowel Obstruction	687	2	0.72	86.44
Fever and/or Neutropenia	668	10	0.7	87.14
Back Pain	647	3	0.68	87.82
Psychiatric illness	589	1	0.62	88.44
Dehydration	578	3	0.61	89.05
Syncope	559	6	0.59	89.64
Ischemia	535	1	0.56	90.2
Neurological complain	487	1	0.51	90.71
Confusion/Delirium/Altered Mental Status	457	9	0.48	91.19
Allergic Reaction/Anaphylaxis	410	3	0.43	91.62
Alcohol/Drug Withdrawal	406	8	0.43	92.05
Group B Strep	391	1	0.41	92.46
Anemia	387	5	0.41	92.87
Medication/Drug Overdose	375	10	0.39	93.26
Vaginal bleeding	369	3	0.39	93.65
Headache/Migraine	360	4	0.38	94.03
Hip fracture	353	5	0.37	94.4
GU complaint	329	2	0.35	94.75

Condition	Total Uses	Count	% By Use	Cumulative %
Trauma	295	3	0.31	95.06
Diabetic Emergency (DKA, HHS, KNHOC)	235	7	0.25	95.31
Diarrhea	231	2	0.24	95.55
Leukemia	230	6	0.24	95.79
Gastroenteritis	220	3	0.23	96.02
Arrhythmia	185	6	0.19	96.22
Atrial Fibrillation	177	8	0.19	96.41
Neutropenia	176	1	0.19	96.59
Hyperkalemia	167	2	0.18	96.77
Lymphoma	149	15	0.16	96.92
Seizure/Epilepsy	147	8	0.15	97.08
Dysphagia	141	1	0.15	97.23
UTI	129	7	0.14	97.36
Disseminated Intravascular Coagulation	126	3	0.13	97.49
Head injury	116	1	0.12	97.62
Peritonitis	111	2	0.12	97.73
Heart failure	108	6	0.11	97.85
Cystic Fibrosis	103	2	0.11	97.96
Stress ulcer	101	1	0.11	98.06
Constipation	94	2	0.1	98.16
Dizziness/Weakness	92	1	0.1	98.26
Thrush	87	1	0.09	98.35
Varicose veins	87	2	0.09	98.44
Metabolic derangement	85	1	0.09	98.53
Chorioamnionitis	83	1	0.09	98.62
Hypertrophic pyloric stenosis	82	1	0.09	98.7
Elevated INR	64	1	0.07	98.77
Meningitis	64	3	0.07	98.84
Cleft palate	55	1	0.06	98.9
Sexual assault	52	2	0.05	98.95
Hypercoaguability	50	1	0.05	99
Acute tubular necrosis	47	1	0.05	99.05
Thrombocytopenia (heparin-induced)	44	1	0.05	99.1
Drug ingestion	42	1	0.04	99.14
Sarcoma	42	2	0.04	99.19
Wound/bite	42	2	0.04	99.23
Hyperglycemia	38	1	0.04	99.27
Allergic Reaction or Asthma	35	1	0.04	99.31
Neonatal Jaundice	31	4	0.03	99.34

Condition	Total Uses	Count	% By Use	Cumulative %
Ovarian cancer	31	3	0.03	99.37
Renal disease/failure	30	6	0.03	99.41
Disease/Fluid Exposure	29	4	0.03	99.44
Intracranial Hemorrhage	29	2	0.03	99.47
Eye complaint	26	2	0.03	99.49
Pelvic Pain	25	1	0.03	99.52
SOB	24	1	0.03	99.55
Vertigo	24	1	0.03	99.57
Orthopedic condition	22	1	0.02	99.59
Hypothermia	20	1	0.02	99.61
Urinary retention	19	1	0.02	99.63
Allograft rejection	18	1	0.02	99.65
Rectal pain/Bleeding hemorrhoids	18	1	0.02	99.67
Pancreatitis	17	4	0.02	99.69
Bursitis	14	1	0.01	99.71
Multiple Sclerosis	14	3	0.01	99.72
Hypertensive emergency	13	1	0.01	99.73
Thrombophilia	13	3	0.01	99.75
Epistaxis	11	1	0.01	99.76
Hypocalcaemia	11	1	0.01	99.77
Fetal demise	10	2	0.01	99.78
Groin pain	10	1	0.01	99.79
Lung Nodule or Cancer	10	3	0.01	99.8
Pheochromocytoma	10	1	0.01	99.81
Hepatic encephalopathy	9	1	0.01	99.82
Sickle Cell Crisis	9	4	0.01	99.83
Acute aortic dissection	8	1	0.01	99.84
Heartburn/indigestion/GERD	8	1	0.01	99.85
Lupron Depot	8	1	0.01	99.86
Pertussis	8	1	0.01	99.87
Angina	7	1	0.01	99.87
Peritonsillar abscess/tonsillitis	7	1	0.01	99.88
Loss of vision	6	1	0.01	99.89
Miscarriage	6	2	0.01	99.89
Repetitive strain injury	6	1	0.01	99.9
Thyroid cancer	6	1	0.01	99.91
Gastroenteritis	5	1	0.01	99.91
HEENT	5	1	0.01	99.92
Hip pain	5	1	0.01	99.92

Condition	Total Uses	Count	% By Use	Cumulative %
Non-Hodgkin's Lymphoma	5	1	0.01	99.93
STD	5	1	0.01	99.93
Atrial fibrillation	4	1	0	99.94
Dementia	4	1	0	99.94
Hepatitis B	4	1	0	99.94
Hepatocellular carcinoma	4	1	0	99.95
Intracranial hypertension	4	1	0	99.95
MRSA/MSSA	4	2	0	99.96
Primary CNS tumor	4	1	0	99.96
Croup	3	1	0	99.96
Full code	3	1	0	99.97
Hyponatremia	3	1	0	99.97
Newborn (HIV+ mother)	3	1	0	99.97
Symmetrical paralysis	3	1	0	99.98
Brain Tumor	2	1	0	99.98
H Pylori	2	1	0	99.98
Hernia	2	2	0	99.98
Hypernatremia	2	1	0	99.99
Pressure ulcer	2	1	0	99.99
Prolapsed uterus	2	1	0	99.99
Tobacco dependence	2	1	0	99.99
Bronchiolitis	1	1	0	99.99
Esophageal foreign body	1	1	0	99.99
Hypocalcaemia	1	1	0	99.99
Mania	1	1	0	100
Pelvis and lower extremity fracture	1	1	0	100
Pre-eclampsia/eclampsia	1	1	0	100
Thyroid/Parathyroid condition	1	1	0	100
VRE	1	1	0	100

Appendix B-2

Order set number and usage: task (n = 513)

Task	Total Uses	Count	% By Use	Cumulative %
Insulin	17568	33	8.4	8.4
Angiography/Angioplasty	15401	39	7.37	15.77
Arthroplasty (hip, knee or other joint replacement)	8322	17	3.98	19.75
Epidural/Intrathecal	7295	21	3.49	23.24
Electrolyte Replacement	6877	20	3.29	26.53
PCA	5100	12	2.44	28.97
Blood transfusion	5014	9	2.4	31.37
Heparin	4153	20	1.99	33.36
Craniotomy	4116	5	1.97	35.32
Thoracic surgery	3915	2	1.87	37.2
Bowel Resection or Other Surgery	3911	3	1.87	39.07
C section	2998	11	1.43	40.5
Gynecological surgery	2896	10	1.39	41.89
Morphine/Hydromorphone	2818	1	1.35	43.23
Hepatobiliary surgery (transplant, resection, or other procedure)	2764	5	1.32	44.56
Lumbar/cervical surgery	2672	6	1.28	45.84
Cardiac Surgery, Transplant or Device Insertion	2639	18	1.26	47.1
Sedation/Analgesia	2560	12	1.22	48.32
Albuterol & Ipratropium	2422	1	1.16	49.48
Echo	2350	4	1.12	50.6
Physical/occupational therapy	2258	1	1.08	51.68
Breast surgery	2154	13	1.03	52.72
NPO diet	2120	1	1.01	53.73
Oxygen	2036	1	0.97	54.7
Furosemide	1971	3	0.94	55.65
Continuous Veno-Venous Hemofiltration	1969	10	0.94	56.59
Electrophysiology/Catheter Ablation	1920	5	0.92	57.51
Respiratory therapy	1808	1	0.86	58.37
Bariatric Surgery (Lap Band OR Gastric Bypass)	1704	9	0.82	59.19
Pantoprazole	1700	4	0.81	60
Thyroid/parathyroid surgery	1684	3	0.81	60.8
Renal Surgery (Transplant, Nephrectomy OR Other Procedure)	1659	7	0.79	61.6
Arthroscopy	1593	7	0.76	62.36
Ventilation	1579	8	0.76	63.12
Stool specimen/culture	1532	1	0.73	63.85
IV fluids	1504	2	0.72	64.57
Abdominal Aortic Aneurysm Repair	1496	2	0.72	65.28

Task	Total Uses	Count	% By Use	Cumulative %
Dialysis	1488	7	0.71	66
Peripherally inserted central catheter	1430	7	0.68	66.68
Triage	1374	1	0.66	67.34
Vitals and monitoring	1329	4	0.64	67.97
Magnesium sulfate	1327	5	0.63	68.61
Warfarin	1271	6	0.61	69.22
Cholecystectomy	1270	5	0.61	69.82
Ciprofloxacin	1220	4	0.58	70.41
Circumcision	1124	3	0.54	70.94
Albuterol	1079	4	0.52	71.46
Vancomycin	1073	3	0.51	71.97
Withdrawal Assessment for Alcohol	1063	3	0.51	72.48
Carotid endarterectomy	1013	6	0.48	72.97
IV Flush/Heparin Lock Flush	998	4	0.48	73.44
Prostatectomy	989	3	0.47	73.92
Diet advancement	986	2	0.47	74.39
Discharge care planning	984	2	0.47	74.86
Zosyn	972	1	0.46	75.32
ABG	946	1	0.45	75.78
Vicodin	875	2	0.42	76.2
Spinal surgery	873	6	0.42	76.61
Colorectal surgery	845	9	0.4	77.02
Urine specimen	844	3	0.4	77.42
Blood culture	802	1	0.38	77.8
Pitocin	784	3	0.38	78.18
Venous ultrasound	754	1	0.36	78.54
Dilation & Curettage	752	4	0.36	78.9
TVT Sling	722	4	0.35	79.25
Cardiac enzymes	666	6	0.32	79.56
Ankle/Foot Surgery or Amputation	655	6	0.31	79.88
Acetaminophen	654	1	0.31	80.19
Hemoglobin/Hematocrit	639	2	0.31	80.5
Ipratropium	627	4	0.3	80.8
Total parenteral nutrition	623	4	0.3	81.09
Azithromycin	616	3	0.29	81.39
Zofran	603	1	0.29	81.68
Fluticasone	601	7	0.29	81.96
Feeding tube	597	3	0.29	82.25
Lower extremity revascularization	592	1	0.28	82.53

Task	Total Uses	Count	% By Use	Cumulative %
Morphine	583	4	0.28	82.81
Ceftriaxone	565	1	0.27	83.08
Hysterectomy	562	3	0.27	83.35
Triponin	562	1	0.27	83.62
Sputum specimen	560	1	0.27	83.89
Hip surgery	556	2	0.27	84.15
Detox	504	4	0.24	84.39
Zolpidem	501	2	0.24	84.63
Eye exam	500	1	0.24	84.87
Cosyntropin stimulation test	490	3	0.23	85.11
Oxycodone	478	1	0.23	85.34
Moxifloxacin	474	2	0.23	85.56
Shoulder surgery	467	4	0.22	85.79
Electrocardiogram	456	1	0.22	86
Fempop/tibial/pedal bybass	455	2	0.22	86.22
Omeprazole	448	2	0.21	86.44
Phytonadione	446	1	0.21	86.65
Neurologic evaluation	445	1	0.21	86.86
Laryngeal surgery	441	2	0.21	87.07
Thoracotomy	413	3	0.2	87.27
Digoxin	371	3	0.18	87.45
Steroid taper	369	1	0.18	87.63
Metoprolol	364	2	0.17	87.8
Nose specimen/culture	364	1	0.17	87.97
Chemotherapy	360	28	0.17	88.15
Cystectomy/Urinary Diversion	355	2	0.17	88.32
Metformin	355	1	0.17	88.49
Lisinopril	351	1	0.17	88.65
Nicotine patch	337	1	0.16	88.81
Chest tube	335	1	0.16	88.97
Docusate sodium	330	1	0.16	89.13
Bone Marrow Transplant	325	1	0.16	89.29
Photoselective Vaporization of the Prostate	319	1	0.15	89.44
Wound/ulcer culture	318	1	0.15	89.59
Appendectomy	312	2	0.15	89.74
Rituximab	312	4	0.15	89.89
Extracorporeal membrane oxygenation	311	3	0.15	90.04
Bowel care	302	4	0.14	90.18
Ativan	300	2	0.14	90.33

Task	Total Uses	Count	% By Use	Cumulative %
Aspirin	293	1	0.14	90.47
Transphenoidal surgery	282	1	0.13	90.6
Dilaudid injection	281	1	0.13	90.74
ENT Surgery	280	4	0.13	90.87
Amiodarone	275	3	0.13	91
Drainage	270	1	0.13	91.13
Metronidazole	269	2	0.13	91.26
Normal saline	269	2	0.13	91.39
EEG	267	2	0.13	91.52
Transurethral resection of the prostate OR prostate/bladder tumor	265	3	0.13	91.64
Laproscopic Nissen fundoplication	261	1	0.12	91.77
Stress test	252	4	0.12	91.89
Atorvastatin	242	1	0.12	92
ACL repair	239	1	0.11	92.12
Thoracentesis	237	2	0.11	92.23
Trazodone	227	1	0.11	92.34
Sodium bicarbonate	225	1	0.11	92.45
Calcium gluconate	218	1	0.1	92.55
Diabetes management	215	1	0.1	92.66
Comfort/End-of-Life care	208	3	0.1	92.76
Aminoglycoside	206	1	0.1	92.85
Sodium chloride nebulizer	200	1	0.1	92.95
Whipple	197	2	0.09	93.04
Restraints	195	3	0.09	93.14
Levothyroxine	192	2	0.09	93.23
Laparoscopic surgery	190	1	0.09	93.32
BMT	183	2	0.09	93.41
Fractional excretion of sodium calculator	183	1	0.09	93.49
Imipenem	183	1	0.09	93.58
Chemoembolization	175	2	0.08	93.67
Colporrhaphy	173	2	0.08	93.75
Prednisone	173	1	0.08	93.83
Diltiazem bolus and drip	170	1	0.08	93.91
Renal biopsy	170	3	0.08	93.99
Potassium replacement	169	1	0.08	94.08
Kpad	167	1	0.08	94.16
Type & screen	167	3	0.08	94.23
Nutrition panel	164	1	0.08	94.31
Lumbar Puncture	163	6	0.08	94.39

Task	Total Uses	Count	% By Use	Cumulative %
Fluconazole	160	2	0.08	94.47
Simvastatin	160	1	0.08	94.54
Senokot	156	1	0.07	94.62
Endoscopy	151	7	0.07	94.69
Percutaneous ultrasonic lithotripsy	146	1	0.07	94.76
Dilation & Evacuation	140	2	0.07	94.83
Pepcid	134	1	0.06	94.89
Metocopramide	131	1	0.06	94.95
Head and neck surgery	127	1	0.06	95.02
Nystatin	125	1	0.06	95.08
Peripheral nerve block	124	4	0.06	95.13
Promethazine	124	1	0.06	95.19
Distal upper extremity surgery	121	1	0.06	95.25
Amlodipine	120	1	0.06	95.31
Dalteparin	119	4	0.06	95.37
Extubation	119	1	0.06	95.42
Liver Biopsy	119	1	0.06	95.48
Magnesium oxide	119	1	0.06	95.54
Levofloxacin	118	1	0.06	95.59
Biphenhydramine	115	1	0.06	95.65
Ibuprofen	115	1	0.06	95.7
Methylprednisolone	114	2	0.05	95.76
Cervical cerclage	111	2	0.05	95.81
Vaginal surgery	110	2	0.05	95.86
Laparotomy	109	1	0.05	95.92
Paracentesis	109	2	0.05	95.97
Amputation due to infection	108	1	0.05	96.02
Haloperidol	105	4	0.05	96.07
Interleukin	105	1	0.05	96.12
Lactulose	102	1	0.05	96.17
Bisocodyl	101	1	0.05	96.22
Hernia repair	99	5	0.05	96.26
Albuterol and ipratroprium	98	2	0.05	96.31
Diltiazem	96	2	0.05	96.36
Pleural fluid culture	96	1	0.05	96.4
TB skin test	95	2	0.05	96.45
Ranitidine	90	1	0.04	96.49
Carvedilol	83	1	0.04	96.53
Hydromorphone	83	2	0.04	96.57

Task	Total Uses	Count	% By Use	Cumulative %
Lung transplant	82	1	0.04	96.61
Pain management consult	82	1	0.04	96.65
Pyloromyotomy	82	1	0.04	96.69
Vasoactive infusions	81	1	0.04	96.73
Gabapentin	80	2	0.04	96.77
Milk of magnesia	79	1	0.04	96.8
Phenytoin	78	2	0.04	96.84
Upper extremity surgery	78	1	0.04	96.88
Atenolol	77	1	0.04	96.92
Cardioversion	75	2	0.04	96.95
CSF specimen	74	1	0.04	96.99
Basic metabolic panel	73	1	0.03	97.02
Cefazolin	73	1	0.03	97.06
GI cocktail	73	1	0.03	97.09
Hand/wrist/elbow/forearm surgery	72	3	0.03	97.13
Modified barium swallow	72	1	0.03	97.16
Tubal ligation	72	3	0.03	97.19
Cervical ripening	71	2	0.03	97.23
Ferrous sulfate	71	1	0.03	97.26
Percocet	71	1	0.03	97.3
Anal sphincteroplasty and RVF	69	2	0.03	97.33
Calcium carbonate	68	1	0.03	97.36
Clonidine	67	1	0.03	97.39
Fluticasone/salmeterol	67	3	0.03	97.43
Levetiracetam	67	1	0.03	97.46
Magnesium sulfate	67	3	0.03	97.49
Psych evaluation	67	1	0.03	97.52
Clindamycin	66	1	0.03	97.55
Intubation	66	3	0.03	97.59
Glucose screening	64	1	0.03	97.62
Hydrochlorothiazide	64	1	0.03	97.65
Spironolactone	64	1	0.03	97.68
Abortion	63	3	0.03	97.71
Clopidogrel	61	1	0.03	97.74
Throat culture	60	1	0.03	97.77
Ampicillin injection	59	1	0.03	97.79
Catheter culture	59	1	0.03	97.82
Citalopram	59	1	0.03	97.85
Levalbuterol	59	3	0.03	97.88

Task	Total Uses	Count	% By Use	Cumulative %
Aspiration and biopsy	58	1	0.03	97.91
Acetylcysteine	56	2	0.03	97.93
Laparoscopy	56	1	0.03	97.96
Peripheral vascular surgery	56	1	0.03	97.99
Cleft palate repair	55	1	0.03	98.01
Enalaprilat	55	1	0.03	98.04
Bone marrow biopsy	54	1	0.03	98.06
Colonoscopy	54	1	0.03	98.09
Fentanyl	53	1	0.03	98.12
Racepinephrine neb	52	1	0.02	98.14
Ascorbic acid	50	1	0.02	98.16
Cyclobenzaprine	50	1	0.02	98.19
Rhogam	50	2	0.02	98.21
Specialty bed ordering	50	1	0.02	98.24
Hydralazine	49	1	0.02	98.26
Benzonatate	48	1	0.02	98.28
Fluoxetine	48	1	0.02	98.31
Knee fluid specimen	46	1	0.02	98.33
Sertraline	46	1	0.02	98.35
Splint, sling	46	1	0.02	98.37
CBC	45	1	0.02	98.39
Clonazepam	45	1	0.02	98.41
Alteplase for catheter occlusion	42	1	0.02	98.43
Morphine sulfate	42	1	0.02	98.45
Pleural fluid labs	41	1	0.02	98.47
Aprepitant (Emend)	40	1	0.02	98.49
Octreotide	40	1	0.02	98.51
Quetiapine	40	1	0.02	98.53
Salmeterol	40	1	0.02	98.55
Creatinine clearance calculator	39	1	0.02	98.57
Fondaparinux	39	4	0.02	98.59
Isosorbide mononitrate	39	1	0.02	98.61
MRSA cultures	38	1	0.02	98.63
Alprazolam	37	1	0.02	98.64
CT	37	2	0.02	98.66
Aripiprazole	36	1	0.02	98.68
Potassium labs	35	1	0.02	98.69
Artificial tears	34	1	0.02	98.71
Divalproex	34	1	0.02	98.73

Task	Total Uses	Count	% By Use	Cumulative %
Saline lock	34	1	0.02	98.74
Distal pancreatectomy	33	2	0.02	98.76
Hydrocortisone	33	1	0.02	98.77
Loperamide	33	1	0.02	98.79
Rad001 (everolimus)	33	1	0.02	98.81
Acyclovir	32	1	0.02	98.82
Aorta repair	32	1	0.02	98.84
Glipizide	32	1	0.02	98.85
Myelogram	32	2	0.02	98.87
Risperidone	32	1	0.02	98.88
Aortic reconstruction	31	2	0.01	98.9
Glyburide	31	1	0.01	98.91
Hydroxyzine pamoate	31	1	0.01	98.93
Lovastatin	31	1	0.01	98.94
Metoclopramide	31	1	0.01	98.96
Temazepam	31	1	0.01	98.97
Valsartan	31	1	0.01	98.99
Mirtazapine	30	1	0.01	99
Cephalexin	29	1	0.01	99.02
Ketogenic diet	29	1	0.01	99.03
Nebulizer	29	1	0.01	99.04
Simethicone	29	1	0.01	99.06
Ketorolac	28	1	0.01	99.07
Nicotine replacement	28	2	0.01	99.08
Prochlorperazine	28	1	0.01	99.1
Peak and trough drug level monitoring	27	1	0.01	99.11
Saline lock	26	1	0.01	99.12
Vagina/cervix specimen	26	2	0.01	99.13
Darvocet	25	1	0.01	99.15
Triamcinolone	25	2	0.01	99.16
VRE cultures	25	2	0.01	99.17
"Butt Balm"	24	1	0.01	99.18
Lasartan	23	1	0.01	99.19
Administer Colyte/Golytely	22	1	0.01	99.2
Aluminum-magnesium hydroxide	22	1	0.01	99.21
BIPAP/CPAP	22	1	0.01	99.22
Diazepam	22	1	0.01	99.24
Drug trial	22	1	0.01	99.25
Patient Assistance Fund (financial) screening	22	1	0.01	99.27

Task	Total Uses	Count	% By Use	Cumulative %
PT/INR lab	22	1	0.01	99.26
Antipyrine/Benzocaine	21	1	0.01	99.28
Duloxetine	21	1	0.01	99.29
Neuromuscular blockade	21	2	0.01	99.3
Contrast	20	1	0.01	99.31
Gentamicin	20	3	0.01	99.32
Naloxone	20	1	0.01	99.33
Naproxen	20	1	0.01	99.34
Peridural	20	1	0.01	99.34
Rosuvastatin	20	1	0.01	99.35
Uterine artery embolization	20	3	0.01	99.36
Baclofen	19	1	0.01	99.37
Caspofungin	19	1	0.01	99.38
Esomeprazole	19	1	0.01	99.39
Eszopiclone	19	1	0.01	99.4
Nitroglycerin patch	19	1	0.01	99.41
Nutrition panel	19	1	0.01	99.42
Pain management	19	3	0.01	99.43
Propofol	19	1	0.01	99.44
Famotidine	18	1	0.01	99.45
IV	18	2	0.01	99.45
Muromonab-CD3	18	1	0.01	99.46
Olanzapine	18	1	0.01	99.47
Version (external cephalic)	18	1	0.01	99.48
Acetaminophen w/ codeine	17	1	0.01	99.49
Acid-fast bacteria cultures	17	1	0.01	99.5
Enalapril	17	1	0.01	99.5
Influenza Decision Tree	17	1	0.01	99.51
Joint aspiration	17	1	0.01	99.52
Labetalol	17	1	0.01	99.53
Organ harvesting	17	1	0.01	99.54
Tobacco cessation	17	1	0.01	99.54
Lidocaine	16	1	0.01	99.55
Peritoneal fluid specimen	16	1	0.01	99.56
Amniocentesis	15	3	0.01	99.57
Donepezil	15	1	0.01	99.57
ECT, galantamine	15	1	0.01	99.58
Hydroxyzine	15	1	0.01	99.59
Intra aortic balloon pump	15	1	0.01	99.6

Task	Total Uses	Count	% By Use	Cumulative %
Nadolol	15	1	0.01	99.6
Allopurinol	14	3	0.01	99.61
Brachytherapy (tandem ovoid applicator)	14	1	0.01	99.62
D5 1/2	14	1	0.01	99.62
Escitalopram	14	1	0.01	99.63
Lansoprazole	14	1	0.01	99.64
Midazolam	14	1	0.01	99.64
Mouth care	14	1	0.01	99.65
Oxytocin induction	14	1	0.01	99.66
Paroxetine	14	1	0.01	99.66
Cefotetan	13	1	0.01	99.67
Oxytocin	13	1	0.01	99.68
Venlafaxine	13	1	0.01	99.68
Argatroban	12	1	0.01	99.69
Chantix	12	1	0.01	99.69
Fosphenytoin	12	1	0.01	99.7
Oxybutynin	12	1	0.01	99.7
Penicillin	12	1	0.01	99.71
Renal function labs	12	1	0.01	99.72
Alendronate	11	1	0.01	99.72
Bone marrow harvest	11	1	0.01	99.73
Granisetron	11	1	0.01	99.73
Linzolid, vancomycin or placebo	11	1	0.01	99.74
Nafcillin	11	1	0.01	99.74
Nicotine polacrilex gum	11	1	0.01	99.75
Thrombolytics (TNK)	11	1	0.01	99.75
Amitriptyline	10	1	0	99.76
Cefazolin, gentamicin	10	1	0	99.76
Erythromycin	10	1	0	99.77
Integrillin	10	1	0	99.77
Metabolic panel	10	1	0	99.78
DX-88	9	1	0	99.78
Infliximab	9	2	0	99.79
Pravastatin	9	1	0	99.79
Amputation	8	2	0	99.79
Bupropion	8	1	0	99.8
Burn medications	8	1	0	99.8
Captopril	8	1	0	99.81
Cytarabine/Idarubicin	8	2	0	99.81

Task	Total Uses	Count	% By Use	Cumulative %
Glycoprotein antagonists	8	1	0	99.81
Latanoprost	8	1	0	99.82
Peripheral IV	8	1	0	99.82
Propranolol	8	1	0	99.82
Thrombolytics	8	6	0	99.83
Tracheostomy	8	3	0	99.83
Bactrim	7	1	0	99.84
Bronchoscopy	7	3	0	99.84
Dantrolene	7	1	0	99.84
HEAL protocol	7	1	0	99.85
Nitroglycerin	7	1	0	99.85
Sequential compression device	7	2	0	99.85
Ziprasidoen	7	1	0	99.86
Amnioinfustion	6	1	0	99.86
Candesartan	6	1	0	99.86
Collagen injection therapy	6	1	0	99.86
Extended-release morphine	6	1	0	99.87
Radioactive iodine therapy	6	1	0	99.87
Benztropine	5	1	0	99.87
Beta blocker	5	3	0	99.87
Cerumenex	5	1	0	99.88
Esophagectomy	5	1	0	99.88
Ezetimibe/simvastatin	5	1	0	99.88
Immune globulin IV	5	1	0	99.88
Iron dextran infustion	5	1	0	99.89
Lithium	5	2	0	99.89
Nimodipine	5	1	0	99.89
Partial thromboplastin time	5	1	0	99.89
Patients own meds	5	1	0	99.9
Perphenazine	5	1	0	99.9
Ticarcillin	5	1	0	99.9
Valium challenge	5	1	0	99.9
Vascular Access Device	5	1	0	99.91
Angiotensin	4	1	0	99.91
AV fistula and graft	4	1	0	99.91
Beclomethasone	4	1	0	99.91
Brachytherapy	4	1	0	99.91
Cefoxitin	4	1	0	99.92
CT oral contrast	4	1	0	99.92

Task	Total Uses	Count	% By Use	Cumulative %
Cytarabine	4	1	0	99.92
ESHAP	4	1	0	99.92
Infection/amputation	4	1	0	99.92
Intrathecal morphine	4	3	0	99.92
Iron Dextran	4	1	0	99.93
Isolation	4	1	0	99.93
Mannitol	4	1	0	99.93
Olmesartan	4	1	0	99.93
Periolace	4	1	0	99.93
Respiratory care protocol	4	1	0	99.94
Rifampin	4	1	0	99.94
Voriconazole	4	1	0	99.94
Wafarin	4	1	0	99.94
Alteplase	3	1	0	99.94
Bimatoprost	3	1	0	99.94
Bunionectomy	3	1	0	99.95
Codeine	3	1	0	99.95
Decolonization	3	1	0	99.95
Dorzolamide-timolol	3	1	0	99.95
Doxorubican/Ifosfamide	3	1	0	99.95
High-dose cement	3	1	0	99.95
Inapsine	3	1	0	99.96
Induction therapy	3	1	0	99.96
Losartan/HCTZ	3	1	0	99.96
Neuroembolization	3	1	0	99.96
Renal/liver/pancreas/kidney transplant	3	1	0	99.96
Support stockings	3	2	0	99.96
Tigecycline	3	1	0	99.96
Timolol	3	1	0	99.97
Abdominal radiology	2	1	0	99.97
Aggrenox	2	1	0	99.97
Carbamide	2	1	0	99.97
Enteral feeding	2	1	0	99.97
Fluids	2	1	0	99.97
Flunisolide	2	1	0	99.97
IV Immunoglobulin	2	1	0	99.97
Niacin	2	1	0	99.97
Oxytocin IV	2	1	0	99.97
Pirbuterol	2	1	0	99.97

Task	Total Uses	Count	% By Use	Cumulative %
Rehabilitiation activity	2	1	0	99.98
Sequential compression device, exnoxparin	2	2	0	99.98
Thoracoscopic Wedge	2	1	0	99.98
Tolterodine	2	1	0	99.98
Transurethral resection	2	1	0	99.98
Uterine arterial embolization	2	1	0	99.98
Abciximab	1	1	0	99.98
ACTH stimulation test	1	1	0	99.98
Amphotericin	1	1	0	99.98
Beclomethasone	1	1	0	99.98
BM aspiration and biopsy	1	1	0	99.98
Brimonidine	1	1	0	99.98
Cardiothoracic surgery	1	1	0	99.98
Cephradine	1	1	0	99.99
CEPP	1	1	0	99.98
Chondrocyte implant	1	1	0	99.99
Code orders	1	1	0	99.99
Conjugated estrogens	1	1	0	99.99
CVP	1	1	0	99.98
Daptomycin	1	1	0	99.99
Dental Surgery	1	1	0	99.99
Depakote	1	1	0	99.99
Dexamethasone	1	1	0	99.99
Dofetilide	1	1	0	99.99
Dolasetron	1	1	0	99.99
Drotrecogin	1	1	0	99.99
Esmolol	1	1	0	99.99
Fluvastatin	1	1	0	99.99
Gatifloxacin	1	1	0	99.99
Glycerin supplement	1	1	0	99.99
Heart transplant	1	1	0	99.99
HIDAC	1	1	0	99.99
High dose cytarabine	1	1	0	99.99
Intravenous pyelogram	1	1	0	99.99
Laminaria	1	1	0	99.99
Lamotrigine	1	1	0	99.99
Latdorsi reconstruction	1	1	0	100
Lobectomy	1	1	0	100
Orthosis	1	1	0	100

Task	Total Uses	Count	% By Use	Cumulative %
Osteotomy	1	1	0	100
Pre-employment physical	1	1	0	100
Rabeprazole	1	1	0	100
Racepinephrine	1	1	0	100
Sargramostim	1	1	0	100
Smoking cessation	1	1	0	100
Ultrafiltration	1	1	0	100
Ventricular/Lumbar Drain	1	1	0	100

Appendix B-3

Order set number and usage: service (n = 67)

Service	Total Uses	Count	% By Use	Cumulative %
Emergency/Trauma	48258	187	13.84	13.84
Obstetrics & Gynecology/Labor & Delivery	36639	71	10.51	24.34
Anesthesia	31807	49	9.12	33.46
Orthopedic surgery	24148	42	6.92	40.39
Hospitalist	16960	14	4.86	45.25
Cardiac Surgery	14579	17	4.18	49.43
Cardiology	14538	25	4.17	53.6
Pediatrics	13508	43	3.87	57.48
Neurosurgery	13133	14	3.77	61.24
Gynecological Surgery	9197	30	2.64	63.88
General surgery	9009	15	2.58	66.46
Neurology	8551	6	2.45	68.91
Same Day Surgical Unit	7894	2	2.26	71.18
ICU	7338	70	2.1	73.28
Vascular Surgery	6556	18	1.88	75.16
Surgery	6490	49	1.86	77.02
Thoracic surgery	6419	5	1.84	78.86
Medicine	6332	5	1.82	80.68
Surgical ICU	6031	7	1.73	82.41
Neonatal ICU/Special Care Nursery	5894	16	1.69	84.1
Newborn nursery	5858	7	1.68	85.78
Urology	5138	16	1.47	87.25
Pharmacy	4926	64	1.41	88.66
Psychology/Psychiatry/Behavioral Health	4093	18	1.17	89.84
Cardiac Arrhythmia	4004	8	1.15	90.99
Critical Care	3596	9	1.03	92.02
Nephrology	3588	12	1.03	93.05
Pediatric ICU	3559	1	1.02	94.07
Hematology/Oncology	1734	30	0.5	94.56
Radiology	1595	15	0.46	95.02
Endocrinology	1593	2	0.46	95.48
Interventional Radiology	1497	6	0.43	95.91
Telemetry	1486	4	0.43	96.33
Nursing	1374	1	0.39	96.73
Angiography	1287	8	0.37	97.1
Renal Transplant	1169	6	0.34	97.43
Neonatal	1133	3	0.32	97.76

Service	Total Uses	Count	% By Use	Cumulative %
Oral and Maxillofacial Surgery	965	1	0.28	98.03
Gastroenterology	814	2	0.23	98.27
Transitional care unit	796	1	0.23	98.49
Podiatry	683	6	0.2	98.69
Rehabilitation	662	5	0.19	98.88
Gynecology	576	4	0.17	99.05
Plastic	513	2	0.15	99.19
Hospice/End-of-Life	435	3	0.12	99.32
Palliative care	332	1	0.1	99.41
Electrophysiology	252	1	0.07	99.48
ENT	230	3	0.07	99.55
Burn unit	192	1	0.06	99.61
Cardiac transplant	171	4	0.05	99.65
Radiology/Angiography	171	1	0.05	99.7
Triage	157	5	0.05	99.75
Speech	156	1	0.04	99.79
Surgery - Pediatric	152	3	0.04	99.84
Critical assessment team	148	1	0.04	99.88
Surgery - Plastics	134	1	0.04	99.92
Cardiovascular prep care unit	61	1	0.02	99.94
Critical Care/Pulmonology	56	1	0.02	99.95
IV Therapy	50	1	0.01	99.97
Cardiac ICU	29	3	0.01	99.97
Sleep lab	29	3	0.01	99.98
ICU/ED	20	1	0.01	99.99
Pulmonary	16	1	0	99.99
Nuclear medicine	14	1	0	100
Gynecology	9	2	0	100
Infection control	2	1	0	100
Surgery observation	1	1	0	100