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Software design to facilitate information transfer at hospital discharge

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ABSTRACT

Discharge communication between inpatient and outpatient physicians is often an inefficient and error-prone process. Adverse events result from poor communication at the time of discharge. The objective of this study was to describe development of discharge software to overcome communication barriers. The secondary objective was to assess factors that influence the time to complete tasks with the software. Methods were a performance improvement model and database analysis of 336 discharges. Software design specifications included computerised physician order entry, immediate utility, minimal development and deployment costs, acceptability to physician-users, and satisfaction of primary care physicians, patients and pharmacists. Design features included simple 'just-in-time' prompts and point-of-care prescribing resources. The dependent variable for analysis was physician time to complete discharge prescriptions and instructions while using the software. General linear and mixed-effects regression models adjusted for physician effects and other predictors. Results revealed that physician factors significantly affected the time to complete a discharge while using the software. As the number of accesses (log-ins) and free text typing increased, then time to complete the computerised discharge increased. Patient-related factors that increased physician time were discharge diagnoses, prescriptions and length of stay. In conclusion, discharge software can help inpatient physicians transfer timely, complete and legible information to outpatient physicians, pharmacists and patients. Physician and patient factors influence the time to complete discharges using the software.

Keywords: continuity of care, electronic discharge summary, hospital information systems, hospitalists, medical records systems–computerized, medication reconciliation, patient care transitions, patient discharge

Introduction

Patients are vulnerable to adverse events when they transfer from hospital to outpatient care.[1–3] Approximately 19–23% of patients experience adverse events within four weeks after acute care hospitalisation.[3,4] Adverse events are attributed to poor communication between inpatient healthcare providers and outpatient primary care physicians.[3] In addition, ineffective communication of the discharge plan to the patient is associated with adverse events after discharge.[1,2,5] Medication errors occur during the discharge process and contribute to adverse events.[3] Prescribers might fail to reconcile pre-hospital medicine lists with

discharge prescriptions: 64% of elderly patients have at least one medicine not ordered by the discharging physician.[6] In many hospitals, discharge communication between the inpatient physician and the outpatient physician or the patient is an inefficient and error-prone process.[2,7]

Inpatient physicians use various processes to communicate with outpatient physicians. The most common process is the structured discharge summary.[7] Discharge summaries are often inadequate as communication because they arrive, on average, two to four weeks after hospital discharge.[7] As a consequence of systematic communication delays, 66–92% of patients visit their outpatient physicians before complete discharge information is available.[7] Between 16% and 53% of patients contact their outpatient physician before arrival of any discharge information.[7] For 51% of patients with inadequate discharge communication, the discharge summary is never sent to the follow-up physician.[8] When discharge communication is delayed or insufficiently detailed, post-discharge management is affected adversely for 10–14% of patients.[7]

One promising intervention to improve discharge communication is computerised physician order entry (CPOE).[9,10] By definition, CPOE is a computer-based system that automates direct entry of orders by physicians and ensures standardised, legible and complete orders.[9] In some observational studies, physician workflow and satisfaction improve when inpatient physicians discharge patients with CPOE applications coupled to automated databases.[11–14] Costs of CPOE include hardware, software and technical support.[10] Often under-recognised, there are additional important costs to train users and to integrate software with existing systems.[10]

Using an evidence-based approach, we developed and assessed a discharge software application that facilitates communication of timely, complete, accurate and legible patient care information among providers and to patients. The primary objective of this paper is to describe the development of the discharge software. The secondary objective is to assess factors that influence the time to complete tasks with the software.

Methods

We developed a discharge software application to address deficiencies in our current paper-based system. The development process employed a performance improvement model with small-scale, rapid cycle, iterative changes.[15] Resident and attending physicians were the subjects of qualitative data surveys. The physicians included hospitalist physicians who used the discharge software and outpatient primary care physicians who received the output of the software. We demonstrated the application during group sessions. Physicians completed an online multimedia demonstration of the software, and were coached, one on one, during initial usage. Users submitted 'on-the-fly' voluntary comments to the developer from within the discharge software and via direct verbal feedback. We used spontaneous and induced responses to guide rapid cycle changes in the software application. The Central Illinois Pharmacists' Association assisted in the design of the printed prescription format.

The setting for our performance improvement project was a 730-bed, tertiary care, teaching hospital in Central Illinois. We designed the discharge software to replace the following standard process for discharge. Physicians and nurses completed handwritten discharge forms on or before the day of discharge. The forms contained blanks for discharge diagnoses, discharge medications, medication instructions, post-discharge activities and restrictions, post-discharge diet, post-discharge diagnostic and therapeutic interventions, and appointments. Patients received a copy of the handwritten discharge instructions on the day of discharge. Ward clerks were expected to send copies of the completed handwritten discharge forms to outpatient primary care physicians via facsimile transmission. Patients were given handwritten copies of the forms, one page of which also included medication instructions and prescriptions. Hospital physicians were encouraged to communicate with primary physicians via telephone to discuss transition of care; however, compliance with this recommendation was left to the discretion of the individual physician. The usual care process in our hospital closely resembled processes reported by hospitals elsewhere.[16]

We designed the discharge software to address deficiencies in this current process, specifically those involving communication with subsequent providers. A recent systematic review identified commonly encountered deficiencies in existing discharge processes, including missing diagnoses, absent results of abnormal inpatient investigations, incomplete discharge medication lists, missing follow-up plans, no list of test results pending at discharge, and unknown or illegible contact physician in hospital to answer questions after discharge.[7] We also designed the discharge software to include desirable characteristics lacking in current systems. Physician satisfaction surveys suggest that physicians prefer discharge summaries which are structured in format, received within one week after discharge, and limited to two pages or less.[7,17] Table 1 lists deficiencies in the current discharge process and remedies built into the discharge software.

Table 1 Discharge process deficiencies and software features designed to address deficiencies

Discharge process deficiency	Software design feature to address deficiency
Illegible discharge instructions	Software generates typed instructions to patient
Illegible discharge summary to primary care physician and consulting physicians	Software generates typed letter to primary care physician and consultants
Illegible discharge prescription	Software generates typed prescription for pharmacist
Illegible or unknown name of person to contact if questions about inpatient care	Software generates typed report with names of discharging physician and supervisory physician
Delay between date of discharge and date of dictation of discharge report to primary care physician	Physician order entry and data entry occur immediately before discharge. The software compiles a discharge report to the primary care physician immediately and automatically
Delay between date of dictation and date of transcription of the discharge report to primary care physician	Same as above
Delay between transcription of discharge report and receipt by primary care physician	Same as above. The report is immediately available for distribution via electronic means to the primary care physician
Failure to reconcile pre-admission medications and discharge medications for therapeutic duplication or polypharmacy	Software requires physician to specify medications that are new prescriptions, unchanged prescriptions from pre-admission and deleted prescriptions
Failure to communicate new allergies or adverse drug reactions that emerged during the admission	Software requires physician to specify new allergies or adverse drug reactions that emerged during the admission
Incomplete list of discharge diagnoses	Software offers a menu of ICD-9-CM codes, including the top 99 codes most frequently selected by discharging physicians
Incomplete list of procedures performed during the hospital admission	Software offers a search engine for 13 000 ICD-9-CM codes, including procedure codes
Missing results of abnormal inpatient investigations	Software prompts discharging physician to enter results
Missing list of inpatient investigations with results pending at discharge	Software prompts discharging physician to enter tests
Missing follow-up appointments	Software requires discharging physician to enter follow-up physician name, appointment date and instructions for making appointment
Missing diet, activity, return to work/school, in-home monitoring and durable medical equipment orders	Software prompts discharging physician to order
Missing list of unresolved laboratory abnormalities	Software prompts discharging physician to order tests after discharge
Unstructured, lengthy discharge summaries	Software generates structured discharge report less than or equal to two pages
Physicians who write discharge prescriptions are physically separated from drug information resources	From within discharge software, physicians may launch MICROMEDEX® drug information software
Feedback to the prescriber occurs remotely from the discharge process	Software automatically prompts the physician during prescription entry with warnings related to potential error-prone processes

The software was designed to meet the following specifications:

- The application should improve the quality and timeliness of communication of discharge information from inpatient physicians to outpatient primary care physicians.
- Output should include clear and legible prescriptions for medications, diet and activity, and instructions for follow-up tests and appointments.
- Prompts and error checks should be liberally employed to improve the completeness and quality of the information provided to subsequent providers and to patients.
- Medication safety should be promoted through the use of a standardised drug list, presentation of 'just-in-time' prompts for selected higher-risk medications, confirmation dialogues, clearly-stated, legible instructions to pharmacists and patients, and provision for convenient access to an online prescribing resource.
- Investment should be minimised by using 'off-the-shelf' development tools.
- Deployment costs should be minimised by employing existing servers and local area networks.
- Quality assessment activities should be supported by capturing data relevant to outcomes and quality-of-care measures.
- The application should be acceptable to physician-users.
- Requirements must include minimal keyboard entry, efficient and flexible search algorithms, and logically designed screens that conform as much as possible to currently used forms and workflow.

Measurements

When evaluating CPOE software, one of the major correlates with physician-user satisfaction is time to complete tasks.[18,19] The discharge software measured the time between physician log-in and log-out. When physicians logged in more than once to complete one discharge, then we recorded the cumulative time for every log-in as time per discharge. Accesses were defined as the number of times physicians logged into the software to complete one discharge. Since training effect may bias assessments of physician time, we required all users to complete the same online training. In addition, we excluded from analysis the discharges performed by physicians with low experience, defined as fewer than five discharges. Physicians used the software to enter diagnoses, prescriptions and free text. We recorded these entries as potential predictors of time to complete the discharge.

For each discharge, the prescription variable was the sum of new prescriptions, changes in previous prescriptions, unchanged previous prescriptions and discontinued prescriptions. We defined the character variable as the sum of all characters typed as free text by the physician-user. In addition, we recorded patient factors such as age, gender and length of stay.

Statistical analysis

We analysed physician time to complete a discharge using the software as the dependent variable in several models. Since time to complete a process is a skewed variable, we analysed the natural logarithm (ln) transformation of time, time(ln). We tested continuous predictor variables, including patient age, length of stay and the numbers of accesses, diagnoses, prescriptions and characters. In order to improve the normal distribution of variables, we analysed the natural logarithm transformation of accesses and length of stay and the square root (sqrt) transformation of diagnoses, prescriptions and characters. We evaluated patient gender as a categorical predictor variable. We computed Pearson correlations with the transformed variables to test univariate associations. Using general linear model univariate (GLMU), we calculated the average time per physician-user as mean and standard error of the mean (SEM). Physician differences in time(ln) were tested using GLMU. Mixed-effect regression models used transformed variables since transformation significantly improved both the Akaike's Information Criterion and the Schwarz's Bayesian Criterion. The discharges were clustered for each of 19 physician-users in the mixed-effect regression model. In the initial mixed-effect regression model, the dependent variable was time(ln) and the predictor variables were accesses(ln), age, diagnoses(sqrt), length of stay(ln), prescriptions(sqrt), gender and characters(sqrt). Age and gender were not significant and were eliminated from the final mixed-effect regression model. Since one physician entered 20% of the discharges, we conducted sensitivity analyses with mixed-effect regression models with and without the high-volume physician. We analysed data with SPSS 13.0.1 (SPSS Inc., Chicago, Illinois). The established threshold for significant *P* values was less than 0.05.

Results

We developed a software application to replace the current discharge process at our institution. In the old process, discharging physicians wrote, by hand, prescriptions and discharge instructions. The discharge software allowed physicians to enter information by keyboard and mouse.

The program was designed to conform to the following requirements:

1 Ease of use was emphasised to facilitate physician acceptance. We used drop-down menus extensively to minimise keyboard entry. Search algorithms allowed prompt and efficient look-ups. The user encountered screens oriented logically to conform as much as possible to currently used forms and workflow patterns. Redundant data entry, present in the paper-based system, was eliminated.
2 Standardised databases of diagnoses and medications were employed to facilitate comparisons and audits for clinical quality improvement purposes (for example, 'What percentage of patients with heart failure were discharged on an angiotensin-converting enzyme inhibitor?').
3 Easy deployment, using technologies already available to most healthcare enterprises, was a goal.

The user interface for the software is described in Appendix 1. The software generated four discharge documents.

1 The outpatient physician received a personalised letter to communicate pertinent features of the hospitalisation. Information included discharge diagnoses with codes for International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM).[20] The letter detailed information about changes to the patient's previous medication regimen, diet and activity instructions, patient education materials provided, and follow-up appointments and studies. Because the program prompted the discharging physician to complete all pertinent fields, the result was more complete communication with the outpatient physician. Correspondence was generated in real time and was therefore immediately available to the patient's outpatient provider by mail or facsimile transmission. A copy was generated for inclusion in the inpatient record. The chart copy functioned as an interim summary if readmission occurred before transcription of the formal discharge summary. The Hospitalist Division secretary accessed the letter to the primary care provider from the secure server within one business day. Attending physicians reviewed and revised the discharge letter. A final letter was then printed and distributed to the primary care physician.
2 Software output included printed and legible prescriptions, along with specific information for the dispensing pharmacist about changes and deletions to the patient's previous regimen.
3 Patients received a printed summary of instructions, follow-up appointments and studies. The software automatically supplied addresses and telephone numbers for follow-up appointments.
4 Hospital nurses received a printed and legible discharge order including the aforementioned information with copies for the patient's hospital chart.

The client application was written in Microsoft Access® (Microsoft Corporation, Redmond, Washington). The application was deployed to designated client workstations as a royalty-free runtime module using Systems Management Server® (Microsoft Corporation, Redmond, Washington). The back-end database was in native Microsoft Access® (.mdb) format and resided on a secured enterprise network server.

We evaluated the data entered by physician-users and their time required to complete discharges. There were 360 discharge records entered by physicians between November 2004 and February 2006. To minimise bias, we excluded eight discharges performed by four physicians with low experience. We excluded 16 discharges entered by the software investigators. We analysed 336 hospital discharges entered by 19 users who were resident physicians in training. The characteristics of the discharges appear in Table 2.

We conducted analyses that treated the physician as the unit of analysis. The number of discharges per physician ranged from six to 68 with a mean of 18 discharges (SEM = 3.4). One physician entered 20% (68/336) of the discharges. Each of the remaining physicians entered less than 10% of the discharges. The average time per physician ranged from 24 to 67 minutes with a mean time of 42 minutes (SEM = 2.4). Physicians varied significantly in the amount of time(ln) taken to complete a computer discharge ($F = 3.196$, $P < 0.001$).

Subsequent analyses used the discharge as the unit of analysis. Pearson correlations for time(ln) were significant ($P < 0.001$) with accesses(ln), age, diagnoses(sqrt), length of stay(ln), prescriptions(sqrt) and characters(sqrt) with values ranging from $r = 0.270$ to $r = 0.545$. Gender did not have a significant association with time(ln) ($r = 0.102$, $P = 0.061$).

We analysed variables that predicted time to complete a discharge while adjusting for the effect of the physician-user. The final mixed-effect regression model eliminated patient gender and patient age since neither were significant in earlier models. The variables that significantly predicted time(ln) were accesses(ln), diagnoses(sqrt), length of stay(ln), prescriptions(sqrt) and characters(sqrt) ($P < 0.001$ respectively). As each predictor variable increased, the physician time to complete the computer discharge also increased. Parameter estimates for the final mixed-effect regression model appear in Table 3.

Sensitivity analysis assessed potential bias caused by physician experience. We assumed that physicians with more experience with the discharge software would have shorter times to complete discharges. After excluding physicians with low experience (fewer than

Table 2 Characteristics of 336 hospital discharges performed with the discharge software

	n = 336
Female patients, *n* (%)	184 (54.8%)
Patient age, years, *n* (%)	
18–44	80 (23.8%)
45–64	138 (41.1%)
65–84	103 (30.7%)
85 or older	15 (4.5%)
Characteristic, per discharge, median (25%, 75%)	
Diagnoses, *n*	7 (5, 10)
Prescriptions, *n*	9 (5, 13)
Accesses (log-ins), *n*	2 (1, 3)
Hospital length of stay, days	3 (2, 7)
Total physician time to complete discharge, minutes	37 (25, 53)

Table 3 Parameter estimates for mixed-effect regression model for time (ln) to complete discharge

Parameter	Estimate (95% confidence interval)	*P* value
Diagnoses(sqrt)	0.131 (0.062, 0.200)	<0.001
Prescriptions(sqrt)	0.189 (0.141, 0.237)	<0.001
Accesses(ln)	0.432 (0.337, 0.526)	<0.001
Characters(sqrt)	0.014 (0.011, 0.017)	<0.001
Length of stay(ln)	0.125 (0.077, 0.173)	<0.001
Intercept	1.720 (1.531, 1.909)	<0.001

NB. sqrt = square root transformation; ln = natural logarithm transformation.

five discharges), we examined the correlation between the numbers of discharges per physician versus mean discharge completion time per physician. We found a non-significant correlation (Spearman rho = –0.191, P = 0.433). In addition, we assessed the impact on time(ln) of the physician who entered the plurality (20%) of the discharges. We performed mixed-effect regression models with and without the discharges entered by the high-volume physician. In the sensitivity analysis, all of the confidence limits for variable estimates overlapped substantially. We conclude that our results are insensitive to potential bias from the most experienced physician.

Discussion

We have described a software application that facilitates communication at the time of hospital discharge. The software helped inpatient physicians transfer timely, complete and legible information to outpatient physicians and patients. The software design incorporated principles of CPOE with basic levels of clinical decision support. Features include required fields, pick lists, standard drug doses, alerts, reminders and online reference information.

The discharge software was developed at minimal cost. Public domain reference databases were used in the initial version of the application. The incorporation of a more robust medication database in subsequent revisions will allow implementation of expanded rule-based decision support. In the future, the application may be migrated to Microsoft SQL Server® (Microsoft Corporation, Redmond, Washington) if justified by demand and performance considerations.

What are the potential mechanisms of the benefit of discharge health information technology? Computerised physician order entry decreases medication errors by 55–81% and eliminates medication errors due to illegible prescriptions and transcription errors.[9] Observational studies suggest 43% of potentially harmful prescribing errors are likely prevented by CPOE.[21] In addition, the discharge application prompts physicians to enter a post-hospital appointment date. When patients receive a written follow-up appointment during the discharge process, they are more likely to arrive for the appointment.[22] Discharge software prompts inpatient physicians to generate written drug information for patients. The presence of such information might improve patient satisfaction and outcomes.[2] Discharge communication applications can remind physicians to order preventive services like vaccines.[23] Computerised prompts can assist inpatient physicians to reconcile admission medications with in-hospital changes and with discharge prescriptions. Medication reconciliation improves concordance between discharge prescriptions and community pharmacy patient profiles and reduces medication errors and adverse drug events.[24–26] The potential benefits of CPOE have been tested in other inpatient settings.[9,10] Future studies should test the potential benefits when computerised interventions occur at hospital discharge.

One factor that affects physician satisfaction with CPOE is time to complete tasks.[18,19] We found the median physician time to complete discharge orders by computer was 37 minutes (see Table 2). Without comparative data, we do not know if the handwritten discharge process is faster or slower than the computerised discharge process. Anecdotal responses suggest the computerised process consumes more physician time – an experience confirmed by other CPOE investigators.[27] Physicians themselves significantly contributed to time variability. Physician variability may result from experience or training effects. In our analysis, we minimised potential bias by excluding physicians with low experience. Other physician-related factors that prolonged completion times were the number of accesses (log-ins) and the amount of free text typed by physicians. The number of accesses could be related to the way some physicians organise their workflow or respond to interruptions. We did not perform time–motion analyses, so we cannot quantify predictors related to workflow or interruptions. The software was designed to minimise the requirement for typing free text by the liberal use of drop-down menus and buttons. However, some physicians preferred to type free text and their preferences contributed to longer completion times.

We found several patient factors that significantly predicted longer times to complete discharges. Patients with multiple comorbidities or complications have more diagnoses, prescriptions and length of stay. It is logical to assume that complicated patients would require longer times to complete discharge software processes.

We acknowledge several limitations. The discharge software was evaluated in small-scale tests-of-change according to the performance improvement model. We have evaluated only one dependent variable so far: physician time to complete the discharge prescriptions and instructions. We do not know if the discharge software has clinically important value when compared to the handwritten discharge process. The value of the discharge software may be related to a balance of other factors involving the patient, the hospitalist physician, the outpatient physician and the retail pharmacist who fills the discharge prescription. To assess the value of the discharge software, we initiated a cluster randomised and controlled clinical trial with blinded outcome assessment. The study is designed to compare the benefits of discharge software versus handwritten discharge process in high-risk patients recently discharged from acute care hospitalisation. The trial outcomes are readmission within six months, post-discharge adverse events, and effectiveness and satisfaction with the discharge process from the patient, physician and pharmacist perspectives. The cost outcome is the physician time required to perform the discharge process. (The trial protocol is available for review at www.clinicaltrials.gov/ct/show/NCT00101868?order=188.) Trial enrolment is ongoing and results are expected in 2007.

Another limitation was the experience of the physician users. We did not detect a relationship between the number of discharges and the time to complete discharges. Perhaps correlations were obscured because there were insufficient numbers of physicians with sufficient experience. Future studies should include more physicians and assess physician experience as a predictor variable.

A third limitation was our study setting. We developed the software in a tertiary care teaching hospital with resident physicians and academic hospitalist attending physicians. The results in our setting might not generalise to other physicians and settings.

Conclusion

In summary, we described discharge software that helps inpatient physicians transfer timely, complete and legible information to outpatient physicians, pharmacists and patients. Physician and patient factors influenced the time to complete discharges using the software. Future studies should measure clinically relevant outcomes, like adverse events, patient satisfaction and provider satisfaction, to assess the value of the discharge software.

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CONFLICTS OF INTEREST

None.

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Appendix 1: Description of the user interface for the discharge software

The user interface is presented as a succession of task-oriented screens, each contingent upon completion of the preceding screen. Users may save changes at any point for completion within 96 hours. After successful password-protected access to the application, screens are sequentially presented in the following manner.

Screen 1: Patient information

The inpatient physician enters demographic information in the Patient Information screen. The physician enters an account number that is unique to the hospitalisation. Pop-up calendar controls are available to facilitate entry of *admission* and *discharge dates*. The *attending physician* combo box is populated with the names of attending hospitalist physicians. The *primary physician* combo box is populated from the database of over 1100 regional primary care physicians who admit patients to the hospital service. An option (*add new*) is provided to launch a modal pop-up form for on-the-fly entry of primary physicians and accompanying demographic information for primary care providers not already in the database.

Screen 2: Diagnoses

The Diagnoses screen allows entry of discharge diagnoses. The diagnosis coding system is the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM).[20] Search algorithms and interfaces help physicians intuitively and quickly identify the smallest list of codes likely to include their patient's specific diagnosis. The algorithm maps frequently used diagnoses to synonyms commonly used by physicians. For example, if one enters 'CHF' in the *by word or phrase* text box, the software displays commonly assigned diagnoses for heart failure even though the term 'CHF' does not appear in the ICD-9-CM dictionary. If one clicks the *expand search* check box, the software presents an expanded list, including additional, less commonly used, codes for heart failure.

Users may enter incomplete words or phrases in the text box in order to minimise typing entry and allow flexibility in the number of matches returned. Entries here are matched by substring within the ICD-9-CM textual description or assigned synonym(s). Users have the additional option to browse all ICD-9-CM descriptions *by organ system* and *subsystem*.

Screen 3: Medications

The Medications screen allows entry of the patient's discharge prescriptions. Medication prescriptions are classified and organised into one of the following categories: NEW prescriptions; previous prescriptions with NEW INSTRUCTIONS; previous prescriptions to be continued UNCHANGED; or DISCONTINUED prescriptions.

Pop-up message boxes display customised drug information alerts for selected medications as determined by the physician database administrators. For example, message boxes prompt the prescribing physician to carefully consider possible interactions before a prescription for warfarin is generated.

The medication database within the software was extracted from a subset of the United States Food and Drug Administration Orange Book. The software does not display parenteral drugs that are inappropriate for outpatient therapy. Prescribers may select drugs by trade or generic name. The software presents only approved doses and dosage forms to minimise medication errors by prescribers.

The drug menu in the software is not complete. Missing from the drug menu are over-the-counter drugs, parenteral drugs and herbals. The software allows entry of free text. Prescribers may enter medications as text within the combo box, after acknowledging that such entries are outside of the included medication database domain. Medications entered as text by the user are flagged in the database to facilitate subsequent audit.

The Medication screen includes a field to document new allergies. An entry must be made or the *no NEW allergies* check box must be selected.

There is a *drug information* button to encourage and facilitate point-of-care look-up of information about the drug prescribed. The button launches a browser window linked to Micromedex® (Thomson MICROMEDEX, Greenwood Village, Colorado) for the drug entered in the prescription text box.

Screen 4: Instructions

The Instructions screen allows specific patient instructions, including diet, activity, blood glucose monitoring, home blood pressure monitoring, recording daily weights and work restrictions. Prescription sections for home oxygen and durable medical equipment were added in response to user feedback. The software offers multiple categories and options to prompt physicians to specify more complete discharge instructions. Check boxes and drop-down combo boxes are extensively used to facilitate rapid entry. Text boxes offer flexibility during data entry. A list box allows physicians to select written patient education

materials to be distributed to the patient by the nursing staff.

Screen 5: Appointments

The next screen is for follow-up appointments. An unlimited number of physician appointments and post-discharge studies may be specified from this screen. The '*With whom*?' combo box initially defaults to the patient's primary care physician as specified on the *Patient Information* screen. To help assure appropriate follow-up, an entry must be made in the physician appointment field before the user can proceed further through the program. Follow-up *physician appointments* and *labs and tests* may be designated by indicating an interval from the combo box (such as '2 weeks'), or a specific date and time can be entered as text. Physicians' office addresses and telephone numbers are automatically merged into the patient instructions.

Screen 6: Free text

The final screen allows free text entry of additional pertinent information to be included in correspondence to the physician who will subsequently assume the patient's care. This includes studies which are still pending at the time of discharge, procedures and studies performed during the hospitalisation, and specific types of follow-up care to be communicated to the subsequent provider. An input box allows the user to indicate the names of other physicians who should receive a copy of the discharge letter. Other physicians who materially participated in the patient's care during the hospitalisation may be designated by selection from a list box.

Documents may be finalised for printing and distribution from the last screen, or saved for completion within 96 hours. After 96 hours, pending documents are purged and must be re-entered. Once finalised, documents cannot be further edited within the system without administrator access.