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A Comparison of Two Methods of Medical Discharge Summary Generation

by

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Abstract

Background: The discharge summary is an important method of communicating information necessary for continuing patient care. Deficiencies in discharge summary content, accuracy, and timeliness are a common problem. To improve summaries, studies have assessed physician-in-training (housestaff) education, alteration of the summary format, and collating information within computer databases into a summary. The most promising technology for improving discharge summaries is the clinical database. However, no study assessing these interventions has convincingly documented an improvement in discharge summary quality since: patients were not randomized; an acceptable control group was not concurrently compared with the intervention; or complete and clinically relevant outcomes were not measured.

Primary Objective: To compare medical discharge summaries generated from a clinical database with those created by narrative letter dictation.

Design: Randomized controlled trial assigning patients to database (DB) or dictated (dictated - random or D-R) summaries. This was preceded by a prospective cohort study where summaries for all patients were created by dictation (dictated - cohort or D-C group).

Inclusion Criteria and Study Setting: All patients admitted to and discharged alive from the general internal medicine service in a tertiary care teaching hospital.

Intervention: For patients randomized to the DB group, housestaff completed forms capturing hospital and discharge information important for the discharge summary. This information was entered into a database along with portions of the admission history and physical-examination form. Information in the database was collated into a report to create a database discharge summary. For patients in the D-R and the D-C group, housestaff used narrative dictation to create summaries.

Outcomes: The primary outcome was discharge summary quality. This was assessed with a 100 mm visual analogue scale (VAS) by family physicians and consultants who received the summary (0-worst score, 100-best score). Secondary outcomes included summary completeness, pertinence, organization, and timeliness (using a similar VAS) and the proportion of admissions for which a summary was generated by 4 weeks of discharge. Other outcomes included objective measurements of physician assessments (i.e.

summary completeness, pertinence, organization, and timeliness), summary accuracy, and housestaff preference.

Results: There were 782 eligible patients during the cohort study (D-C group) and 293 eligible patients during the randomized trial (dictated - random [D-R] group, 151; database [DB] group, 142). Groups were comparable at baseline except that D-R patients were less likely to be admitted to the intensive care unit. Significantly more patients in the database group had a discharge summary created within four weeks of discharge (DB 113/142 [79.6%] vs. D-R 86/151 [57.0%]; P<0.00001).

Mean summary quality was similar between the groups (DB 72.7 [Standard Deviation 19.3] vs. D-R 74.9 [SD 16.6]; P=0.50) as were assessments of summary completeness (DB 73.4 [19.8] vs. D-R 78.2 [14.9]; P=0.11), pertinence (DB 77.2 [15.4] vs. D-R 79.1 [15.2]; P=0.46), organization (DB 77.4 [16.3] vs. D-R 79.3 [17.2]; P=0.49), and timeliness (DB 70.3 [21.9] vs. D-R 66.2 [25.6]; P=0.30). Summary assessments varied by physician specialty. Consultants gave *lower* scores to database summaries for quality (DB 64.6 [24.7] vs. D-R 76.2 [13.6]; P<0.05), completeness (DB 68.2 [21.7] vs. D-R 79.5 [13.5]; P<0.05), and organization (DB 69.4 [23.6] vs. D-R 76.0 [16.6]; P<0.05). Family physicians gave *higher* scores to database summaries for timeliness (DB 72.2 [22.7] vs. D-R 62.6 [28.2]; P<0.05).

Other outcomes showed significant differences between the summaries. Data *more* likely to be in database summaries included: active past medical history [DB 100% vs. D-R 86.7%; P<0.0001]; pre-admission medications [DB 100% vs. D-R 66.3%; P<0.00001]; admission vital signs and other physical examination findings [100% vs. 90.8%; P<0.01 and 100% vs. 93.4%; P<0.01 respectively]; discharge diagnosis [DB 100% vs. D-R 65.1%; P<0.00001]; discharge medications [DB 100% vs. D-R 93.0%: P<0.01]; community services arranged for patient [DB 40.7% vs. D-R 20.9%; P<0.01]; laboratory investigations pending at discharge [DB 40.7% vs. D-R 9.3%; P<0.00001]; and therapeutic recommendations [DB 28.3% vs. D-R 15.1%; P<0.05]. Data *less* likely to be in database summaries included: social history [DB 6.2% vs. D-R 37.2%; P<0.00001]; admission diagnosis [DB 0.9% vs. D-R 70.9%; P<0.00001]; statement of reason for patient admission [DB 0% vs. D-R 14.0%; P<0.00001]; consultations in hospital [DB 18.6% vs. D-R 40.7%; P<0.001]; and functional status at discharge [DB 0.9% vs. D-R 10.5%; P<0.01]). Database summaries reported more extreme lab results (DB 48.5% vs. D-R

30.1%; P<0.01) and diagnostic blood tests (DB 30.0% vs. D-R 16.7%; P<0.05) found at laboratory review but were less likely to report consultations (DB 19.0% vs. D-R 46.8%; P<0.0001) found at chart review. Database summaries contained fewer lines (DB 57.3 vs. D-R 64.8; P<0.05). Fewer lines were dedicated to pre-admission (DB 24.4 vs. D-R 27.7; P<0.05) and hospital information (DB 13.5 vs. D-R 22.1; P<0.00001) but there were more lines for discharge information (DB 19.4 vs. D-R 14.9; P<0.00001). Procedures reported in database summaries were less likely to be found at chart review (DB 66.7% vs. D-R 93.0%; P<0.01). Database summaries contained more headings (DB 13.1 vs. D-R 8.63; P<0.0001) and were created significantly faster (DB median 2 days vs. D-R 5 days; P<0.00001 Log Rank test). Housestaff found the database method significantly quicker, less burdensome, and preferred it to the dictated method.

Conclusions: The database method significantly increased the probability that a discharge summary was created when a patient was discharged from the hospital. Physicians thought that their quality, completeness, pertinence, organization, and timeliness was similar to dictated summaries. However, family physicians and consultants differed in their views of the database summary, with family physicians being more favourably disposed than consultants. Database summaries were more likely to contain certain data, improved the reporting of important blood work, decreased the total summary length while increasing the number of headings, decreased the delay between patient discharge and summary generation, and decreased the work expended by housestaff for discharge summary creation. Because of these improvements, this study suggests that using clinical databases to generate discharge summaries is promising and merits further study and refinement.

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My thesis supervisors provided essential feedback that allowed me to parlay an idea into a thesis. Their knowledge was appreciated at all stages of the process.

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1.0 Introduction

1.1 The Purpose and Definition of a Discharge Summary

Clinical data that is accumulated during a patient's hospital stay is processed for three goals. First, appropriate patient care is possible only after all data pertinent to the case is considered. Second, accurate classification of events during the hospital stay is essential for health care planning, utilization review, appropriation of health care funds, and epidemiological studies. Third, in many jurisdictions in Canada, in-hospital patient care is often provided by a physician other than the patient's family doctor. Therefore, information about the patient's hospital stay needs to be communicated to a patient's family physician and other health care workers to ensure appropriate continuing patient care. This project will address the last component of clinical data management.

The primary method of communication between hospital based physicians and family doctors is the discharge summary. For this study, we will define a discharge summary as *a typewritten document prepared by hospital physicians to communicate clinical information gathered during hospitalization to other physicians involved in the patient's care*. This definition does not classify the following documents as discharge summaries: *handwritten* notes given to the patient for delivery to other physicians ("Dear Doctor" letters or interim discharge reports); or consult notes prepared by hospital physicians for post-discharge patient assessment ("follow-up consults"). A discharge summary *system* is the series of procedures performed to produce a discharge summary.

1.2 Literature Review: Previous Assessments of the Discharge Summary

Previous assessments of discharge summaries have concentrated on various aspects including its content, accuracy, and timeliness of delivery. See Exhibit 1 for the search strategy used on the MEDLINE database to identify investigations regarding discharge summaries.

Several studies have shown deficiencies in the ***content*** of discharge summaries. Three studies, presented in Exhibit 2, reviewed a cohort of discharge summaries to determine the proportion lacking particular data. Tulloch et. al.[1] surveyed eighteen family physicians to determine what data was necessary for the discharge summary. The same eighteen family physicians then reviewed all discharge summaries they received during a 10 week period and determined the proportion of summaries missing the identified

data. Definitions or criteria for these data were not given and the reliability of the summary reviews was not assessed. A review of the patient's hospital medical record was not performed so reviewers were unable to determine if particular data was missing because that information was not gathered in hospital. Mageean studied communications received for 89 consecutive patients admitted to the hospital following assessment at a general practice in England.[2] Each communication was reviewed for: investigations; diagnosis; hospital treatment; and follow up. In our own centre, the summaries of a random selection of patients discharged from a general internal medicine service were reviewed to determine the proportion containing admission diagnosis, physical examination, significant laboratory results (defined a-priori), discharge diagnosis, and discharge medications.[3] The medical record was also reviewed to determine the proportion of significant laboratory results not mentioned in the summary.

Despite using different methodologies in different clinical settings at different times, these studies all show a high prevalence of missing information (Exhibit 2). The proportion of summaries without a physical examination varied from 1% to 20%. Any mention of investigations were absent in 33 to 75% of summaries, while greater than 40% of significant lab results were missing in our series.[3] Discharge diagnosis was missing in 10% to 25% of summaries, discharge medications were absent in 20 to 40% of summaries, and medical follow-up was not specified in 5% to 40% of summaries. Although the importance of some of the content items (e.g. presenting symptoms) probably varies depending on the patient's diagnosis, it is arguable that several items (e.g. discharge medications and medical follow up) are necessary regardless of the patient's diagnosis. Although estimates for the proportion of summaries that were missing each data item varied between the studies, all three studies showed that a concerning proportion of summaries are missing items necessary for continuing patient care.

One study assessed the ***accuracy*** of the information in discharge summaries. In an audit from a vascular surgery service in Great Britain, all discharge summaries were computer generated after standardized forms completed by medical staff were entered into a database system.[4] Over a 10 month period, 637 summaries were reviewed by the vascular surgery consultants under whom the patients were admitted. The following errors (presumably from memory) were identified with the following frequency: general errors (e.g. wrong patient name, incorrect physician) 1.7% of summaries; diagnostic errors (e.g.

incorrect diagnoses, coding errors, missed diagnoses) 3.3%; operative data errors (e.g. wrong operation, missing operation, no reporting of significant concomitant pathology found at operation) 3.0%; missed complications 2.2%; and incorrect follow-up information 1.6%. Overall, 10% of summaries had at least one error. The relatively low error rate may have been due a number of factors. First, the study setting was a surgical service where patient problems at presentation and procedures in hospital are often well defined. Second, the staffpeople may have missed errors. Third, housestaff created discharge summaries by completing standardized forms, the content of which were entered into a clinical database by secretarial staff. This standardization may have resulted in fewer omissions, and the fact that housestaff needed to complete only seven fields (responsible consultant, principal complaint, principal diagnoses, operative or procedural interventions, complications, changes to medication and follow-up plans) probably resulted in fewer errors. Finally, the housestaff who prepared greater than 80% of the summaries were aware that the discharge summaries were being reviewed by their supervisors and they received weekly feedback from the staff consultants regarding their discharge summaries. The external validity of this study may be low for teaching hospitals where patients are more complex and their problems less defined, where discharge summaries are created by narrative dictation, and where housestaff are less likely to receive feedback from supervisors regarding their discharge summaries.

The ***timeliness*** of the discharge summary is another important characteristic. As delay between patient discharge and receipt of the summary increases, the probability that physician decisions do not consider hospital information will also increase. In their survey of communications between general practitioners and consultants in two communities in Great Britain, Long and Atkins found that more than 40% of discharge summaries failed to arrive at their practices within 1 week and 21% within 1 month.[5] They also noted that, since family physicians were not involved with in-hospital patient care and other methods of communication were scarce, the discharge summary was the sole source of in-hospital information in 85% of the cases. Mageean's study considered both typewritten discharge summarizes and hand-written interim reports as discharge communications.[2] For one group practice in Chesire, 15.2% of patient discharge communications were delayed more than 1 month while no communications were received for 11% of patients. Penney documented a mean delay in summary receipt of 25.3 days, with

32% of summaries taking greater than 1 month to arrive and 17% of admissions having no discharge summary created.[6] While the mean interval between patient discharge and first family physician visit was 25 days in Norway, Geitung showed that it took a mean of 28 days to receive the discharge summary. As a result, the family physician had no information on the patient's admission for 38% of patients when they were initially seen after hospital discharge.[7] Haikio et. al. showed that no communication was received for 61% of patients admitted to a local hospital after referral to the emergency room from a family medicine group practice.[8] The probability of receiving a summary from the hospital did not increase if the patient's medications were altered, or if the family physician specifically requested a discharge summary on the referral letter. In our own centre, no discharge summary was dictated in 7.0% of all patients admitted for greater than 48 hours and the median time from patient discharge to summary transcription was 13 days.[3] For patients with a family physician, no discharge summary was received by the family doctor in 32.5% of the time. These papers illustrate that problems with discharge summary timeliness is prevalent throughout the world and has been persistent over time.

Why are these discharge summary deficiencies so prevalent and persistent? First, discharge summary dictation is just one of many physician responsibilities. Since the summary does not *immediately* effect the patient's care (and specifically does not affect the *dictating* physician's ability to care for the patient), a hospital physician may not prioritize its creation. Second, many of these studies are based in teaching hospitals where patient care is performed by teams of physicians in training. Young physicians may not appreciate the summary's importance and therefore give its preparation a lower priority. When several physicians are involved in a patient's care, confusion as to who is responsible for the summary could result. Third, voice dictation at patient discharge is the most commonly used medium to create summaries. From memory and with the medical record for reference, the physician must collate all appropriate hospital data and organize it properly. Not surprisingly, some information is forgotten. In summary, there are many reasons why the discharge summary is a less-than-optimal communication tool.

1.3 Literature Review: Previous Attempts to Improve the Discharge Summary

Many avenues have been pursued to address the discharge summary's shortcomings. These include the use of interim reports, physician education, altering the summary format, and using clinical

databases to generate summaries. Studies assessing the effect of each of these interventions have been performed. These studies will now be discussed followed by an overall analysis of their design.

Discharge summary dictation is often delayed. To accommodate for this, many centres provide a hand-written ***interim report*** (in addition to the typewritten discharge summary) to patients for delivery to their family physician. Several studies in different populations have shown that large proportions of these reports are received by the family physician.[6,9-11] With modifications, the interim report can serve as a patient information tool which significantly improves patients' medication knowledge.[12] However, the accuracy and completeness of the interim report has not been properly assessed. Interim reports can be illegible since they are hand-written by the hospital physician. They also require hand-delivery to the family physician by the patient. Since they lack much of the information necessary for ongoing care, a dictated discharge summary is usually still required for complete transfer of information. Finally, most of the information in the interim report is dictated by the physician into the discharge summary. Therefore, information is first written onto the interim report and then dictated. In its attempt to accommodate for inadequacies of the discharge summary, the interim report results in more work and unnecessary duplication.

Physician education is another method of potentially improving discharge summaries. With a before-after design, Flyer et. al.[13] assessed the effect of a formal teaching session on discharge summaries from internal medicine housestaff. Discharge summary attributes which were assessed included reporting of the history of presenting illness, physical examination, hospital course, laboratory data, condition at discharge, discharge instructions, and follow up plans. These were assessed in an unblinded fashion by the study authors using a 5-point Likert scale with no defined anchors. The ratings were collated into an overall "summary score", presumably by calculating a mean from the ordinal rating for each attribute. The authors reported that their intervention significantly improved the mean overall score from 3.72 to 4.08 ($p < 0.05$). The study's strongest potential for bias includes the unblinded assessment of the summaries. Also, one expects discharge summary quality to improve over time (independent of any intervention) with physicians in training. Therefore, the association of the educational sessions with improved discharge summaries is tenuous. While it makes sense to educate housestaff on the importance of the discharge

summary and how to improve them, surveys have shown that very little effort is expended on instructing housestaff in discharge summary preparation.[14,15]

Several investigations have studied the effect of discharge summary ***format*** on overall quality. To improve the discharge summaries from a military hospital cardiology service, Oetgen et. al. "required" the housestaff to dictate summaries using a format resulting using a more structured presentation of the patient's clinical data.[16] With no formal measurement, the authors claimed that referring physicians "applauded the ... concise communication". For patients discharged from a geriatric service, Howard replaced the narrative discharge summary with a structured discharge letter.[17] 92% of the surveyed family physicians found the new system an improvement over the previous dictated narrative letter, although some of this improvement may have been due to the decreased delay in receipt of the summary instead of its formalized structure. King and Barber surveyed all family practitioners in Exeter, England and attained a 100% response rate.[18] Physicians were shown a very structured discharge summary and asked to compare it with longer narrative discharge summaries previously received from the hospital. 88% of the physicians preferred the shorter, structured format. Lloyd and Barnett[19] modified a fictitious narrative summary by replacing the past medical history with a list. One hundred family physicians were surveyed and a 93% response rate was achieved. 83% of respondents preferred the structured summary. In a follow-up survey, family physicians chose between discharge summaries that were identical except that one summary presented the recommended therapy, in addition to the past medical history, in a list.[20] 88% preferred the more structured summary. Family physicians in our own community also preferred discharge summaries using a standardized format.[21] Second discharge summaries were created with a standardized format from a random sample of narrative discharge summaries stratified by the dictating physician's level of training, discharge summary length, patient length of stay, and number of discharge diagnoses. A random sample of 180 family physicians were sent a pair of the discharge summaries. Responding physicians indicated that the standardized formats were significantly easier to abstract data from, communicated information most relevant to continuing patient care, and had a higher overall quality. Although these studies utilized different designs and surveyed very different populations, a remarkably consistent preference for discharge summaries using a standardized format is detected. Despite this, most

discharge summaries use a narrative format with varying degrees of structure. This is likely because voice dictation is the most common method of discharge summary generation and dictating using a structured format is more difficult and less "natural" than using a narrative format.

Discharge summaries may be improved by using a method other than voice dictation to create them. Many studies have modified ***computer databases*** to generate discharge summaries so that dictation is unnecessary.[22-41] These studies report how clinical databases were modified to allow the generation of a very structured report. There is some variation between the systems with regards to data entry methods (secretarial input from forms completed by physicians versus direct physician input) and system versatility (some allow the addition of a dictated narrative component to the summary). However, only a handful of these studies measured outcomes to determine the effect the databases had on the discharge summary. Llewelyn et. al. developed a system where narrative descriptions of routine physical findings, diagnoses, and management were stored in a database. For discharge summary preparation, selections which most closely described the patient's hospital course were printed from each database field.[30] The consultant then edited the printout and a secretary modified the database descriptions into a discharge summary. This system was used to generate summaries for all patients admitted to the author's general medicine service over 3 months and the timeliness of these summaries were compared to hand written notes from the service of another consultant at the same hospital. Discharge summaries were prepared for every patient on the intervention team while a summary was prepared for 87.5% of patients in the control group. Summaries from the computer based system were complete within 1 week 80.2% of the time while the same was true for only 32.7% of discharges in the control group. Assessment of the summaries and feedback from family physicians was not reported.

Less complicated systems have been tested. Janik et. al.[24] studied discharge summaries generated from a database containing information from a form completed by various members of the health care team in the neonatal intensive care unit. A before-after design was used. However almost all outcomes for the "before" summaries were based on *estimates* by various members of the health care team. For an obstetrics service, Smith et. al. assessed a system in which housestaff completed forms

which were entered into a clinical database that generated discharge summaries.[31] When compared with an historical control in which narrative summaries were prepared using voice dictation, mean delay from patient discharge to summary generation was significantly decreased (3.8 vs. 20.9 days; p=0.001). Again, no assessment of discharge summary quality was reported. In Lissauer's study[33], housestaff on a neonatal service prepared two discharge summaries for each patient: one with narrative dictation and the other from a database into which the same physicians directly entered clinical data. Outcomes were measured by the author and included: timeliness; completeness (proportion of pre-determined data items mentioned in the summary); accuracy (the medical record was reviewed and the most important diagnoses recorded; the summaries were then reviewed and the proportion of these diagnoses which were reported was calculated); and readability (subjective assessment on a 10-point ordinal scale without anchors). More patients had database generated summaries than dictated summaries (98% vs. 71%). Summaries from the database had fewer data omissions (0.72 vs. 5.38 per summary), omitted fewer diagnoses (1 vs. 5), but received a lower readability score (median 6 vs. 8). The study concluded that databases can be used to generate discharge summaries for babies from a neonatal ward. Castledon's study surveyed family physician's opinions of discharge summaries after a database was used to prepare discharge summaries for a surgical service in Australia.[35] 88% of responding physicians who reported a change in the discharge summary thought that these changes were an improvement over the dictated summaries received previously. Adams et. al.[39] used a clinical database to generate discharge summaries for half of the surgical services in a teaching hospital in Cheltenham, England. The other services used dictation to produce narrative summaries. A survey revealed that 35% of family physicians found the narrative summaries inadequate compared to 8% for computer generated summaries. Brazy et. al. asked family physicians to compare computer-generated and dictated discharge summaries from a neonatal unit using a 5-point ordinal scale.[40] The computer-generated discharge summary was mildly or strongly preferred to the dictated summary within the following domains: presentation of patient's demographics, current status, hospital course and delivery; relevance; ease of abstracting information; and timeliness of summary. 73% of physicians preferred the computer generated summary while 9% preferred dictated reports. These differences were not compared for statistical significance.

These studies attempted to measure the effect each intervention had on the discharge summary but the studies have many weaknesses which decrease the reliability of their results (Exhibit 3). In several studies[13,30,31,33] the investigators themselves assessed the effect of the intervention on the discharge summary using subjective outcomes, raising the possibility of bias towards the intervention. If other physicians were used to assess the summaries, no formal survey instrument was used [16] or the instrument used did not assess all important components of the summary.[17-20,35,39] Several studies did not assess the intervention's effect on the discharge summary in a real clinical practice.[18-21] Others tested their intervention in a real clinical situation but did not compare the summaries concurrently,[13,16,17,31,35,40] or failed to use randomization to assign patients or physicians to the intervention.[30,39]

The optimal study design to measure an intervention's effect on the discharge summary should use physicians other than those involved in the study to assess the discharge summary using a measurement tool that detects changes in various components of summary quality. The study should be done in a real clinical situation and should concurrently compare the intervention to the current method of summary generation. Consecutively admitted patients should be randomly assigned to the method of summary preparation. Finally, a baseline assessment of the control process of summary preparation should be made prior to the introduction of the intervention method to measure possible changes in the control method due to contamination by the intervention.

1.4 Defining Discharge Summary Quality and its Components

A formal definition of discharge summary *quality* is not available in the published literature, making it necessary to develop one for this study. Given that the purpose of the discharge summary is to communicate hospital information to a patient's regular physician(s) so care can be resumed following discharge, the following definition of discharge summary quality has been chosen: *A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician.* This definition acknowledges that a discharge summary needs to contain appropriate information and transfer it in a timely manner in order to fulfill its purpose. Strictly speaking this definition applies to a *discharge summary process* since timeliness of transfer is not a characteristic of the discharge summary itself.

This definition was used in a survey which determined contributors to discharge summary quality.[42] A list of content and process items (Exhibit 4) which potentially influence the quality of the discharge summary was generated based upon a review of discharge summaries produced at our institution and studies addressing discharge summary content.[1,2,18,19,39,40,43-48] Several of the items were altered to determine what effect these changes had on summary quality. A one-on-one survey was performed on a convenience sample of fifty family doctors and fifty hospital-based physicians using an ordinal scale. Results were transformed to a continuous scale using transformations described by Guilford[49] so that items *increasing* discharge summary quality were ranked above zero and items *decreasing* quality were ranked below zero. After transformations, the scale ranged from a minimum of -6.6 ("Item makes discharge summary useless") through 0 ("Item has no effect on summary quality") to 10 ("Item is so essential that discharge summary is useless without it"). There was a significant difference in the amount that each item contributed to discharge summary quality. Discharge summary content was significantly more important than the process used to create the summary. Discharge information was more important to quality than pre-admission or hospital information (Exhibit 5). The items that increased summary quality most included admitting diagnosis, therapeutic procedures in hospital, complications in hospital, discharge diagnosis, complete discharge medication information, and active medical problems at discharge (Exhibit 6, Exhibit 7). Summary quality was inversely proportional to delay between patient discharge and summary receipt (Exhibit 8). There was a curvilinear relationship between quality and summary length with optimal length between 1/2 and 2 pages. Quality increased when a structured rather than a letter style format was used. Including all pre-admission medication and medical allergy information significantly improved quality; however, including only *pertinent* aspects of the history of presenting illness, past medical history, and social history was preferred (Exhibit 9). Similar results were found with physical examination and hospital investigations where summary quality was increased most when only pertinent results were included in the summary (Exhibit 9). All therapy administered in hospital, whether successful or not, was preferred to citing only successful therapy. Quality decreased if the summary listed only the changes to admission medications rather than listing *all* discharge medications (Exhibit 8). Comparison of quality scores between hospital and family physicians revealed remarkable consensus. In a follow-up questionnaire with an 86%

response rate (see section 2.5), no physicians objected to the definition developed for discharge summary quality.

Several conclusions can be made from this survey. First, since no physicians objected to our definition of discharge summary quality, it likely is acceptable to practicing physicians. Second, in addition to the actual content of the discharge summary, the *process* used to produce the summary (i.e. delay to summary receipt, discharge summary length, and format) also affects discharge summary quality. Finally, various aspects of discharge summary content and process contribute significantly different amounts to discharge summary quality.

The results of this survey can be used to develop a schema for assessing discharge summaries and the system used to produce them (Exhibit 10). When assessing a *discharge summary system*, it is necessary to determine the system's effect on *discharge summary quality* and the *resources* needed to produce the summary. Components of discharge summary quality include its *content, organization,* and *efficiency* or *timeliness*. Content refers to the information actually provided by the summary, and may be affected by three domains. ***Completeness*** refers to whether the discharge summary contains all of the information necessary to continue patient care. ***Pertinence*** refers to whether all of the information provided by the summary is necessary for continuing patient care. Consider a summary that provides all of the information necessary for continuing patient care (i.e. it is *complete*) but "buries" that information within unnecessary data. In this situation, necessary information "hidden" to the receiving physician may not be considered in decisions about patient care and the quality of the discharge summary is therefore decreased. ***Accuracy*** refers to whether information provided by the summary truly reflects what happened to the patient in the hospital. If the summary's information is incorrect and is used to make patient care decisions, ongoing patient care will suffer. ***Organization*** refers to how information provided by the summary is grouped and ordered. By collating clinical data into suitable groups ("The patient's discharge medications included ..."), and appropriately sequencing the data ("Because of the patient's gout, indomethacin was given which caused a bleeding duodenal ulcer, a marked drop in the hemoglobin, and a myocardial infarction..."), information will make more sense to the physician receiving the summary. If this increases the probability that information will be considered in decision making, continuing patient care will

be improved in addition to the quality of the discharge summary. ***Efficiency*** or ***timeliness*** refers to the delay between patient discharge and receipt of the summary. If this delay is long, information in the summary will not be available for decision making. The ***resources*** used to produce summaries are an important consideration. A system that produces the highest quality summaries but consumes excess resources is not optimal and likely unsustainable. An inferior discharge summary system could increase a ***physician's time*** and ***effort***. Since it is unlikely that such a system is acceptable to physicians, it is necessary that physician acceptance is measured. Because a change in the discharge summary system can affect any or all of these elements, possibly in opposite directions, proper assessment of a discharge summary system involves measuring its effect on all of these areas.

1.5 Previous Attempts to Measure Discharge Summary Quality

Two surveys were performed using the definition of discharge summary quality given above. The first survey was a follow-up to the one-on-one survey described in section 1.4. Ten discharge summaries from the general internal medicine service at the Ottawa Civic Hospital were randomly selected. Random combinations of three summaries were mailed to participating physicians along with a one-page survey (Appendix 1). A brief description was provided of a 100 mm visual analogue scale anchored in the middle and at both ends. The definition of "discharge summary quality" was given and physicians were asked to rate the quality of all three discharge summaries on the same scale. 86 of 100 physicians responded (86%) and the quality ratings of the ten summaries (in millimetres) are given in Exhibit 11. Several observations can be made. First, there is a large amount of variability in quality ratings for each discharge summary as shown by the relatively wide confidence intervals. Second, a wide range in the mean quality, from 34 for summary "D" to 74 for summary "A" was seen. Finally, statistically significant differences in quality ratings were seen between summaries. It was concluded from this survey that a visual analogue scale could be used for measuring discharge summary quality.

A second survey was performed to determine the following: how would quality ratings change if physicians rated only one summary per scale rather than three; what is contributing to a physician's overall quality rating; and is the discharge summary quality visual analogue scale responsive to changes in the discharge summary. Summaries "A", "D", and "E" from the previous survey (Exhibit 11) were chosen

because they represented a wide range in quality. Following a review of the patient's medical record, summaries "D" and "E" were re-dictated by CvW to produce (what was felt to be) a higher quality discharge summary. To determine if quality ratings changed when one summary was assessed alone rather than along with two other summaries, summary "A" was not modified. All 509 family physicians who received at least 1 discharge summary from the general internal medicine service between January and December 1995 were sent one of the five summaries accompanied with a questionnaire (Appendix 2). This questionnaire asked physicians to rate the overall quality of the discharge summary along with its content, length, and organization. Definitions for the last three domains were not given on the questionnaire. Reminders were *not* sent to non-responding physicians.

A 45% response rate was obtained (229 / 509) and the survey results are summarized in Exhibit 12. Again, considerable variability was seen for assessments of each summary domain as indicated by the wide confidence intervals surrounding the point estimates. Significant improvement was seen in all domains between the original summaries ("e" and "d") and their respective modified summary ("e-mod" and "d-mod"). Ratings for the various domains followed similar patterns for the five summaries with summary content and organization always rating higher than length. The point estimate for mean summary quality always ended up between the mean ratings for content, length, and organization. Stepwise multivariate linear regression was performed with quality as the dependent variable. Assessments of summary content, length, and organization all entered the model ($R^2 = 0.6927$). When compared to the previous survey (Exhibit 11), the quality rating for summary "A" was almost identical, whereas quality ratings for summaries "D" and "E" increased significantly. As with the previous survey (Exhibit 11), none of the mean ratings were above 80. The following was concluded:

1. Large variations are encountered in the assessment of discharge summary quality using visual analogue scales and different physicians, even when the *same* summary is assessed.
2. Visual analogue scales assessing discharge summary quality and its components are responsive to changes in the discharge summary.
3. Much of the variation of discharge summary quality is explained by summary content, length, and organization as assessed by the physician.

4. Three observations make the *objectivity* and *reproducibility* of visual analogue scales in discharge summary assessment questionable. First, summary quality ratings increased significantly when summaries are assessed without other summaries for comparison. Second, assessments of all five summaries (Exhibit 12) followed very similar pattern. Third, none of the mean ratings were above 80 suggesting a possible ceiling effect of the scale. Given these potential limitations of using visual analogue scales to assess discharge summaries, other methods of measuring summary attributes are necessary for ensuring a valid assessment.

1.6 Summary

In summary, the following points merit emphasis:

1. The discharge summary is an important method of communicating information and is necessary for continuing patient care.

2. Deficiencies in discharge summary content, accuracy, and timeliness are a common problem in many medical jurisdictions.

3. Interventions to improve discharge summaries that have been studied include physician education, altering summary format, and computer databases. None of these interventions have convincingly increased discharge summary quality. The most promising intervention is the computer database because it produces structured summaries with greater ease and stores the information in a retrievable format useful for clinical, administrative, and research purposes.

4. Previous studies examining methods to improve discharge summaries used designs with a strong potential for bias. To accurately assess an intervention's effect on the discharge summary, a study should randomly allocate patients to different discharge summary generation methods and use physicians other than those involved in the study design to assess discharge summary quality.

5. It is impossible to blind hospital physicians to the method of discharge summary preparation being used for a particular patient. Introduction of a new method of summary generation may alter how summaries are generated with the previously used method. It is therefore possible that physician behavior, independent of the intervention itself, could result in changes in the discharge summary. Studies assessing new methods

of summary generation should try to measure changes in the control group which are secondary to the introduction of the intervention.

6. Discharge summary quality consists of many components. When a discharge summary process is assessed, its effect on both summary content as well as "extra-content" aspects of the discharge summary (e.g. its length, format, timeliness) should be assessed. In addition to discharge summary quality, an assessment of the discharge summary system's effect on physicians is also important.

7. If visual analogue scales are used for discharge summary assessment, other measurements should be recorded concurrently to assess the validity of the scalings and ensure an accurate assessment of the discharge summary.

2 Aims and Objectives of Study

The objectives of this study were:

1. To compare medical discharge summaries generated from a clinical database with those created by dictation of a narrative letter.
2. To determine if the introduction of the clinical database changed the dictated discharge summary.

3 Methods

3.1 Study Design Overview

The study consisted of two major parts: the ***cohort study*** (also called the baseline assessment in this report) in which all patients had their discharge summaries generated with the dictated discharge summary system; followed by the ***randomized study*** in which patients were randomly assigned to have their summaries generated with either dictation or the database summary system. To determine the effect of the database summary system, summaries generated in the randomized portion of the study were compared to each other. To determine if the dictated summaries changed during the randomized trial, they were compared with summaries generated during the cohort study. The organization of the study is shown in Exhibit 13. Significant study dates are given in Exhibit 14. The study was reviewed and approved by the Ottawa Civic Hospital institutional review board.

3.2 Study Setting and Housestaff Instruction

The study took place between September 1996 and June 1997 on the general internal medicine service at the Ottawa Civic Hospital. The Ottawa Civic Hospital is a 700 bed tertiary care teaching hospital. The 80-bed general internal medicine service consults on patients presenting to the emergency department with multi-system or undifferentiated illnesses, in addition to patients potentially needing in-hospital therapy. Patients were assessed in the emergency department by housestaff with varying levels of training who conferred with staffpeople and decided whether the patient required admission to hospital.

Internal medicine beds were initially divided between four clinical teams composed of a staffperson certified by the Royal College of Physicians and Surgeons of Canada, a second or third year internal medicine resident, and one or two interns and medical students. In November of 1996, the service's structure was changed to three housestaff teams composed of a second or third year internal medicine resident along with two to three interns and two to four medical students. The housestaff team was supervised by two staffpeople, each responsible for half of the team's patients. All housestaff teams admitted new patients on a daily basis with a maximum capacity of twenty-five patients per team. For the remainder of this report, the term "housestaff" will refer to all physicians in training and medical students who cared for patients in hospital and produced discharge summaries. The term "staffperson" will refer to physicians who supervised the housestaff.

In the cohort study, the dictated discharge summary method described in section 3.3 was used for all patients. All housestaff received a five to ten minute instruction session from an investigator (CvW) on the importance of the discharge summary. They also received an information and instruction sheet about discharge summary preparation and the Ottawa Civic Hospital dictation system (Appendix 3). Use of the history and physical form (Appendix 7 to Appendix 10 - discussed in section 3.5) was also explained and encouraged. The housestaff were told that each discharge summary would be accompanied by a questionnaire to assess the discharge summary. Housestaff were shown a copy of the questionnaire (Appendix 17) and the summary domains to be assessed were explained. It was emphasized that results were available to the study author only.

During the randomized portion of the study, all housestaff on the general internal medicine service received a different information session. This started with a short survey (Appendix 4) which elicited demographic information as well as previous experience in dictating discharge summaries (not shown). The survey also measured attitudes towards discharge summary preparation (time required and burden of preparing summaries) and the discharge summaries themselves (completeness, pertinence, and organization). The basic purpose and design of the study was explained followed by a description of the two discharge summary systems. During the description of the dictated discharge summary system, housestaff were given the same handout as that used in the cohort summary (Appendix 3). Since most physicians had some experience with the dictated discharge system, more time was spent explaining the database discharge system (approximately 5 - 10 minutes vs. 2 - 5 minutes). Overall, the whole information session lasted between 10 and 15 minutes.

3.3 Inclusion and Exclusion Criteria

All patients admitted to the general internal medicine service during the study period were eligible for inclusion. Eligible patients were identified through the hospital administrative database which classifies admitted patients by the staffperson under whom they are admitted. During the randomized portion of the study (Exhibit 13), patients were excluded if they were admitted *without* a standardized history and physical form (Appendix 7 to Appendix 10, described in section 3.5). Patients who were transferred from another service to a general internal medicine team were excluded because discharge summary preparation for these patients could be more difficult if housestaff did not have contact with the patient throughout the hospitalization. Patients who died were excluded since their discharge summary is used for notification rather than for continuing medical care. Patients transferred from general internal medicine to another service were excluded since physicians on the general internal medicine service are not responsible for discharge summary preparation for these patients. Finally, patients were excluded if they remained in hospital past the dates given in Exhibit 14.

3.4 Control Group: The Narrative or Dictated Discharge Summary System

With the narrative or dictated discharge summary system, housestaff discharging a patient were responsible for dictating that patient's discharge summary. This involved logging onto the hospital dictation

system and dictating a letter communicating information thought necessary for continued patient care. The patient's medical record was available to the physician during dictation. The information included and the format used was left to the dictating physician's discretion. Each housestaff received an information sheet containing suggested discharge summary content (as well as information about the dictation system) at the start of their internal medicine rotation from CvW (Appendix 3). Hospital policy directs that summary dictation is not mandatory for patients discharged within 2 days of admission. Usually, the dictating physician requested that a copy of the summary be sent to the patient's family physician. If this was not done, a copy of the summary was not sent to the family doctor. The dictated letter was typewritten verbatim a median of 3 days (inter-quartile range 2 to 5 days) following dictation. The summary was printed at midnight following transcription (Appendix 5 and Appendix 6). Copies of the summary were then sent to the medical record, the attending staffperson, and any physician requested during the dictation.

3.5 Intervention Group: The Database Discharge Summary System

The database discharge summary system collates information in a patient database into a discharge summary. Each field in the database represents information which significantly improved discharge summary quality in the survey described in section 2.4. Exhibit 15 displays the information contained in the database and the amount each item contributed to discharge summary quality in the survey.

Fields in the database were completed using information documented on three separate forms which had sections corresponding to fields in the database. These forms were completed by housestaff treating the patient in the hospital . *Pre-admission information* was documented on sections of the patient's admission history and physical form (Appendix 7 to Appendix 10). This 4-page form has discrete sections from which the following information was abstracted for the database: active pre-admission medical problems (Appendix 7); history of presenting illness consisting of chief complaint, duration of chief complaint, and symptoms associated with the chief complaint (Appendix 7); medications on admission (Appendix 8); and physical examination consisting of vital signs on admission, general appearance on admission, and abnormal physical findings on admission (Appendix 9 and Appendix 10). *Hospital information* was recorded on the "Hospital Summary Form" (Appendix 11) on which physicians documented

pertinent laboratory data, admission diagnoses and therapy, complications and therapy, and miscellaneous information. This form was printed on durable high grade paper and was placed in the medical record immediately following the admission history and physical form. When physicians identified information which they thought was necessary for the discharge summary, they entered it in the appropriate section of the form. The reverse of the form was identical if additional space was necessary to record all hospital information. *Discharge information* was recorded on the Database Dear Doctor Letter (Appendix 12). This form provided space for physicians to record three types of discharge diagnoses (primary, others treated in hospital which lengthened patient stay, and others treated but not affecting length of stay), discharge medications, arranged medical follow-up and community services, laboratory investigations pending at discharge, and medical issues that may need attention following discharge. A carbon copy of the completed form was given to the patient as an interim report for hand-delivery to the family physician.

The day following patient discharge, data from these three completed forms were entered into the database by the investigator (CvW). All data written on the forms was entered verbatim into the database with the following exceptions: 1) short-forms used during documentation were entered into the database in long form (e.g. if "Gr II/VI SEM loudest LLSB → carotids bil." was entered on the history and physical form (Appendix 9), the following was entered into the database: "grade 2/6 systolic ejection murmur, loudest at left lower sternal border radiating to carotids bilaterally"); 2) phrases were formatted to simplify reading (e.g. if "D/C lasix" was documented as a treatment (Appendix 11), "lasix was discontinued" was entered into the corresponding field in the SDSD). Data entry took between ten and twenty minutes depending on case complexity and the amount of data written on the forms. When data entry was complete, information from each of the fields was formatted into a database discharge summary (Appendix 13) using a "macro" within a word-processing package. This was done on the evening that data was entered into the database with the exception of data entered on the weekend which was collated into a summary on the following Monday. If fields in the database were empty for active pre-admission medical problems, pre-admission medications, and discharge medications, "None identified" was placed in the summary under the appropriate heading. There was a mean delay of 1.4 days between data entry and summary printing.

Summaries were sent to the chart, the staffperson, and all physicians noted on the database "Dear Doctor" letter (Appendix 12) the day following printing.

If the any of the forms (Appendix 11 and Appendix 12) were completely blank when the medical record was retrieved on the day following discharge, stickers were placed on the blank forms instructing physicians to complete the blank forms for the database summary generation. This occurred in 51 / 142 (35.9 %) of patients in the database group. The stickers also instructed physicians to page CvW following completion of the form so data could be entered into the database. Physicians were never contacted in person by the investigator if the forms were incomplete.

3.6 Randomization

The unit of randomization for the randomized portion of the study (Exhibit 13) was the hospital admission. Therefore, patients readmitted during the study could be randomized (provided all inclusion and exclusion criteria were satisfied) on the repeat admission. During the randomized trial 17 / 293 (5.8 %) randomized patients had been previously randomized (7 to the other group). The housestaff physician was not used as the unit of randomization because many patient factors (such as case complexity) and admission factors (such as number of housestaff on the team, number of other patients cared for, and whether the patient was discharged on the week-end) are independent of the physician and could influence discharge summary preparation. Also, it was necessary for randomization that take place when the patient was admitted to the hospital. Because multiple housestaff care for each patient, it is impossible to determine which housestaff group (i.e. control or intervention) would create the summary when the patient is admitted. Three problems would result from using the housestaff physician as the unit of randomization: to ensure their equivalency, many more housestaff would need to participate in the study and the trial would take longer to complete; intervention forms (Appendix 11 and Appendix 12) would need to be placed on each patient's chart possibly increasing contamination of the dictated group; and elicitation of housestaff comparisons of the two summary systems could change because housestaff in the intervention group would be comparing the database summary process to the dictated summary process used prior to the study, thereby increasing the chances of recall bias.

A balanced randomization scheme stratified by physician team was used. Block sizes for each team were randomly selected using a random number table.[50] The randomization schedule was created using the Moses-Oakford assignment algorithm as described by Meinert.[51] Opaque envelopes containing paper indicating the intervention to which a patient was assigned was generated for each team. The block size of two teams was 6 while the remaining team had a block size of 4. The investigator was blinded to each team's block size and randomization schedule. On each morning during the randomized trial, the patient census for each physician team was generated. Patients admitted in the twenty-four hours since the previous randomization were identified. If the patient was admitted to hospital using the history and physical form (Appendix 7 to Appendix 10), the following information was documented in the randomization log: the patient's name; hospital unique number; admission registration number; admission date; and physician team. Only then was the next available randomization envelope for that team opened to determine which group the patient was randomized to. If the patient was randomized to a database discharge summary, the hospital summary form (Appendix 11) was placed in the "progress notes" section of the medical chart immediately following the admission history and physical form (Appendix 7 to Appendix 10). The database "Dear Doctor" letter (Appendix 12) was placed as the first sheet in the orders section (upside down to protect the carbon). If the patient was randomized to a dictated discharge summary, a form printed on cardboard similar to the hospital summary form (Appendix 15) was placed in the chart immediately following the admission note. This form was included to control for any intervention bias resulting from Appendix 11 in the intervention group. It instructed physicians that the patient was randomized to a dictated discharge summary. It also reminded them to: dictate the summary when they discharged the patient; send a copy of the summary to all physicians involved in the patient's care; only include information thought necessary for continuing patient care; and complete the front sheet of the patient's chart. Finally, if randomized to the dictated summary, a "Dear Doctor" interim report was placed in the patient's chart as the first page in the medical orders (Appendix 16). This interim report was identical to that usually used on the general medicine service. However the reports are not usually placed in the patient's chart. This was done during the randomized trial since Appendix 12 was placed in the charts of patients randomized to the database discharge summary.

3.7 Data Collection

Each discharge summary sent to eligible physicians was accompanied by a questionnaire (Appendix 17). This questionnaire was a modification of the questionnaire (Appendix 2) used in the survey described in section 1.5. Following the study's definition of "discharge summary quality", physicians rated the summary's quality on a 100 mm visual analogue scale anchored with defined qualifiers ("terrible", "acceptable", and "excellent") at both ends and the middle. Using identical scales, the survey also elicited a rating for the summary's *completeness*, *pertinence*, *organization*, and *timeliness*. "Completeness", "pertinence", and "timeliness" were defined. A stamped return envelope was included with all questionnaires. If a physician did not return the questionnaire within 1 - 2 months of discharge summary transcription, a reminder questionnaire (with a copy of the discharge summary) was sent. For the timeliness domain of the reminder survey, physicians were asked to assume that they received the summary 3 days following transcription. This date was displayed prominently on the discharge summary.

Each summary was reviewed with a summary abstraction form (Appendix 18) with abstraction rules (Appendix 19 and Appendix 20) to determine the content and organization of all discharge summaries. This form collected all admitting diagnoses, procedures, therapy, consultations, complications, and discharge diagnoses as defined in the abstraction rules. It also documented whether several content items (history of presenting illness, active past medical illness, medications on admission, admission physical examination, admitting diagnosis, reason for admission, therapy in hospital, procedures, consultations, complications, discharge diagnosis, discharge medications, medical follow-up, pending investigations, diagnostic and therapeutic investigations) were under headings. The total number of upper case headings was also recorded. When information from one category was located within information from another category, a "misclassification" was counted (Appendix 20). When events in the history of presenting illness or course in hospital were given prior to events which occurred *previously*, a "dyschronology" was counted (Appendix 20). The total number of misclassifications and dyschronologies were tallied. During the randomized portion of the study, the number of lines of print (complete or incomplete) was counted for each summary. This total was broken down into pre-admission information (including all pre-hospital history including the admission physical examination), hospital information

(including all hospital information up to but not including discharge diagnosis), and discharge information (including all remaining information). The summary was reviewed by one of two investigators. The first 45 summaries of the cohort study were reviewed by both investigators. The mean kappa statistic for each category was 0.70 (95% confidence interval 0.65 - 0.76) indicating excellent inter-rater agreement for summary abstraction.

To assess summary completeness and accuracy, each patient's chart was reviewed with a standard form (Appendix 21) using standardized abstraction rules (Appendix 22). First, patient identification and the patient's family physician was abstracted from the front sheet. Second, the interim discharge report (if available) was abstracted for discharge diagnosis, therapy and procedures, discharge medications, and medical follow-up. Third, all medications written in the medical orders were documented. Vitamins, elements, medications given on an "as-needed" basis or as a one-time dose only, and those which were taken by the patient prior to hospitalization (as documented in the admission note - Appendix 8) were excluded. Fourth, the consultation section of the chart was reviewed to capture all medical and surgical consultations. Fifth, the admission history and physical form was reviewed to determine active medical problems, medications at admission, and the admitting diagnoses. Finally, the progress notes were reviewed to identify procedures, complications, and family physician visits. For patients randomized to the database group, the hospital summary form (Appendix 11) was not examined during the chart review.

Each admission's summerative laboratory report capturing all laboratory data accumulated during each patient's hospitalization was reviewed for: extreme results providing an objective assessment of the patient's severity of illness (Appendix 23); and laboratory tests helpful for continuing patient care (Appendix 23). Radiology tests performed during hospital stay were ascertained from the hospital radiology database. The discharge summary was abstracted to determine if the tests in Appendix 23 were reported.

The hospital's administrative and medical record abstraction database provided the patients primary discharge diagnosis and indicated whether patients were admitted to hospital special care areas (including the intensive care unit and monitored acute medical area). The dictation system documented the date that each dictated summary was created and the amount of time each physician used for summary

dictation. In a random sample of fifty dictated summaries not included in this study, the dictation time had a very high correlation with the number of words in the summary ($R^2 = 0.81$, p-value < 0.00001). Therefore, the dictation time was used to measure summary length for all dictated summaries.

Finally, housestaff attitudes towards each discharge summary system were measured with a survey mailed to all housestaff at the end of the study (Appendix 24). The survey elicited the following: the number of dictated and database summaries they had created during their internal medicine rotation; the number of dictated and database summaries they had read during their internal medicine rotation; an assessment of the two discharge summary systems in terms of housestaff resources (time and burden); an assessment of the summaries themselves (completeness, pertinence, and organization); and discharge summary system preference. Space was provided for comments.

With the exception of summary surveys (Appendix 17) and housestaff surveys (Appendix 24), data collection (i.e. medical record, laboratory, radiology, and summary review) was complete for each patient.

3.8 Outcomes

Exhibit 16 is a modification of Exhibit 10. It indicates the outcomes measured for the study and their relation to the schema used for assessing a discharge summary system. The ***primary outcome*** was overall discharge summary quality as assessed by the receiving physicians using Appendix 17.

Secondary outcomes included:

1. Summary completeness, pertinence, organization, and timeliness as assessed by the receiving physicians using Appendix 17.
2. Proportion of admissions for which a summary was generated within four weeks of patient discharge.

Tertiary outcomes included subgroup analyses of physician summary assessments, objective measurements of the secondary outcomes, measurements of summary accuracy, and housestaff preference. Specifically, tertiary outcomes were:

1. Physician assessments of summary completeness, pertinence, organization, timeliness and overall quality (Appendix 17) stratified by the specialty of the responding physician and the type of survey response (i.e. whether or not the response was a reminder).

2. Summary completeness measured in two ways. First, the proportion of summaries containing content items (chief complaint, history of presenting illness, active past medical history, inactive past medical history, family medical history, social history, pre-admission medications, admission physical examination, admission diagnosis, reason for patient admission, medical treatment in hospital, diagnostic and therapeutic procedures, complications consultations, discharge diagnosis, discharge medications, fate of admission medications at discharge, medical follow up, prognosis, lifestyle modifications recommended, arranged community services, patient functional status, pending laboratory investigations, and diagnostic and therapeutic recommendations) as defined in Appendix 19 and Appendix 20 was calculated. This is referred to as the "***apparent completeness***" since many of these items (e.g. complications) may not appear in the summary if they did not actually occur in the hospital. The second measure, "***true completeness***", was therefore measured and defined as: the proportion of consultations, procedures, new medical therapy, and complications detected at chart review (Appendix 21) which were documented in the summary; and the proportion of significant laboratory results (Appendix 23) found on laboratory review which were documented in the summary.
3. Summary pertinence as measured by summary length. Summary length was used as a possible correlate for pertinence since the probability that unnecessary information is included in the summary should increase as summary length increases.
4. Summary organization as measured by: total number of headings; the proportion of selected content items (chief complaint, active medical problems, admission medications, admission physical examination, admission diagnosis, reason for admission, treatment in hospital, procedures, complications, consultations, discharge diagnosis, discharge medications, medical follow-up, pending lab results, diagnostic and therapeutic recommendations) under a heading as defined in Appendix 19; and the total number of "misclassifications" and "dyschronologies" as defined in Appendix 19 and Appendix 20.
5. Summary timeliness as measured by calculating the number of days from patient discharge to summary printing.

6. Summary accuracy as measured by calculating the proportion of consultations, procedures, complications, and significant investigations documented on the summary which were detected at chart and laboratory review.
7. Housestaff resources used for summary creation and housestaff preference as measured by the questionnaire completed by housestaff creating summaries following the randomized portion of the study (Appendix 24).

3.9 Sample Size Calculation

An outline of the sample size calculation for the randomized portion of the study is given in Exhibit 17. The primary outcome was overall discharge summary quality (Appendix 17). The mean quality of dictated summaries (the control group) and the variance of this assessment (lines 1 and 2) were obtained from an interim analysis of summary quality scores of baseline summaries. The survey described in section 1.5 determined the minimal important difference in discharge summary quality, as assessed by family physicians (line 3). Of 221 physicians returning a survey, 77 gave a minimal important difference in discharge summary quality. The median *relative* minimal important difference was a 19% increase in summary quality over the control summary. A 19% increase from the baseline summary quality of 74.3 results in a mean summary quality of 88.4 for the database group. To ensure that the study did not miss a clinically important difference, the mean database summary quality that the study tried to detect (line 4) was decreased to 85. Using an α-error of 0.05 (2 sided) and a β-error of 0.15 (1-sided), the unadjusted total sample size necessary to detect this difference was 94 assessments of summary quality.

Adjustment of this sample size was necessary since summary quality assessments (Appendix 17) are not received for all randomized patients because: the discharge summary is not dictated for all patients discharged from the general internal medicine service following a length of stay of less than 2 days (lines 12 and 13) or greater than 2 days (lines 15 and 16); some patients are not discharged from the general internal medicine service because of death (line 18) or transfer to another service (line 21); not all summaries are sent to physicians who are eligible to assess the summary (section 3.7) (line 19); and not all summary assessments by eligible physicians are returned (line 20). All probabilities were derived from the baseline assessment except for: probabilities for the database summaries (lines 13 and 16) and the

probability of getting transferred from internal medicine to another service (line 21) which were estimates. Equations for adjusting the sample size[51] for each of these probabilities were applied resulting in the final sample size of 370 patients.

3.10 Data Analysis

Medications, diagnoses and procedures were coded for analysis. Medications were simplified to a common classification (e.g. Isordil and Nitrodur both became nitroglycerin). All medications were assigned a six digit American Hospital Formulary Service (AHFS) code. The code for each medication was made unique by adding an additional digit to the AHFS code. All procedures and diagnoses from chart and summary review were assigned an ICD-9 diagnosis by a trained health records analyst who was unaware of the patient or the group that the patient was randomized to.

Summaries created more than 4 weeks following discharge were excluded from analysis because they are very distinct from summaries generated closer to patient discharge. When housestaff do not dictate a discharge summary, this is done by the staffperson only when the oversight is identified by health records. When the staffperson finally dictates these summaries, the delay can reach months. The summary's contribution to continuing patient care is often perceived by staffpeople as negligible, so the primary reason for dictating the summary is the avoidance of suspension of admission privileges. This results in a very different summary and they were therefore excluded from analysis. This exclusion affected 16.4% of summaries.

All analyses were performed on SPSS (version 6.1.3), Excel 5.0 (Microsoft, Redmond), and EPI-INFO (Center for Disease Control). When more than one assessment (Appendix 17) was received for a single summary, the mean of each quality, completeness, pertinence, organization, and timeliness rating was calculated. Continuous measures were compared with Student's t-test with equal variances if the p-value of Levene's test for homogeneity of variance was greater than 0.10 (otherwise Student's t-test with unequal variances was used). Student's paired sample t-test was used to compare housestaff opinions of the discharge summary systems (Appendix 24). Categorical measures were compared with Chi-Square test (using the Yates correction for Chi-Square if less than 5 observations were expected in one of the cells). The Log-Rank test was used to compare curves plotting time to summary generation. A p-value

less than 5% was considered significant. Since the tertiary outcomes delineated section 3.8 were collected and analyzed to explain the primary and secondary outcomes, no corrections for multiple testing of these outcomes were performed.

To determine the relationship between physicians' assessments and objective measures, the following outcomes were compared: completeness score vs. the number of items in the summary (Appendix 18); pertinence score vs. summary length (measured by recording length for dictated summaries and number of lines in the summary for summaries from the randomized trial); organization score vs. the total number of headings and the proportion of items (Appendix 18) under headings; timeliness score vs. time from patient discharge to summary generation. For each comparison, simple linear regression was performed using the physician assessment as the independent variable. The association was considered significant if the coefficient of the physician assessment in the regression equation was significantly different than 0. If the association was significant, the strength of the association was measure with the R-squared value.

4 Results

Following descriptive statistics (sections 4.1 to 4.3), results will be presented according to the schema presented in Exhibit 16.

4.1 Patient Enrollment and Flow Through Study

Exhibit 18 indicates patient flow through the baseline portion of the study. During the cohort study, 960 patients were discharged from the general internal medicine service. Fifty seven patients were ineligible for the study because they were transferred from other services (28 patients), discharged from the emergency department prior to transfer to a hospital bed (13 patients), or the patients carried a "non-teaching" status and were not cared for by the housestaff (16 patients). Therefore, 903 patients entered the study cohort, of whom 121 died in hospital making their discharge summaries ineligible for analysis. This left 782 patient admissions eligible for dictated discharge summary generation. In the remainder of this report, this group will be refereed to as the "dictated - cohort" (abbreviated as "D-C") group, or the "baseline" group.

Exhibit 19 indicates patient flow through the randomized portion of the study. Between March 17 and May 12, 442 patients were admitted to the general internal medicine service. Seventeen patients were ineligible for randomization because they were transferred *to* the medicine service from another service (11 patients), were discharged from the emergency department (5 patients) or had a "non-teaching" status (1 patient). This left 425 patients eligible for randomization of whom 54 patients were not randomized for the following reasons: patients were admitted without the history and physical form (Appendix 7 to Appendix 10) (28 patients); patients were admitted to the general medicine service by physicians other than those participating in the study (17 patients), patients were admitted *and* discharged within 24 hours and therefore could not be randomized (4 patients); or patients were accidentally overlooked during the randomization process (5 patients). Of the 371 patients remaining, 187 were randomly assigned to the dictated summary system while 184 patients were assigned to the database summary system. Within the dictated and database summary group, patients were ineligible for summary generation because they died in hospital (10 and 18 patients respectively), were transferred to another service (21 and 18 patients respectively), or remained in hospital past the discharge exclusion date (Exhibit 14) of June 1 1997 (5 and 3 patients respectively). Three further patients randomized to the database group were excluded for the following reasons: the hospital summary form (Appendix 11) was accidentally removed by administrative staff during chart "thinning" making discharge summary generation with the database impossible; a physician who had just started the internal medicine service discharged a patient randomized to the database group but *dictated* a summary for the patient since he had not yet been introduced to the study; and a discharge summary was needed immediately for patient transfer to another institution and since the physician (incorrectly) assumed that this could not be done with the database system, a dictated summary was created. Following these exclusions, 151 patients randomly assigned to the dictated summary system and 142 patients randomly assigned to the database system were eligible for summary generation. To distinguish them from the dictated - cohort group, patients randomized to a dictated summary will be referred to as the "dictated - random" (abbreviated as "D-R") group while those randomized to a database summary will be called the "database" (abbreviated as "DB") group.

4.2 Comparison of Study Groups at Baseline

Exhibit 20 compares patients in all three study groups. The groups had similar mean age (about 64 years) and gender composition (approximately 50% female). The groups had a similar burden of illness with patients having a mean of 2 to 3 chronic illnesses prior to admission. When these illnesses were sub-classified, the only significant difference observed was a higher prevalence of rheumatoid arthritis and osteoarthritis in the database group. Mean length of stay was approximately six days and decreased between the baseline and randomized portions of the study, although not significantly. Between 2 and 4% of patients in the dictated-cohort and database group spent a portion of their admission in the intensive care unit (ICU), while none of the patients in the dictated-random group did so ($P < 0.05$). Patients in the dictated-random group were also less likely to visit the acute monitoring area, although this did not reach statistical significance when all three groups were compared simultaneously. Groups did not differ in the number of extreme laboratory results (Appendix 23), with less than one extreme lab result per patient per admission noted for all three groups. The number of diagnostic laboratory tests was also balanced between groups with slightly more than 2 per patient per admission. Groups were similar in the number of new medications started in hospital, number of consultations with other services, and probability of complications during hospital stay (**Exhibit 20**). Although the mean number of procedures performed during the hospital stay did not differ between groups, patients in the dictated-random group were significantly more likely to have at least one procedure performed. Patients in each group were discharged home on a similar number of medications. Significant differences existed in the primary discharge diagnosis as documented by the health records analyst, with patients in the dictated-random group having a higher prevalence of discharge diagnoses classified as neoplastic or blood disorders but a lower prevalence of circulatory disorders. Considering the large number of baseline factors measured, the three groups were well balanced in characteristics that could affect patient complexity and therefore summary difficulty. With the exception of the probability of ICU admission, the importance of any noted differences is questionable. The groups were also similar when only patients who had a summary generated by four weeks post discharge were considered (Exhibit 21).

4.3 Discharge Summary Preparation and Summary Survey Response

Exhibit 22 compares discharge summary generation in the three study groups. Discharge summaries were significantly more likely to be generated for patients in the database group. During the randomized study, the probability of discharge summary generation within four weeks of discharge increased from 57.0% in the dictated-randomized group to 79.6% in the database group. This difference remained significant if the 4 week "deadline" imposed by the study's protocol was dropped or if patients with a length of stay under or equal to two days were excluded. There was no difference between groups in the proportion of "stat" summaries (i.e. summary requested by physician to be created immediately). The proportion of summaries prepared by medical students was greater in the dictated - random group than the dictated - cohort group ($p < 0.05$). The dictated-randomized and database groups did not differ in level of training of housestaff creating the summaries.

The number of physicians sent a copy of the summary and eligible to complete the summary survey (Appendix 17) increased significantly between the cohort and randomized study. The overall response rate for the study was relatively high at 72.0%. Response rates were significantly lower for the dictated - randomized patients (62.7%). 73.6% (444 / 603) of summaries had at least one assessment by an eligible physician. A significantly higher proportion of the dictated - randomized assessments were reminder surveys. The specialty distribution of responding physicians was similar between the groups.

4.4 Overall Discharge Summary Quality

Exhibit 24 displays overall quality scores elicited with the summary survey questionnaire (Appendix 17). There was no significant difference between the study groups in the mean overall summary quality. The quality of dictated summaries was similar in the baseline and randomized portions of the study (74.8 vs. 74.9). The mean quality for database summaries dropped slightly to 72.7, but this did not approach statistical significance. When the quality ratings were stratified by the specialty of the responding physician, consultants (or non-primary care physicians) gave the database summaries a significantly lower quality rating than the dictated - random group. Family physicians found no differences in summary quality between the randomized groups. When quality ratings were stratified by survey response type (i.e. primary

or reminder survey), the differences between randomized groups were greater for reminder surveys, but did not reach statistical significance.

4.5 Discharge Summary Content - Completeness

Physician assessments of summary completeness are summarized in Exhibit 25. The overall mean completeness score dropped from 76.3 and 78.2 in dictated-cohort and dictated-random summaries, respectively, to 73.4 for the database summaries (not statistically significant). The decrease became statistically significant when content scores were stratified by specialty of responding physician. Consultants gave database summaries significantly lower completeness ratings than the dictated - randomized group. Completeness scores did not differ significantly between groups when family physician ratings were considered alone or when scores were stratified by survey response type. The ranges for content scores were similar to those for quality scores (Exhibit 24).

The apparent completeness of the discharge summaries are presented in Exhibit 26 to Exhibit 28 . Discharge summary content was determined using Appendix 18 with the abstraction rules described in Appendix 19 and Appendix 20. Overall, significant differences existed between summary groups in the prevalence of many content items. Areas where significant differences were noted will be discussed. Active past medical history was significantly more likely to be documented in dictated - cohort (93.2%) and database summaries (100%). The inclusion of inactive past medical history decreased significantly between the cohort and the randomized portion of the study dropping from 43.7% down to less than 15% in both randomized study arms. Social history decreased significantly between the dictated-cohort summaries (56.9 %), the dictated-random summaries (37.2%), and the database group (6.2%). Pre-admission medications were cited in all database summaries as compared to 66.3% for the dictated summaries. There was no difference between the groups in the inclusion of medication names, dosages, or frequency. The admission physical examination and its sub strata were commonly described in all three groups but vitals signs and other elements of the physical examination were more common in the database summaries. Admission diagnosis was commonly given in the dictated summaries (Exhibit 27) but was almost non-existent in the database group (since no field existed for admission diagnosis in the database). Dictated summaries were significantly more likely to state the reason for admission, but this difference

vanished if the reason for admission was implied when the patient's history and physical examination was considered. Reports of consultations were more common in dictated-randomized versus database summaries (40.7% vs. 18.6%) while a discharge diagnosis was much more common in the database group (100% vs. 65.1%). Discharge medications (Exhibit 27) and medical follow-up (**Exhibit 28**) were almost always present in database summaries and were significantly more common than in the dictated summaries. Patient prognosis was rarely given in any summary group. Community services were more common in database summaries (40.7%) but patient functional status was more common in the dictated summaries (between 10 and 20%). 40.7% of database summaries cited pending laboratory results, compared to 9.3% of dictated-random summaries. While there was no difference in the frequency of diagnostic recommendations between groups, database summaries were more likely to contain therapeutic recommendations.

In summary, there were greater differences in apparent summary completeness between the database and dictated - randomized summaries than between the two dictated groups. Database summaries had a significantly higher prevalence of some items (active pre-admission medical history, admission medications, discharge diagnosis, discharge medications, community services arranged for patient, pending investigations, and therapeutic recommendations) and a lower prevalence of other items (social history, admission diagnosis, specific reason for patient admission, consultations, and functional status at discharge). It is noteworthy that those items having a higher prevalence in the database summaries had specific fields on the database data forms (Appendix 7 to Appendix 12). In comparison, those items which were more difficult to place on these forms had a *decreased* prevalence in database summaries. Summaries differed only slightly between the dictated groups with randomized summaries *less* commonly including past medical history, social history, and patient discharge functional status but *more* commonly having duration of discharge therapy, fate of admission medications at discharge, and date of medical follow-up with consultant.

True summary completeness was measured by determining if consultations, procedures, new medical therapy, complications and investigations identified by chart and laboratory review were cited in the discharge summary. Results are presented in Exhibit 29. Significantly more consultations identified by

chart review were cited in both dictated groups as opposed to database summaries (D-C 43.7% and D-R 46.8% vs. DB 19.0%). Summaries in the randomized portion of the study captured significantly higher percentages of procedures (D-R 77.1% and DB 71.7% vs. D-C 58.7%), new therapy (D-R 51.5% and DB 48.9% vs. D-C 36.9%), and complications (D-R 42.1% and DB 59.6% vs. D-C 27.2%). Database summaries reported a significantly higher proportion of extreme (DB 48.5% vs. D-R 30.1%) and diagnostic (DB 30.0% vs. D-R 16.7%) blood results. Reporting of other laboratory investigations was similar between groups. With the exception of ventilation-perfusion scanning, the proportion of imaging investigations reported in the discharge summary ranged between 40 and 50% for all three groups.

4.6 Discharge Summary Content - Pertinence

Exhibit 30 displays the physicians' assessment of the pertinence of the discharge summary content. Objective measurements of summary length are also provided. No difference in the physician assessment of content pertinence was detected between any of the summary groups, regardless of which responses were considered. Pertinence scores range between 70 and 80 and were similar to those given for summary quality and completeness of content.

A significant difference in the total number of lines in the summary was seen between the dictated - random and database summaries (64.8 vs. 57.3). Greater differences between these summary groups are seen when the total number of lines were stratified into pre-admission, hospital and discharge information. Compared with database summaries, the dictated - random group had significantly more lines of pre-admission (27.7 vs. 24.4) and hospital information (22.1 vs. 13.5). In contrast, database summaries concentrated more on discharge information (19.4 vs. 14.9 lines). The dictation time of the two dictated groups was similar.

4.7 Discharge Summary Content - Accuracy

To assess the accuracy of discharge summary information, the proportion of consultations, procedures, complications and significant investigations in the summary which were found at chart review was calculated. Results are presented in Exhibit 31. Although groups differed significantly in the proportion of *chart* consults identified in the summary (Exhibit 29), the proportion of *summary* consults identified in chart review did not differ between the groups (D-C 86.7%, D-R 86.0%, and DB 82.6%).

Procedures in the D-R summaries were significantly more likely to be identified at chart review than those in other groups (D-R 93.0% vs. D-C 75.3% and DB 66.7%). For all three groups, it was uncommon for diagnoses identified as "complications" in the discharge summary to be similarly identified in the chart review, but no difference was noted between the groups (D-C 25.0%, D-R 20.7% and DB 21.3%). The proportion of summary investigations identified in the chart review was consistently high (>90% in most categories) and did not differ between the groups.

4.8 Discharge Summary Organization

Exhibit 32 displays the assessment of summary organization by responding physicians. The overall mean organization score was similar between the three study groups (D-C 78.6, D-R 79.3 and DB 77.4). When ratings were stratified by physician specialty, consultants thought that database summaries had significantly worse organization when compared to dictated-random summaries (69.4 vs. 76.0). No significant differences were seen when results were stratified by survey response type.

Exhibit 33 presents a different assessment of summary organization. The proportion of various data items which were presented under a heading or as the first sentence in a paragraph (see criteria in Appendix 19) is displayed. Database summaries had significantly more headings (DB 13.1 vs. D-R 8.63). When data items were examined individually, database summaries were significantly more likely to place the following information under a heading: chief complaint; admission physical examination; treatment in hospital; procedures; complications; pending laboratory results; diagnostic recommendations; and therapeutic recommendations. When compared to dictated-cohort summaries, dictated-random summaries had a greater proportion of headings for active medical problems, admission diagnosis, procedures, discharge medications and medical follow up. Dictated - random summaries had significantly less misclassifications and dyschronologies than the dictated-cohort summaries. Database summaries had significantly fewer dyschronologies than the dictated - random group.

4.9 Discharge Summary Timeliness

Exhibit 34 displays physician assessment of discharge summary timeliness. Overall, the ratings were lower than those for summary quality (Exhibit 24), completeness (**Exhibit 28**), pertinence (Exhibit 30), and organization (Exhibit 31). The overall timeliness ratings were highest in the database group, but this

increase was not statistically significant. Family physicians gave a significantly higher timeliness rating to database summaries in comparison to the dictated-random group. It is noteworthy that consultants gave the database summaries a *lower* timeliness rating to database summaries. Survey response type did not significantly change the comparisons of timeliness ratings.

Objective assessment of summary timeliness is given in Exhibit 35 and Exhibit 36. In Exhibit 35, the time to discharge summary preparation is displayed *for all patients* in each group using Kaplan-Meier curves. Summary generation is censored at 28 days post discharge. Significant dispersion between the dictated and database summaries is seen almost immediately. Seven days following hospital discharge, 24.7% of database patients had discharge summaries pending compared to 53.4% for dictated-randomized patients and 67.9% for dictated-cohort patients. These differences persisted throughout the observation period and were significantly different between the database and dictated - randomized groups (log rank statistic 37.9, $p<0.00001$). No significant difference existed between the two dictated groups (log rank statistic 2.41, $p = 0.12$). By the end of the observation period, 20.4% of patients in the database group were without a summary compared to 48.3% in the dictated - cohort group and 43.1% in the dictated - random group.

When only patients who actually had a summary generated were considered, differences in timeliness persisted between the groups (Exhibit 36). All but 5.3% of patients in the database group had their summaries generated within a week following discharge compared to 45.5% of patients in the dictated - cohort group and 19.8% in the dictated - random group. Significant differences existed between the database and dictated - random groups (log rank statistic 72.56, $p < 0.000001$) and between the two dictated groups (log rank statistic 5.33, $p < 0.05$).

4.10 Housestaff Description and Summary System Preference

43 housestaff participated in the randomized portion of the study. Eighteen (41.9%) were medical students, 14 (32.6%) were at a first program year (PGY-1) level of training, and the other 11 (25.6%) had attained a PGY-2 level of training or greater. Housestaff participating in the study were rather experienced at discharge summary creation with each physician dictating a mean of 10.5 (SE 1.14) summaries per month. Most had dictated greater than 10 medical discharge summaries during their career (32/43,

74.4%). A large majority (31/43, 72.1%) had received some type of instruction in discharge summary preparation but most had received no feedback on their discharge summaries (28/43, 65.1%).

Housestaff opinions were elicited with surveys administered at the start (Appendix 4) and at the end (Appendix 24) of the randomized portion of the study. These forms elicited housestaff's views on the utilization of physician resources during summary preparation, where a *higher* score meant *less* physician resources were required. The questionnaire also allowed housestaff to assess the completeness, pertinence and organization of the summaries using scales identical to those in Appendix 17. All housestaff who were on the general internal medicine service during the study completed the pre-trial survey prior to the generation of any discharge summaries included in the study. The response rate for the end-of-study survey was 37 / 43 (86.0%).

Results are presented in Exhibit 37. Physicians felt that the time required for dictated summary preparation did not change between the start and the end of the study (pre-study 44.9 vs. post-study 44.5). Similarly, no significant change was elicited in the burden in dictated summary preparation (pre-study 45.0 vs. post-study 41.8). However, housestaff thought there was a significant improvement in physician resource requirements with the database summary system. The time required to create summaries decreased significantly (D-R 46.3 vs. DB 65.3; $P < 0.01$) as did the burden of summary generation (D-R 43.0 vs. DB 65.2; $P < 0.01$). Of note, the mean scores for physician resources utilized in summary generation were above 50, or "acceptable", while those for dictated summaries were below 50 both at the start and the end of randomized study.

Housestaff opinions of the dictated summaries themselves improved during the study. Between the start and the end of the study, housestaff thought the completeness of the dictated summaries increased significantly (pre-study 55.3 vs. post-study 64.2; $P < 0.05$) as did the pertinence of summary information (pre-study 51.2 vs. post-study 58.5; $P<0.05$). Organization scores also increased (pre-study 51.8 vs. post-study 58.9) but did not reach statistical significance. Greater differences were seen when dictated summaries were compared with database summaries. Summary pertinence (D-R 57.4 vs. DB 72.7; $P < 0.001$) and organization (D-R 57.4 vs. DB 72.7; $P < 0.01$) improved significantly for database summaries. No difference was noted in summary completeness.

Physicians indicated preference for either summary generation system using a 100 mm visual analogue scale with scores *below* 50 indicating preference for the dictated summary system and scores *above* 50 indicating preference for the database summary system (Appendix 24). The overall mean preference score favoured the database summary [70.4 (SE 3.99)] which was significantly different from 50 (no preference) (p-value <0.00001). Of 34 housestaff providing an opinion for system preference, 27 (79.4%) preferred the database summary system. When preference scores were categorized by physician level of training, a progressive drop in the mean preference score was noted as housestaff experience increased (medical students 81.2, PGY-1 64.7, and PGY-2+ 62.4), although statistically significant differences did not exist between all three groups.

4.11 Association between physician assessments and objective measurements.

As described in section 3.10, the association between physician assessments and objective measurements were explored using simple linear regression. For presentation, physician assessments were categorized into 10's, and the mean objective assessment for each category was calculated. A significant association existed between the number of information categories or items in the summary and the completeness score (Exhibit 37). The statistical significance of the association is marginal and only 1% of variation in the number of items is explained by the completeness score. No significant association existed between pertinence score and either recording length or total number of lines in the summary. No significant association existed between the organization score and either the number of headings or the proportion of items under headings. A significant association existed between the number of days between patient discharge and summary generation and the timeliness score. Although the association has high statistical significance, only 10% of the variation in summary delay is explained by timeliness score.

5 Discussion

5.1 Does the database method change anything?

Significant results from the randomized study are summarized in Exhibit 40. Database and dictated summaries differ in all outcome categories (Exhibit 16). All significant results will be discussed, along with outcomes which were notable because no significant differences were detected.

The most important difference between the randomized groups was the probability of generating summaries within four weeks of patient discharge (79.6% in the database group vs. 57.0% in the dictated group). The probability that this difference occurred by chance is less than one in ten thousand. This difference is clinically as well as statistically significant. The difference persisted if the 4 weeks "deadline" was abandoned or if patients who stayed in hospital less than forty eight hours were excluded. It is very unlikely that this difference was due to reasons other than a true difference between the interventions.

There are several potential explanations for this result. First, housestaff felt that generation of database summaries took significantly less time and was less burdensome (Exhibit 37). The forms providing all pre-admission and discharge information for the database summary (the admission history and physical, and the "Dear Doctor" letter) are completed as part of routine care. The only extra work needed to create a database discharge summary was completion of the hospital summary (Appendix 11) and this was facilitated in several ways. First, the form was in the patient's chart throughout hospitalization so physicians could document information at any time. Second, all housestaff involved with patient care could document information on the form, thereby spreading the work of summary creation among housestaff. Finally, the form documented key information and, if kept up to date, functioned as a "problem sheet" which quickly summarized key hospitalization issues. This was especially helpful for patients with prolonged hospitalization and voluminous medical records.

Increasing the proportion of patients with discharge summaries has many consequences. First, increased communication between physicians caring for a patient could improve health care and decrease duplication of health care services. This is dependent on the discharge summary actually being used for patient care decisions which seems a reasonable assumption. Second, increasing the proportion of summaries created by housestaff at patient discharge results in less work for the medical records division since staff physicians do not need to be contacted to generate summaries for deficient charts.

Although summaries were created more often for patients in the database group, was summary quality equivalent between the groups? While we found no difference in overall quality between the two discharge summaries, we cannot therefore conclude that the two interventions are equivalent.[52] To test for test for equivalence between therapies, one can determine the one-sided 1 - α confidence interval for the

difference in the primary outcome between the two groups. This is then compared to a maximal difference (δ) between the interventions which is considered to be clinically acceptable.[53,54] With an α of 0.05, the one-sided confidence interval for the between group difference was 7.5 for the present study. Therefore, as long as δ is greater than 7.5 (a 10% relative difference), the database and dictated summary system can be considered equivalent. In the survey described in section 1.5 and 3.9, only 18/72 (25%) of respondents indicated that the minimal important difference was a relative difference of 10% or less. Assuming that this non-random survey is representative of physicians in our community, we can conclude that 75% of physicians in our area would consider the quality of the database and dictated summaries equivalent.

Physicians disagreed in their comparison of database and dictated summaries. On average, consultants preferred dictated summaries, while family physicians thought that there was no difference in quality between the groups (Exhibit 40). Consultants gave database summaries a significantly lower score for summary completeness, organization, and overall summary quality. Although the p-value in each of these differences was borderline (between 0.01 and 0.05), the differences are likely true since consultants gave database summaries lower scores in all five domains. There are several potential explanations for this. First, the summary survey (Appendix 17) may not have standardized the assessment of summaries despite explicit definitions of "discharge summary quality", "completeness", "pertinence", "terrible", "acceptable", and "excellent". Second, most consultants use the narrative format to dictate consult notes. They may prefer the dictated discharge summary because it is more similar to the consultation letter. Finally, consultants are often involved with patient care during the hospital stay and may be more sensitive to missing or incorrect information in the summary than physicians not involved in hospitalized care. If database summaries left out data or contained incorrect information, the consultant may have given them lower ratings. This is probably not the case since only minor differences in the true summary completeness (Exhibit 29) and accuracy (Exhibit 31) were noted between the dictated and database summaries.

It should be noted that the consultants' objectivity in independently assessing *all five* domains is questionable. For example, database summaries arrived in physicians' offices more quickly than dictated summaries (Exhibit 36). However, consultants rated the timeliness of database summaries lower than that

of dictated summaries (**Exhibit 34**). Potentially, the consultants' bias that database summary quality was low could have affected their assessment of the other summary domains.

Although a discrepancy existed between the opinions of the consultants and family physicians, discharge summaries should probably be tailored to meet family physician needs. First, family physicians are often completely dependent upon the discharge summary for information regarding the patient's admission since they often have no contact with patients during their hospitalization. During the cohort portion of this study, only 13 of 768 charts (1.6%) contained documentation by the patient's family physician in the progress notes. Consultants, however, are more commonly involved with patient care during hospitalization and therefore less dependent on the summary for information. Second, when a hospital based consultant needs information regarding a patient's hospitalization, the patient's hospital chart is attainable and laboratory and radiological data are also available. These options are not available for most family physicians. Therefore, although consultants gave the database summaries lower quality scores, the database method may be preferable since it resulted in more family physicians receiving summaries that (in their opinion) were of similar quality.

Database and dictated summaries differed significantly in their content (Exhibit 26 to Exhibit 28). Items more prevalent in database summaries (including active past medical history, pre-admission medications, admission vital signs, other physical examination findings, discharge diagnosis, discharge medications, community services arranged for patient, pending laboratory results, and therapeutic recommendations) had fields in the database specific to these content items. In contrast, content items which were significantly less prevalent in the database summaries (social history, admission diagnosis, reason for patient admission, consultation in hospital, and functional status at discharge) did not contain specific fields in the database. Although there were "free fields" on the hospital summary form ("Other important hospital information") where information not clearly fitting into other fields could be placed, they would not have been used for items such as admission diagnosis or reason for patient admission.

Not all information in the discharge summary is of equal importance to summary quality. Exhibit 6 and Exhibit 7 show how much several content items contribute to summary quality (as perceived by 100 family physicians and housestaff in our community). Items which were more prevalent in the

database summaries (active past medical history = 4.1, pre-admission medications = 5.0, discharge diagnosis = 8.8, discharge medications = 7.9, community services arranged for patient = 6.2, and pending laboratory investigations = 7.6; mean of more prevalent items = 6.6) increased summary quality more than items which were *less* prevalent (social history = 1.7, admission diagnosis = 8.2, consultation in hospital = 6.5, and functional status at discharge = 5.4; mean of less prevalent items = 5.4). Why, then, were completeness scores for the database summaries *lower* than those for dictated summaries (Exhibit 26)? First, the amount a content item contributes to quality is unlikely to be independent of the individual clinical scenario. For example, a patient's occupation could be very important for someone presenting with a solitary pulmonary nodule while almost irrelevant for someone admitted with a urinary tract infection. Therefore, estimates of each item's contribution to quality may be valid for summaries *as a group*, but may not apply to the individual summary. Thus, physician completeness ratings may not correlate with the presence or absence of particular items. Second, study definitions for content items may differ from those in the survey. For example, the present study stated that *any* descriptor of the presenting problem constituted a "history of presenting illness", but some physicians may require more information for a "history of presenting illness". Third, even if the summary contains many content items, a physician could give the summary a low completeness score because: 1) the physician thinks the individual content items are incorrect; 2) the completeness rating is not independent of ratings given to the other domains; 3) the individual content items are not logically associated with each other (e.g. the physical examination describes a patient with a decreased level of consciousness, unilateral dilated left pupil and a mass on the CT of the head, and the procedures section delineates a lumbar puncture) so the physician questions the accuracy of the content; or 4) the physician scores the actual care the patient received in hospital instead of scoring the summary's report of that care. The last explanation occurred several times where the responding physician made it clear that he/she was unhappy with the care provided and gave a very low completeness score. The summaries in question contained all important content items and were logical. The low completeness score in these situations likely reflected displeasure with actual patient care.

Despite extensive differences between the database and dictated summaries in the prevalence of various content items, the summaries were similar in capturing observations from the chart and laboratory

review (Exhibit 29). The proportion of procedures, medical therapies, complications, or radiological investigations identified at chart and laboratory review which were captured by the summary was almost identical between the dictated and database summaries. Database summaries were significantly less likely to capture consultations performed during the hospital stay, but were significantly more likely to capture extreme lab results or diagnostic blood work. This likely occurred because the forms used for the database summaries (Appendix 11) contained fields for the documentation of blood work but none for consultations. Again, the design of the database forms significantly altered what physicians included in the summary.

For an objective assessment of "accuracy", the proportion of significant observations detected on summary review that were also identified at chart review was calculated. The only significant difference between the database and dictated summaries was a lower proportion of procedures cited in the database summary. The reason for this is unclear. For database patients, physicians may have been documenting procedures on the hospital summary form rather than the progress notes. Since the hospital summary form was not reviewed during the chart review, this would result in less procedures found at chart review, and a lower accuracy for the database summaries.

Another potential explanation suggests a problem with the unblinded chart review. The interim discharge report ("Dear Doctor" letter) was reviewed for discharge diagnosis, discharge medications, medical follow-up, and procedures. The interim discharge report for the database system contained fields specific for procedures (Appendix 12) while the interim discharge report for the dictated system did not (Appendix 16). The investigator's vigilance for identifying procedures in the progress notes could have decreased when no procedure was documented on the database "Dear Doctor" letter. If housestaff documented procedures for database patients on the hospital summary form instead of the database "Dear Doctor" letter, procedures would be documented at summary review but not chart review. The accuracy of procedural reporting would therefore drop for database summaries.

Exhibit 31 shows other potential problems with the chart review. Only approximately 20% of complications identified by the summaries were found on chart review. This is probably due to the subjectivity of labeling a diagnosis as a "complication" during chart review in which the progress notes were used to identify "complications" as defined by the study protocol (i.e. diagnosis was not present prior to

hospital admission and was clinically significant - Appendix 22). If documentation by housestaff was not optimal, events would be missed at chart review resulting in decreased summary accuracy. Exhibit 31 supports this theory. Accuracy for complications (completely dependent on housestaff documentation) was less than procedures (more explicitly documented by housestaff), which was in turn less than consultations (which did not rely on housestaff documentation).

Few pragmatic interventions are available to accommodate for the drawbacks associated with chart review. The most rigourous method would have had a second person to review all charts, with all discrepancies resolved by discussion. However, I could not find another person willing to review 1075 charts. A second option would have had a physician involved in the patient's care but not in summary creation (e.g. a physician assistant or staffperson) document all consultations, procedures, and complications prospectively for each patient. This would create a "gold standard" against which summaries are compared. This too was impossible since physician assistants did not exist for all patients on the general internal medicine service and staffpeople would not participate with documenting all occurrences for each patient.

Blinding the chart reviewer to the patient's randomization group could have avoided potential bias in procedural documentation. This would entail the removal of all forms unique to each group (Appendix 11 and Appendix 12, or Appendix 15 and Appendix 16). Since the investigator (CvW) randomized all patients and was aware of patient assignments, another investigator would have been needed for chart review. Alternatively, one could have delayed chart review so that CvW would forget treatment allocation but this would have delayed trial completion. Photocopying each patient chart and removing all patient unique identifiers would have been logistically impossible. Thus, blinding the chart reviewer to randomization group would have been extremely difficult. The study attempted to deal with this drawback by developing objective criteria for chart abstraction, examining multiple outcomes, and by measuring the same outcome using different methods.

Summary organization was measured by the patients' physician and by determining the proportion of key content items immediately under headings or located in the first sentence of a paragraph. As previously discussed, consultants' felt that the database summary organization was significantly worse

than that of the dictated summaries, while family physicians rated the two groups as similar. However, the database summaries contained significantly more headings. In addition, the proportion of many content items under a heading in the database summaries (including chief complaint, admission physical examination, treatment in hospital, procedures, complications, pending lab results, diagnostic recommendations, and therapeutic recommendations) was significantly greater than for the dictated summaries. Family physicians in our community indicated that summaries with more headings provide significantly easier access to information in the discharge summary.[21] If the database summaries have more data points under headings, why did they not receive a higher organization rating on the physician surveys? First, "organization" was not defined on the survey (Appendix 17) and physicians could have interpreted "organization" as how each piece of information in the summary related to other data points. Summaries can organize data poorly in two ways: by presenting data in a such a way that it does not make sense chronologically, (e.g. the summary describes a hospitalized patient's allergic reaction to penicillin then mentions that penicillin was used to treat the patient's pneumonia in the emergency department prior to admission) or by including a piece of information with data from another category (e.g. the summary places the patient's family history in the middle of a list of admission medications). The study attempted to assess this by counting the number of dyschronologies and misclassifications.

Also, physicians may have used the "organization" domain to indicate how well they thought the summary "flowed", or how well one group of data in the summary related to other groups of data. Interpreted in this way, database summaries should receive a lower organization score. Database summaries (Appendix 13 and Appendix 14) "flow" less than dictated summaries (Appendix 5 and Appendix 6). The database summary groups common data-points together so that connecting the data-points in different groups may be difficult. If, for example, a database summary had "pneumonia" as one of the problems at admission (Appendix 11), one would have to look for the respiratory examination in the "Pertinent findings on physical examination" section, review the chest radiograph in the "Pertinent investigations in hospital", and find the therapy in the "Problems at admission and treatment". A dictated summary, in comparison, could relate the same information more easily: "A diagnosis of pneumonia was made based on findings on physical examination (dullness to percussion, increased tactile fremitus, and

bronchial breathing at the right pulmonic base), and chest radiography (an alveolar filling defect was seen in the right lower lobe), and was treated with Cefuroxime". In this example, the reader can effortlessly determine the diagnosis made, the evidence for the diagnosis, and the therapy started.

There are several explanations for the housestaff's preference for the database summary. First, summary generation was easier with the database system since the only extra work necessary for generating a summary was the completion of the hospital summary form (Appendix 11). Second, with the database method, housestaff needed only to "fill in the blanks" on the forms in order to create a summary. They did not have to decide which information categories to include in the summary or how to format the data. These decisions may be difficult for housestaff with less training. The observation that the database system was most popular with the least experience housestaff supports this supposition. Finally, the housestaff may have associated the database method with the investigator which could have biased their rating of the database summaries and method with Appendix 24. However, the increased probability of summary generation in the database group suggests that housestaff preference for the database method was real.

5.2 Did dictated summaries change during the randomized trial?

Physician assessments of summary quality, completeness, pertinence, organization or timeliness (even when stratified by physician specialty or survey response type) did not differ significantly between the two dictated groups (Exhibit 24, Exhibit 25, Exhibit 30, Exhibit 32 and Exhibit 34). For the receiving physicians, introduction of the database method of summary preparation resulted in few changes to the dictated summary. Exhibit 41 lists all statistically significant *differences* between the two dictated summary groups. Dictated - random summaries had more in common with the dictated - cohort than with the database summaries (Exhibit 40). Although the dictated summaries changed during the randomized trial, these changes were less extensive than those seen in the database summaries. This section will discuss potential explanations for these changes.

Several factors may explain any or all differences between the dictated summaries. First, although housestaff in the cohort study were told that all discharge summaries were being evaluated, housestaff during the randomized study were probably more aware of this because of the forms place in the dictated -

random charts (Appendix 15 and Appendix 16) and database charts (Appendix 11 and Appendix 12). As a result, housestaff may have put more effort into dictated summary creation, thus changing the dictated - random summaries.[55] Second, Appendix 15 for the dictated - random patients included reminders such as "dictate the summary when you discharge the patient" and "only include information in the summary that you feel is necessary to continue the patient's care". These reminders may have changed dictated summaries during the randomized study. Finally, changes in the dictated - random summaries could represent true contamination by the database method of summary preparation. Housestaff may have changed how they dictated summaries after using the database discharge summary system. Specific significant differences (Exhibit 41) between the dictated summaries will now be discussed.

The content and organization of dictated-random summaries may have changed because of the database summaries. Dictated - random summaries were more likely to include the duration of discharge summary medication, the fate of admission medications, and the follow up date with physicians other than the family doctor. The database summary was very particular with regards to discharge medications and medical follow-up (Appendix 12) and could have changed the reporting of these items in the dictated-random summaries. Dictated - random summaries had more structure with significantly more headings per summary. Also, the proportion of four information categories (active medical problems, admission diagnosis, discharge medications, and medical follow-up) with a heading increased. During the randomized trial, housestaff may have adopted a more structured method of dictation to create summaries similar to the database summaries.

Summary completeness and accuracy for the dictated groups were very similar. However the completeness and accuracy of procedural reporting of the dictated - random summaries were superior. Housestaff's reporting of procedures may have increased during the randomized study because the database "Dear Doctor" letter (Appendix 12) specifically requested physicians to document procedures.

Finally, dictated - random summaries were created slightly faster than the dictated - cohort group (Exhibit 36). This minimal decrease in time to summary generation was likely due to a combination of effects. First, the mean time to summary dictation was slightly shorter in the dictated - random group (3.17 days [SE 0.55] vs. 4.19 days [SE 0.30]; P = 0.15) and may have been due to Appendix 15. Second, the

dictated - random summaries were also transcribed faster (3.28 days [SE 0.14] vs. 3.77 [SE 0.14]; P = 0.11). This could have resulted from the decreased volume of dictations during the randomized study because half of the patients were assigned to the database group and did not need transcription services. Finally, the dictated - cohort period included the Christmas season (section 3.5, Exhibit 14). Changes in the hospital during this period make it more difficult to produce summaries. Since a sizable proportion of housestaff are absent for holidays during this period, patient care duties increase for those housestaff left at the hospital. Patient volume increases when private offices close for the holiday season, increasing the number of patients reporting to the emergency department and the number of referrals to the internal medicine service. The patients themselves may be more ill because of the winter season. Therefore, housestaff spend more time on patient care duties, leaving less time for summary creation. The number of employees available in medical records for summary transcription also decreases. All of these events could have resulted in a decrease in the timeliness of dictated - cohort patients.

5.3 General discussion on study's internal validity

This section will comment on aspects of the study's design which may have affected the results. The order presented in the methods section will be followed.

The inclusion and exclusion criteria ensured a broad range of patients. The general internal medicine ward includes a diverse range of patients and the broad inclusion criteria (section 3.2) increased the likelihood that all eligible patients entered the study. 76.7% of all patients admitted to the general medicine service during study dates (Exhibit 14) were included in the study ensuring that the study's conclusions apply to a large majority of patients at the Civic hospital. The characteristics of the patients in the two randomized groups were similar: they were all admitted to the hospital by housestaff on the general medicine team; and all patients were discharged from the general medicine service alive. Therefore, although a broad range of patients were included in the study, the study groups were similar with respect to the hospitalization factors potentially affecting summary creation.

The randomized study protocol was possibly biased *against* the database process (section 3.2 and 3.3). First, most of the participating housestaff already had experience with the dictated summary system used for the control group that (section 4.11). In comparison, housestaff had no experience with the

database summary process prior to the study. Although they had a 15 minute instruction session at the beginning of the study, they had no practice completing the hospital summary form or the database "Dear Doctor" forms. Second, few of the housestaff saw a database summary generated from forms they had completed themselves. Therefore, they could not improve their database summaries by modifying the data entered on the forms. This problem could have been addressed with a "run-in" period during which housestaff would be given copies of their summaries generated from the database. This was not done because it may have given the database method excess attention. Finally, the dictated summary system during the study was optimized and may be better than the system used in real life. All physicians were given information sheets containing information to optimize their dictated summaries. During the randomized portion of the study, Appendix 15 provided housestaff advice on summary dictation. By optimizing the control group, it is more difficult for the database summaries to show significant improvements.

There was little chance for bias in the randomization process (section 3.6). Consecutive eligible patients were randomized, with only five out of 376 eligible patients (1.3%) not being randomized (Exhibit 19). Randomization criteria (admission to the general internal medicine service with the admission history and physical form) were simple and objective. Only three patients were excluded after randomization, all for valid reasons. The unbiased randomization method likely explains the similarity of the randomized groups. When the patient and hospitalization characteristics of the dictated-random and database groups are compared (**Exhibit 20** and Exhibit 21), only three of more than 35 comparisons were significantly different (dictated-random patients were less likely to have arthritis, get admitted to the intensive care unit (ICU), or get discharged with a primary diagnosis of circulatory system disorder). Because of the decreased frequency of admission to ICU, patients in the dictated-random group may have been less ill. Since discharge summary preparation may be more difficult for sicker patients, this is the only clinically significant baseline difference between the two groups.

The outcomes chosen for the study (section 3.8, Exhibit 16) were extensive enough to detect most effects that modification of the discharge summary system might have on the discharge summary. With the exception of physician resource utilization, the study was designed to simultaneously assess all outcomes

using both "subjective" and "objective" outcomes. Summaries were assessed by physicians who actually used them for continuing patient care. This resulted in the most clinically relevant summary assessment. Measuring the opinion of physicians who actually use the summary for patient care is essential when contemplating changes to the discharge summary system.

Unfortunately, the physician survey for summary assessment had several weaknesses. First, 159/603 (26.4%) of summaries were not assessed by this outcome because an eligible physician was not sent a copy of the summary or the physician did not complete and return the survey. There were numerous steps between patient randomization and the elicitation of physician opinion so many more patients needed to be randomized. Second, even if a physician received the summary and completed the survey, we could not determine how carefully the summary was reviewed or the questionnaire (Appendix 17) was completed. Did all physicians read the survey's definitions for "terrible", "acceptable", "excellent", "completeness", "pertinence", and "quality" and were these definitions interpreted in the same way? Third, even if two physicians agreed about the summary's quality, the actual quality score given by both physicians may have been quite different. This "noise" makes it more difficult to detect differences between discharge summary systems. Finally, although the survey assessed summary quality and four domains which likely contribute to quality, several factors were not assessed by Appendix 17. Responding physicians could not separately assess the logic or reasoning behind diagnostic or therapeutic courses described in the summary. They could not grade the accuracy of the summary. Without separate scales for physicians to grade these potentially important contributors to summary quality, the "purity" of the assessment of the domains elicited on the survey could be tainted.

Another concern with the physician survey involves its reliability and its responsiveness to change. As noted in section 1.5, ratings for the same summary increased significantly when other comparison summaries were not available. However, in this study single summaries were assessed by physicians without other summaries for comparison. This may have resulted in higher ratings for all summaries in the study. Quality ratings could then have become less responsive to change, making it more difficult to detect a difference between summary types. This possibility is supported by the ceiling effect seen in the frequency histogram for all quality ratings (Exhibit 43). To avoid this, summaries of seemingly very low and

very high quality could have been chosen as reference or anchor summaries. If these accompanied each summary, physicians would have been forced to compare their summaries with the anchor summaries. The quality rating may then have become more responsive to change, thereby increasing the likelihood of detecting differences between the groups. However, it is highly likely that sending anchor summaries would decrease survey response rate because of the increased reading necessary for survey completion. This would have decreased the number of summary assessments in each group and could then *decrease* the chance of detecting intergroup differences. For these reasons, it was decided not to use anchor studies in this study.

The choice of outcomes for this study was complex. Summary assessments by physicians who use them for patient care is the most clinically relevant outcome for studies assessing discharge summaries. Unfortunately, no completely validated tool exists in the literature for the assessment of discharge summaries by the receiving physician. We decided to use a partially validated questionnaire because it was the best measurement tool available at the time, and elicitation of the opinion of physicians using the summary for patient care was necessary to ensure study relevance. As a result, data from the study could be used to validate the measurement tool.

The precision of the sample size calculation for the randomized portion of the study was excellent (section 3.9, Exhibit 17). A clinically relevant outcome (summary quality) was used to determine the sample size. The estimate of this outcome (with its variance) for the patients in the control group was accurate since the measurement tool used in this study (Appendix 17) was used to measure the baseline quality of dictated summaries. As well, the patients, dictating physicians, and responding physicians were virtually identical to those in the randomized study. The minimal important difference was measured with a survey of physicians in the community using a measurement tool almost identical to that used in the study (Appendix 2). The alpha and beta errors chosen for the study (5% and 15%) were both acceptably low. The baseline sample estimate was adjusted for all circumstances important to the creation of a discharge summary. The sample size was adjusted for every reason that physician summary assessment would not be received (Exhibit 17). Finally, with the exception of two estimates, the probabilities used to adjust the

sample size calculation were based entirely on measurements made during the baseline portion of the study.

With such a precise sample size calculation, why did the randomized study fail to show an improvement in the overall mean summary quality? It was not because the study was underpowered. A comparison of the expected and observed probabilities used for sample size calculation reveals that some of the estimates were occasionally incorrect. However, examination of Exhibit 42 reveals that the inaccuracies of the calculation resulted in an overestimated sample size. If the observed values were used for sample size calculation, sample size would have been 55 patients less than the projected sample size. Since enough patients were randomized to detect the difference being sought, other reasons may explain the lack of significant difference detected between the randomized groups. The study was designed to detect a mean quality of 85 in the database group. It may be unreasonable to expect any method of discharge summary generation to create summaries with such a high quality score. First, physicians rating discharge summary quality may have been reluctant to utilize the right hand portions of the scale because of the categorical qualifier assigned to 100 (i.e. the discharge summary quality is "excellent", or "could not be better"). Indeed, a "ceiling effect" is suggested when the quality of summaries are examined in a histogram (Exhibit 43). Also, when summaries were received from more than one eligible physician, the overall quality rating was calculated as the mean of all individual quality ratings. Calculation of the mean will tend to draw the overall quality rating away from 100.

Although the likelihood of detecting a mean quality of 85 using Appendix 17 was slight, designing the study to detect more than a 10 mm improvement in overall summary quality was not a mistake. The minimal important difference used (19% relative increase in summary quality) was based on a survey of community physicians (Appendix 2) who rated the quality of a discharge summary sent with the questionnaire. They were asked to "mark an X ... to show the smallest increase in quality that you consider important." This method of determining the minimal important difference (MID) has many advantages over an arbitrary choice for the MID. First, physicians who actually use the discharge summary determined what was "significant". Second, only family physicians were surveyed. Since opinions regarding significance can differ significantly between physician groups, and family physicians rely most upon the

summary for communication, this was the correct physician group to poll. Finally, the survey was simple and easy to understand, thereby increasing the reliability of the elicited MIDs. Our choice for the MID was valid and ensured that the study was trying to detect a difference in summary quality that practicing physicians considered significant.

5.4 General discussion on study's external validity

The study took place on a general internal medicine service (section 3.1). The patients treated on the service were extremely diverse. Other studies of summaries generated from clinical databases used a very homogenous population and concentrated on procedure-driven services such as a vascular surgery service [4], a neonatal ICU [33], and a newborn nursery.[40] This study's population had considerable variation in baseline demographics (such as age and co-morbid illnesses), reasons for admission, investigations, therapies, and complications in hospital. This broad range of patients increases the study's generalizability to other patients with medical problems. It is possible that the database method may perform better in a homogenous patient population since the summary content could be more easily defined and collected.

The external validity of the study's results are increased by several other factors. First, although the study took place at a tertiary care centre, most patients were treated for common medical problems. Second, the structure of the teams caring for the patients in the study is commonly used in Canadian teaching hospitals. Third, the method used to generate the dictated summaries was similar to those used in other hospitals. Fourth, the database summary software was a simple adjunct to a data abstraction system used in many teaching hospitals across Canada and is easily replicated with proprietary database software. Finally, the database discharge summary system could be easily modified for many medical and surgical specialties.

Two cautionary comments about the study's external validity are necessary. First, it may not be possible to generalize the study's results to non-teaching centers where summaries are not created by physicians in training. Experienced hospital-based physicians probably produce high-quality dictated summaries which may be difficult to improve upon. Also, in hospitals where family physicians are responsible for their patients during the hospitalization, the importance of the discharge summary for

continuing patient care is decreased. Second, during the randomized study, completed database forms were entered into the database by the investigator. Physicians will not do this in actual practice. The most logical individuals to do this outside of the study are health records analysts (HRA). These analysts have experience in medical terminology, interpreting physician notes, and database entry (since HRAs enter chart abstractions directly into computer packages). Also, almost all of the information HRAs must abstract from the record is captured on the forms. HRAs may need extra training on keystroke technique to increase the efficiency of the database system. The feasibility of generating database summaries using HRAs needs further exploration and close monitoring. The potential effect of the database method on the accuracy and completeness of medical record abstraction also merits study.

5.6 Comparison of the Present study with the Published Literature

Exhibit 44 lists studies which compared summaries generated from clinical databases with dictated summaries. Only five studies were identified and took place on either surgical or obstetrical services. Like our study, two studies[31,35] had housestaff complete data acquisition forms, the contents of which were entered into a database. The other studies either had the housestaff enter the data directly into the database[33,40] while one did not describe the method of summary generation in enough detail.[39] Three studies surveyed family physicians to evaluate the summaries. Only one study[40] used a survey to assess one particular summary. However, it asked physicians to compare this particular database summary to his or her impression of dictated summaries they had received *in the past.* Lissauer [33] had the strongest study design, comparing database and dictated summaries generated for the same patient. The dictated summaries were generated by a senior resident while all data was entered into the database by interns and junior residents. This design could have unpredictable effects on either summary type. All patient records were reviewed to document information and diagnosis. Summaries were reviewed by the investigator to determine the proportion of diagnoses and data items that were captured by the summary. It is unclear how similar this list was to the fields in the database. A subjective assessment of summary "readability" and "suitability" was also given. All other studies measured fewer outcomes. Smith[31] limited his assessment to the time to summary generation. Physician surveys used by Adams and Castledon were

limited, but Brazy had physicians assess summary promptness, ease of data abstraction, the relevance of information in summary for continued patient care, and summary preference.

Study results are shown in the table's final column. Studies which surveyed family physicians for summary assessment all showed the database to be better than the dictated summaries, although only one[40] provided statistical evidence that the changes were beyond chance. Brazy's survey showed that family physician's preferred database summaries because they were perceived to be more prompt, easier to abstract data from, and contained improved content. None of the studies included assessments by consultants. This could be important given consultants' attitudes towards database summaries in the present study. Similar to our study, Smith[31] showed that database summaries were generated more quickly. The importance of this outcome alone (without any assessment of the summaries themselves) is questionable). Lissauer showed some interesting results. Like the present study, the probability of summary generation was significantly higher with the database method. Database summaries also contained more diagnoses and content items. Similar to this study, the database summaries were less readable.

In summary, other studies comparing database and dictated summaries have also shown that the database summary systems were more likely to generate summaries and did so more quickly. However, variability in the patient populations studied, the database methods used and the quality of the studies themselves makes further generalizations hazardous. The present study is much more extensive than previous studies.

5.7 Conclusions and recommendations

In this study, generating discharge summaries from a clinical database significantly increased the probability that a discharge summary was created for patients discharged from a general internal medicine service. Physicians thought that the quality, completeness, pertinence, organization and timeliness of database summaries was similar to the dictated summaries. However, family physicians and consultants differed in their views of the database summary, with family physicians rating them more positively that consultants. The database method also had the following effects on the discharge summary:

1. Increased the prevalence of some content items but decreased the prevalence of others.

2. Improved the reporting of blood work but decreased the reporting of consultations.
3. Decreased the total summary length but increased the amount of discharge information.
4. Increased the structure of the summary by placing more information under headings.
5. Decreased the delay between patient discharge and summary generation.
6. Decreased the amount of work expended by housestaff for discharge summary creation.

The randomized trial and the introduction of the database method of discharge summary generation had no effect on the discharge summary as perceived by physicians receiving the summary. Compared with summaries prior to the trial, dictated summaries during the randomized trial had: a slightly changed content; improved reporting of procedures and medical therapy; increased structure; and a decreased delay from patient discharge to summary generation.

I think there is a potential role for database generated discharge summaries on internal medicine services in teaching hospitals. However, several changes are necessary to optimize the method. First, modifications to the data collection forms and the database itself are needed to increase the amount of hospital information retrieved, and to improve the "readability" of the final discharge summary. A suggested format for the hospital summary form is given in Appendix 25. Instead of dedicating space specifically for admission diagnoses and complications (as in Appendix 11), this new format maximizes space available on the form by requesting that the physician indicates whether the diagnosis is a complication or not. This form should increase the amount of hospital data in the discharge summary by requesting a presumed etiology or cause for each diagnosis. Summary readability should improve since all investigations are linked with the diagnosis to which it is pertinent.

Appendix 26 suggests changes to the database "Dear Doctor" letter. Removal of the "secondary" and "other diagnoses" fields decreases duplication since this information is usually captured in the active past medical history field of the admission history and physical form (Appendix 7) and the diagnoses captured by the hospital summary form (Appendix 11 and Appendix 25). This frees up room for fields specifically for consultations in hospital and patients' functional status at discharge (content items which were significantly lower in the database summaries). These changes should improve database summaries

by increasing the amount of hospital data, improving the reporting of consultations and patient discharge functional status, and making the summary more "readable".

Health records analysts need extra training for the database method of summary generation to be feasible. HRAs already have much experience in chart review. HRAs may need extra keyboard instruction for data to be transcribed efficiently from completed forms into the database. They also may need extra training in interpreting and transcribing the documentation of the physical examination documentation (Appendix 9 and Appendix 10). The database itself needs to be more user friendly to simplify and standardize data entry. Database summary production could be accelerated further by enabling the HRA to print a database summary on demand.

This new role for the HRA would not be an entire departure since almost all information that HRAs are required to abstract from the chart is provided by the forms. Therefore, it is possible that the database discharge summary system would decrease, and possibly eliminate, the need for HRAs to abstract the medical record. In essence, the database system would combine two streams of data exportation - that necessary for patient follow-up care (the discharge summary) and that necessary for health care planning (the Canadian Institute for Hospital Information - CIHI - hospital discharge abstract). Between these two streams, a large amount of information is shared making their combination sensible. The possibility of combining discharge summary generation and CIHI discharge abstract creation needs further exploration. Its potential effect on the accuracy and detail of information within the CIHI database is exciting.

The most promising aspect of a database summary system has not been expanded upon in this thesis. Unlike the dictated summaries, information within the database summaries is captured within a database. Information in this database would be useful for many other functions. Continuity of care within the institution could improve if information within the database was accessible from all inpatient and out-patient departments within the hospital. Administrators and quality improvement teams could use data to identify areas of concern and excellence. Researchers could use the database for following patients and for determining study feasibility. Finally, information within the hospital database may be linked with other databases in the city and the province as long as data confidentiality is ensured. The potential applications for a clinical database such as that created with the system delineated in this study is promising.

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1 exp "patient discharge"/ 1874

2 exp "hospital records"/ 240

3 1 and 2 36

4 discharge summary.tw. 32

5 3 or 4 65

6 "correspondence"/ 184

7 "interprofessional relations"/ 3047

8 6 and 7 14

9 5 or 8 79

10 "continuity of patient care"/ 981

11 "communication"/ 3703

12 10 and 11 67

13 9 or 12 145

14 exp "information systems"/ 9950

15 exp "methods"/ 3209

16 exp "communication methods, total"/ 59

17 (14 and 15) or 16 77

18 13 or 17 222

Exhibit 1 Search strategy used on MEDLINE database to identify discharge summary studies.

The search terms were identified by locating several pertinent articles on MEDLINE and determining the keywords used to index them. The Strategy was run on OVID-CD search engine and results shown above are given for the 1993 to August 1997 MEDLINE database. Abstracts were reviewed to identity pertinent articles. References of all retrieved articles were reviewed to identify other studies of interest.

Content Item	Study		
	***Tulloch et. al.*[1]**	***Mageean*[2]**	***van Walraven et. al.*[3]**
	Great Britain 1974	***Great Britain 1986***	***Canada 1995***
	n = 293	***n = 79***	***n = 106***
Presenting symptoms	20.5%	-	-
Admission diagnosis	-	-	34.0%
Physical examination	20.1%	-	0.9%
Significant laboratory results	-	-	42.9%
Investigations	33.1%	75%	-
Discharge diagnosis	10.9%	25%	25.5%
Discharge medications	40.3%	-	22.8%
Medical follow-up	22.9%	37%	5.7%
Advice to family physician	70.7%	-	-
Information given to patient	92.2%	-	-

Exhibit 2 Three studies measuring the proportion of discharge summaries without particular data.

The country of the study origin, year of publication, and the number of summaries reviewed are provided for each study. ("-" = content item not assessed in study).

Principal Author	*Study Year*	*Intervention*	*Assessed by Other MDs*	*Formal Survey*	*Extensive Survey*	*Real Life*	*Concurrent Control*	*Random Assignment*
Flyer[13]	1988	Education	No	-	-	Yes	No	-
Oetgen[16]	1982	Format	Yes	No	-	Yes	No	-
Howard[17]	1986	Format	Yes	Yes	No	Yes	No	-
King[18]	1991	Format	Yes	Yes	No	No	-	-
Lloyd[19]	1993	Format	Yes	Yes	No	No	-	-
Rawal[20]	1993	Format	Yes	Yes	No	No	-	-
van Walraven[21]	1996	Format	Yes	Yes	Yes	No	-	-
Llewelyn[30]	1988	Computer	No	-	-	Yes	Yes	No
Smith[31]	1989	Computer	No	-	-	Yes	No	-
Lissauer[33]	1991	Computer	No	-	-	Yes	Yes	Matched Pairs
Castleden[35]	1992	Computer	Yes	Yes	No	Yes	No	-
Adams[39]	1993	Computer	Yes	Yes	No	Yes	Yes	No
Brazy[40]	1993	Computer	Yes	Yes	Yes	Yes	No	-

Exhibit 3 Summary of the design used by all studies which measured the effect of interventions on discharge summaries.

The table displays all studies which measured the effect of an intervention on the discharge summary. For each study, the year of publication, the intervention assessed, and particular aspects of study design are given. ("Assessed by Other MDs" = summaries were assessed by physicians other than the investigators; "Formal Survey" = a survey instrument which measured multiple summary components was used; "Extensive Survey" = greater than 100 respondents were surveyed to assess intervention's effect; "Real Life" = intervention was assessed on real patient admissions; "Concurrent Control" = the control group produced summaries concurrently with the intervention group; "Random Assignment" = patients were randomly assigned to the interventions).

Process Items
All physicians receiving copy of summary are listed
Time from patient discharge to summary receipt is 1 - 2 weeks
Summary length is 1 - 2 pages
Summary uses narrative or letter style format
Pre-Admission Information
Admitting diagnosis or reason for admission
History of presenting illness
All pre-admission medication information (name, dose, frequency)
Medical allergies with reaction specified
Family medical history
Social history
Entire past medical and surgical history
Hospital Information
Entire physical exam
Therapeutic procedures
Complications during hospital stay
Consultations with other specialties during hospital stay
Course in hospital
All treatment given in hospital
Results of all hospital investigations (both normal and abnormal)
Discharge Information
Discharge diagnosis
Discharge medications (with dose, frequency, and duration)
Active medical problems at discharge
Medical or social issues outstanding at patient discharge
Arranged medical follow-up (appointments and tests)
Community services arranged for patient
Patient prognosis
Patient's functional ability (i.e. mobility, cognition, etc.) at discharge
Recommended lifestyle modifications
Any pending laboratory information
Copy of actual reports for "big-ticket" items (CT scans, angiograms, MRI, etc) sent with summary

Exhibit 4 Discharge summary components which were assessed in a survey determining contributors to discharge summary quality.

Items were categorized into process items (not an actual data element of the discharge summary) and content items (an actual data element of the discharge summary). Content items were further sub-categorized into "pre-admission" information (data known *prior* to patient's admission to hospital), "hospital information" (data gathered during patient's hospital admission), and "discharge information" (data pertinent for care following discharge from hospital). Each item was typed on separate 2 x 4 inch cards. Surveyed physicians placed each item on a 1 x 10 foot scale to indicate how much each item contributed to discharge summary quality. Items shown above were modified and scaled to determine what effect the modifications had on discharge summary quality.

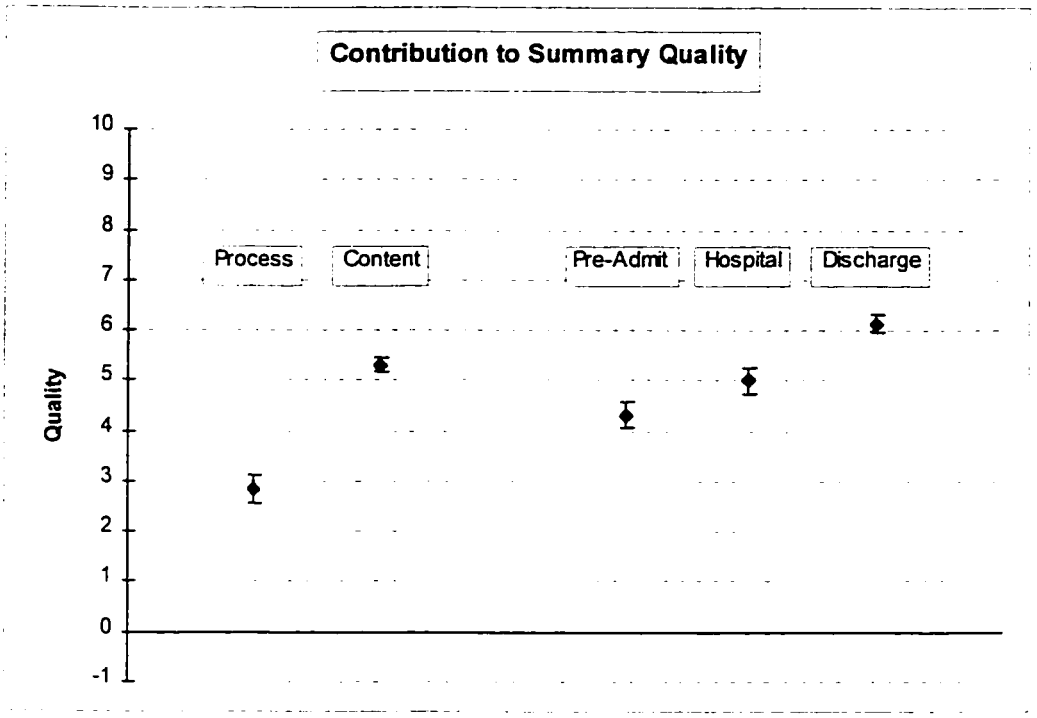


Exhibit 5 Contribution of process and content items to discharge summary quality.

Items were classified as in Exhibit 4. Discharge summary content was sub-categorized into pre-admission, hospital, and discharge information. Quality was defined as: *A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician.* The quality scale extends from a minimum of -6.6 (meaning that item is so detrimental that it makes summary useless) through 0 (item has no effect on discharge summary quality) to a maximum of 10 (item is so essential to summary quality that summary without it is useless). Point estimates are flanked by 95% confidence intervals.

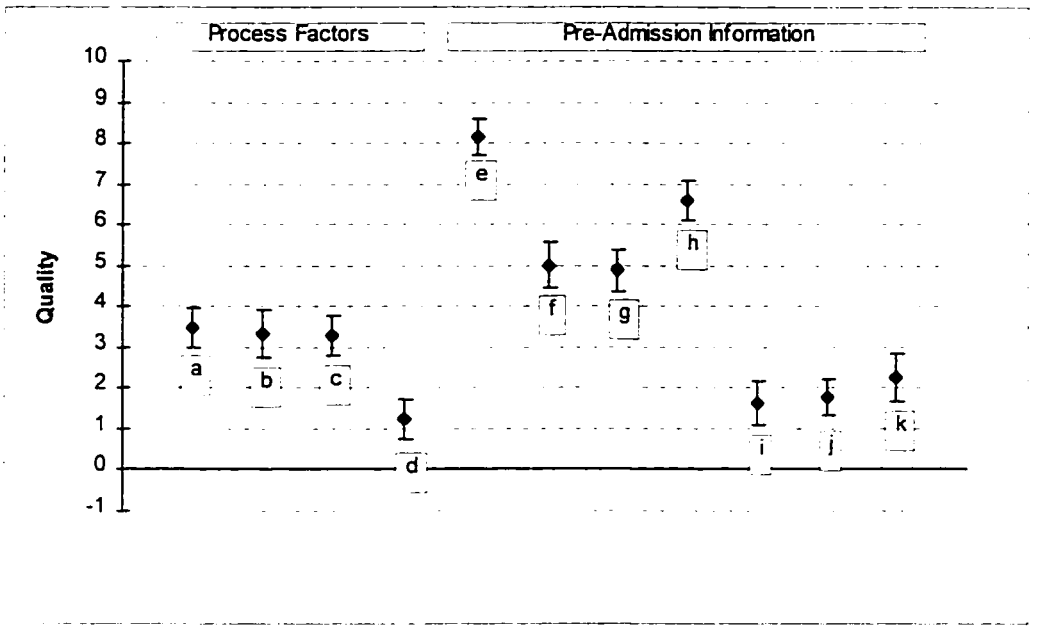


Exhibit 6 Contribution of process and pre-admission items to discharge summary quality.

Quality was defined as: *A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician.* Items "a" through "d" are process items (summary components independent of content) and items "e" through "k" are pre-admissions information. Vertical axis represents contribution to quality and extends from a minimum of -6.6 to maximum of 10. Point estimates are flanked by 95% confidence intervals. (a = all physicians receiving copy of summary are listed; b = time from patient discharge to summary receipt is 1 to 2 weeks; c = summary length is 1 - 2 pages; d = summary uses narrative or letter style format; e = admitting diagnosis or reason for admission; f = all pre-admission medication information (including name, dose, frequency); g = medical allergies with reaction specified; h = history of presenting illness; i = entire past medical and surgical history; j = entire past medical and surgical history; k = social history)

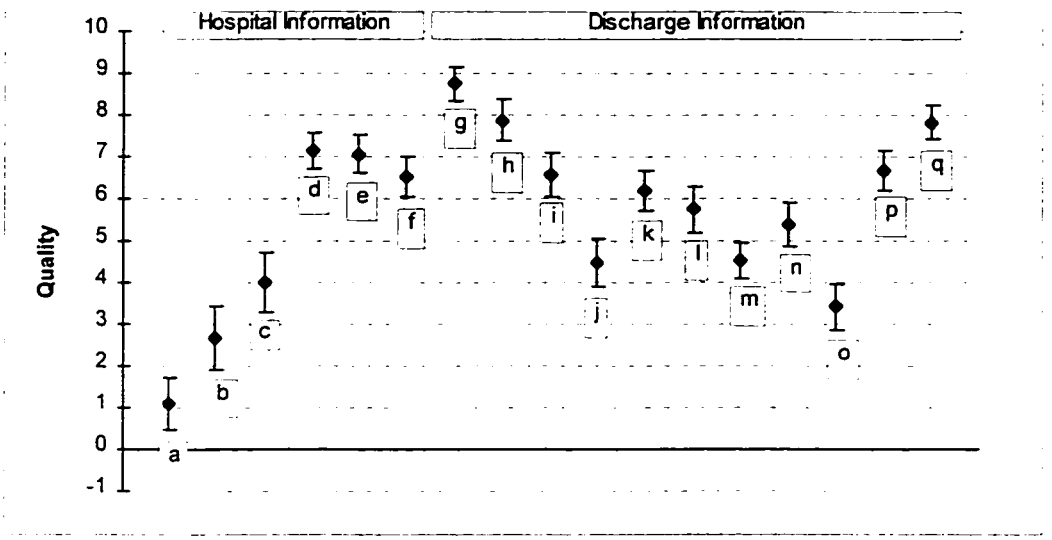


Exhibit 7 Contribution of hospital and discharge information to discharge summary quality.

Vertical axis represents contribution to quality and extends from a minimum of -6.6 to maximum of 10. Quality was defined as: *A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician.* Point estimates are flanked by 95% confidence intervals. (a = entire physical examination; b = results of all hospital investigations (both normal and abnormal); c = all treatment given in hospital; d = therapeutic procedures; e = complications during hospital stay; f = consultations with other specialties during hospital stay; g = discharge diagnosis; h = discharge medications (with name, dosage, frequency, and duration; i = arranged medical follow-up (appointments and tests); j = any pending laboratory investigations; k = community services arranged for patient; l = patient prognosis; m = recommended lifestyle modifications; n = patient's functional ability (i.e. mobility, cognition, etc.) at discharge; o = copy of actual reports for "big-ticket" items (CT scans, angiograms, MRI, etc.) sent with summary; p = medical or social issues outstanding at patient discharge; q = active medical problems at discharge).

Summary factor	*Item*	*Mean (95% CI)*
Delay in summary delivery ****	Delay from patient D/C to summary receipt = 1-4 days	5.7 (5.2, 6.3)
	= 4-7 days	5.0 (4.5, 5.5)
	= 1 - 2 weeks	3.3 (2.8, 3.9)
	= 2 - 4 weeks	0.5 (-0.1, 1.2)
	= 1 - 2 months	-3.2 (-3.8, -2.6)
	> 2 months	-4.8 (-5.3, -4.3)
Summary Length ****	Summary length = 1/2 page	1.9 (1.3, 2.5)
	= 1/2 - 1 page	3.4 (2.9, 3.9)
	= 1 - 2 pages	3.3 (2.8, 3.8)
	> 2 pages	-0.8 (-1.4, -0.4)
Summary format ****	narrative / letter style format	1.2 (0.7, 1.7)
	uses structured format	5.1 (4.6, 5.6)
Admission medications ****	all pre-admission medication information	5.0 (4.4, 5.6)
	only names of pre-admission medications	1.0 (0.3, 1.7)
Allergies ****	medication allergies with specific reaction	4.9 (4.3, 5.4)
	medication allergies with reaction not specified	1.5 (0.9, 2.2)
Presenting history ****	history of presenting illness	6.6 (6.1, 7.1)
	history of presenting illness when diagnosis is uncertain	7.0 (6.5, 7.6)
	history of presenting illness when diagnosis is certain	5.1 (4.5, 5.8)
Past medical history ****	entire past medical and surgical history	1.6 (1.1, 2.2)
	pre-admission history limited to active problems	4.1 (3.5, 4.8)
Social history ****	social history	1.7 (1.3, 2.1)
	social history only if pertinent to admitting problem	4.6 (4.1, 5.1)

Exhibit 8 Effect of modification of baseline process items and pre-admission information on its contribution to discharge summary quality.

Quality was defined as: *A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician.* For each summary factor, the modification and mean contribution to quality with 95% confidence interval is given. Scale extends from -6.6 ("Item makes summary useless") through 0 ("Item has no effect on summary quality") to 10 ("Item so essential that summary is useless without it"). (D/C = discharge, **** $P<0.0001$).

Summary factor	*Item*	*Mean (95% CI)*
Physical examination ****	entire physical exam	1.1 (0.5, 1.7)
	abnormal findings on physical examination only	4.7 (4.1, 5.4)
	normal and abnormal physical examination findings	6.6 (6.0, 7.2)
Hospital investigations ****	results of all hospital investigations (both normal and abnormal)	2.7 (1.9, 3.4)
	results of abnormal hospital investigations only	3.8 (3.1, 4.6)
	results of normal and abnormal hospital investigations	6.8 (6.2, 7.4)
Hospital therapy ****	all treatment given in hospital	4.0 (3.3, 4.7)
	successful treatment only	1.9 (1.1, 2.7)
Discharge medications ****	discharge medications (with name, dosage, frequency and duration)	7.9 (7.4, 8.4)
	discharge medications limited to changes from admission medications	3.4 (2.5, 4.2)
Follow up (p = NS)	arranged medical follow-up (appointments and tests)	6.6 (6.1, 7.1)
	arranged medical follow-up specifying consultants and appointment dates	6.2 (5.6, 6.6)
Pending lab information ****	any pending laboratory results	4.5 (3.9, 5.1)
	important pending laboratory results	7.6 (7.1, 8.0)
Prognosis (p = NS)	patient prognosis	5.8 (5.2, 6.3)
	patient prognosis and whether this was communicated to patient	6.3 (5.8, 6.8)
Reports ****	copy of actual report for "big-ticket items" (CT scans, angiograms, MRI,	3.4 (2.9, 4.0)
	only pertinent findings of "big-ticket items" reported in summary	5.0 (4.4, 5.6)

Exhibit 9 Effect of modification on hospital and discharge information to its contribution to discharge summary quality.

Quality was defined as: *A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician.* For each summary factor, the modification and mean contribution to quality with 95% confidence interval is given. Scale extends from -6.58 ("Item makes summary useless") through 0 ("Item has no effect on summary quality") to 10 ("Item so essential that summary is useless without it"). (D/C = discharge, **** P<0.0001).

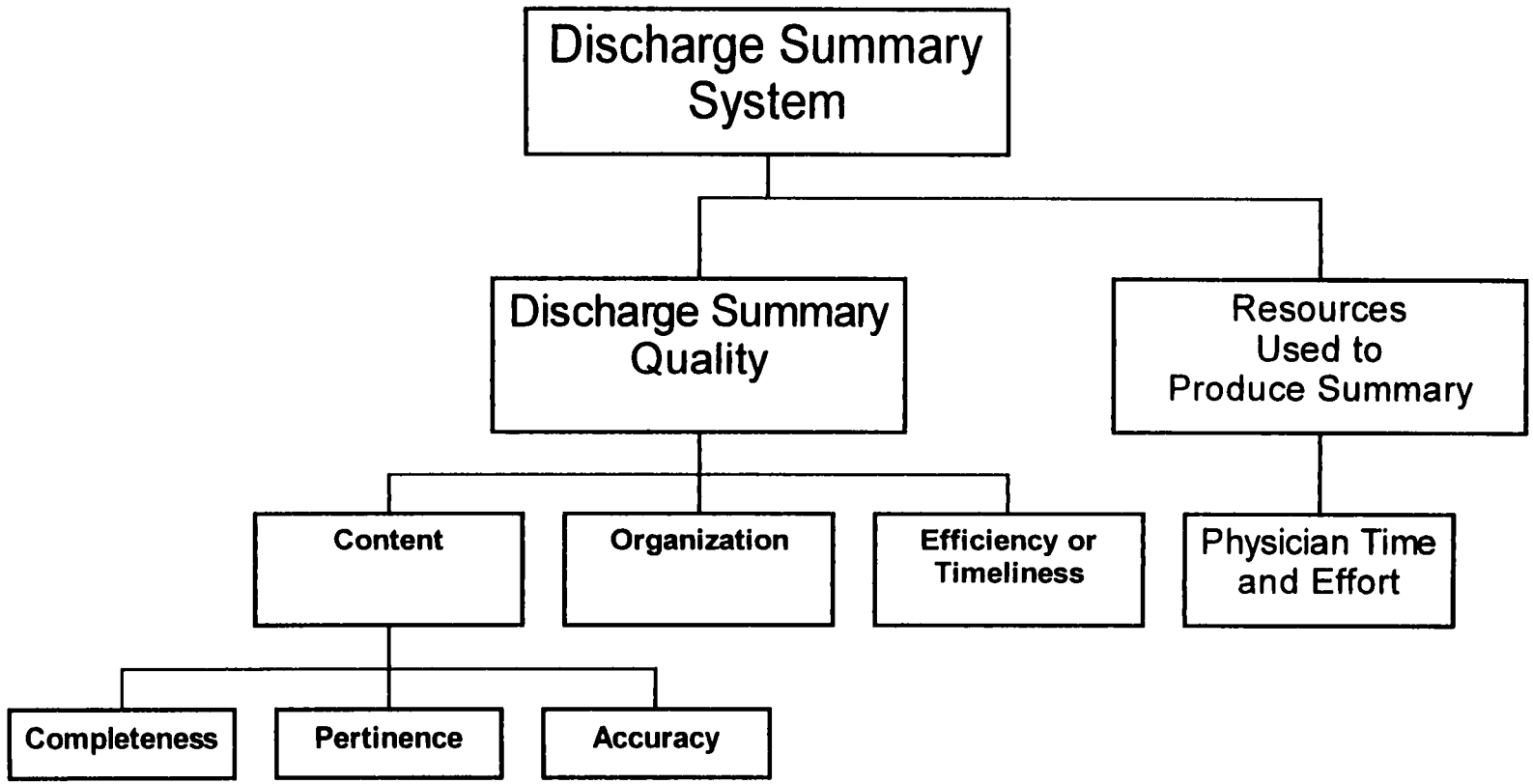


Exhibit 10 Schema used for assessing a discharge summary system.

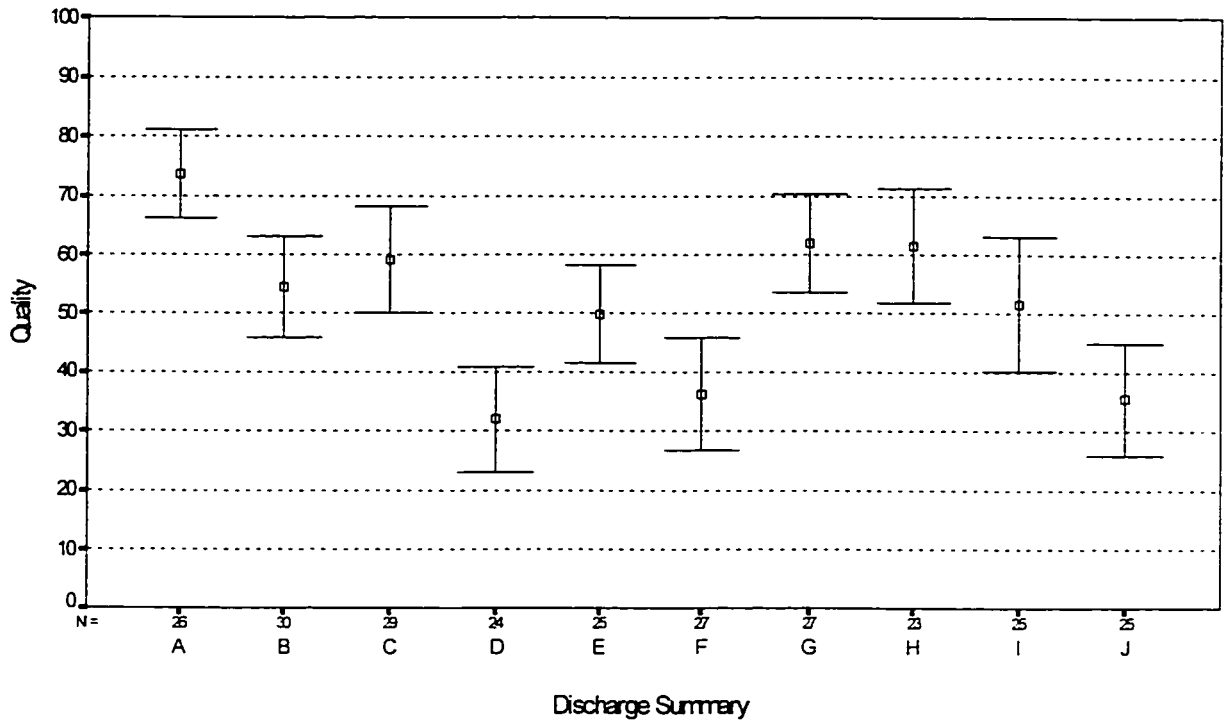


Exhibit 11 Mean quality ratings of ten randomly selected discharge summaries using a 100 mm visual analogue scale.

Each summary is represented by a letter. Quality was defined as: *a high-quality discharge summary efficiently communicates information necessary for ongoing care by the patient's family physician.* Quality scores ranged from 0 to 100 and were elicited with form illustrated in Appendix 1. Point estimates are flanked by 95% confidence intervals. The number of responses contributing to each quality assessment is given under the horizontal axis.

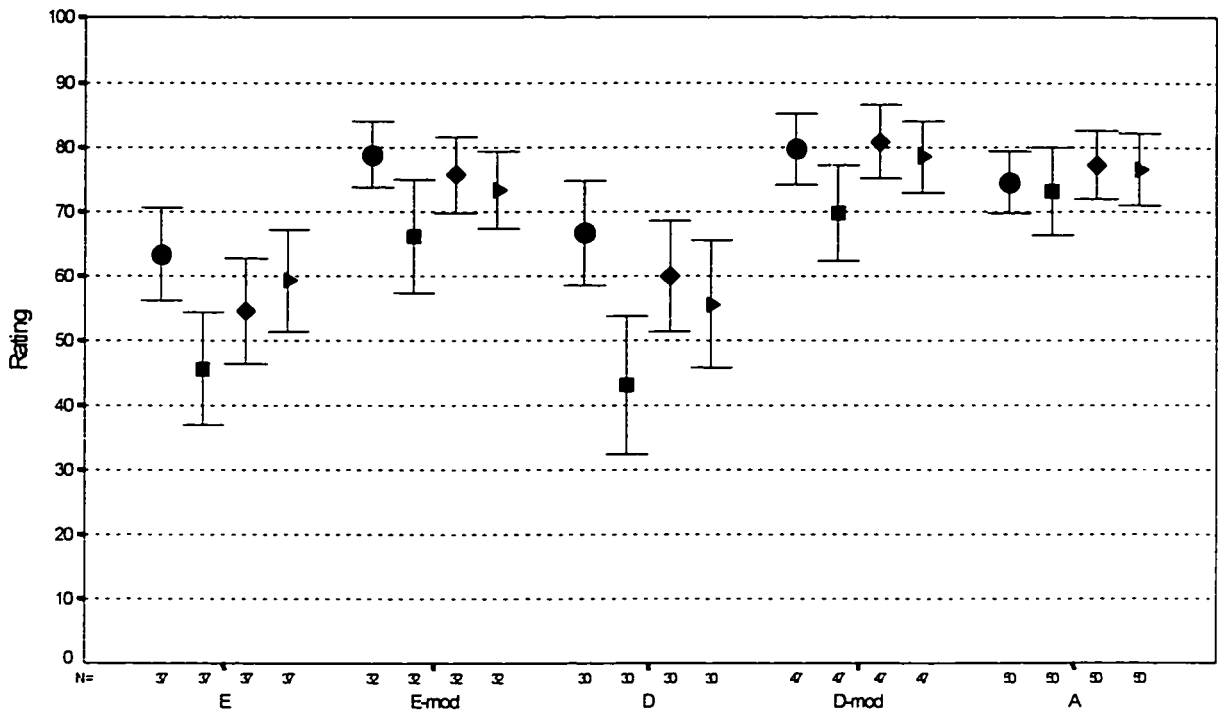


Exhibit 12 Ratings for content, length, organization and quality of five discharge summaries using a visual analogue scale.

Appendix 2 was used elicit all assessments. Responders rated the content (circle), length (square), organization (diamond), and quality (triangle) of each summary from 0 ("terrible") to 100 ("excellent"). The five summaries listed on the horizontal axis correspond to summaries in Exhibit 11. Summaries E and D were modified, and presumably improved, to create summaries "E-mod" and "D-mod". Each mean rating is flanked by a 95% confidence interval. "E-mod" and "d-mod" represent modified versions of summary "e" and "d" respectively. The number of responses for each assessment is given under the horizontal axis.

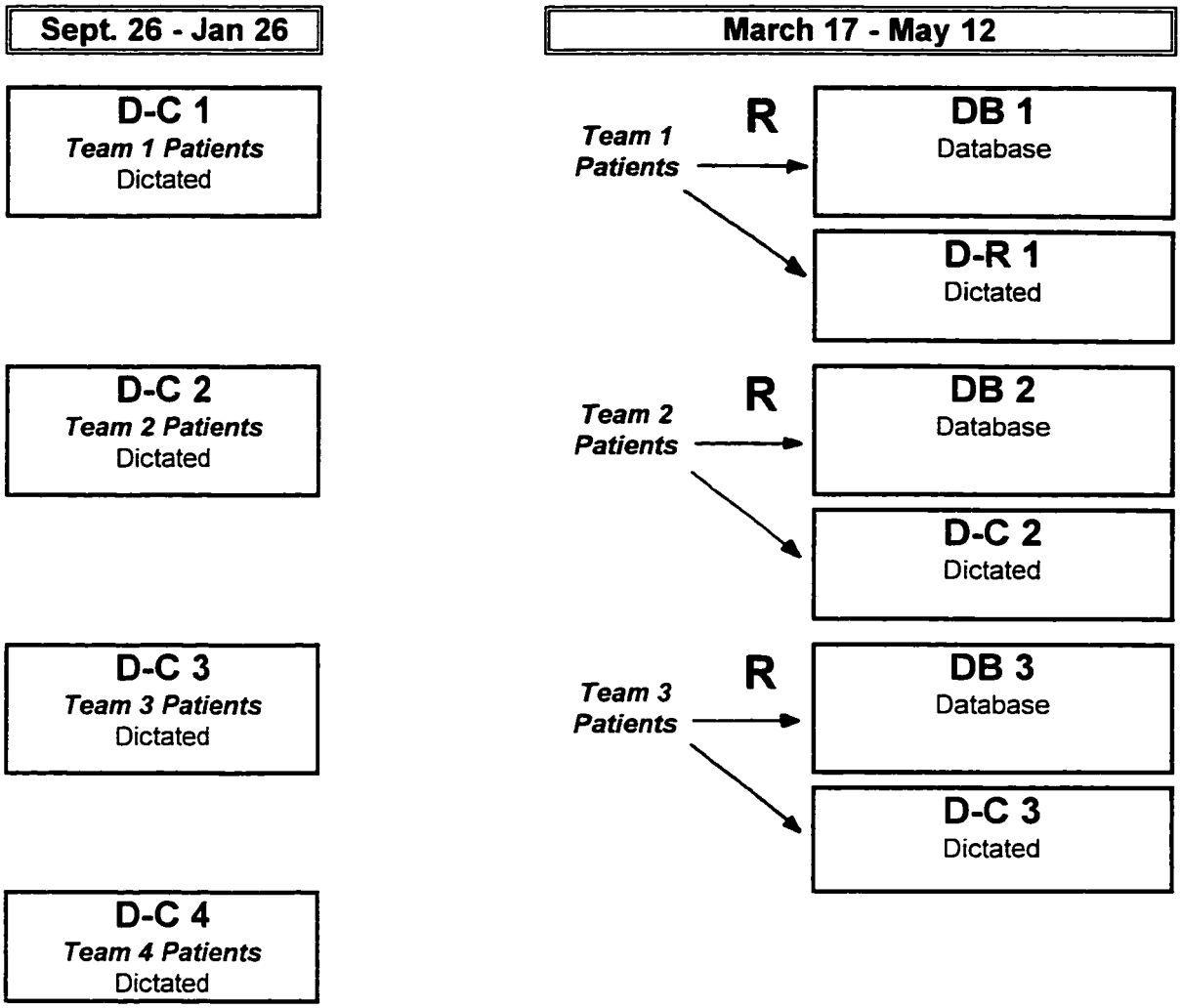


Exhibit 13 Overall organization of study.

The cohort study (baseline assessment) was conducted from September 26, 1996 to January 26, 1997. The randomized portion of the study started on March 17, 1997 and randomization was completed on May 12,1997. In late November 1996, the number of physician teams was reduced to three. (R - randomization)

Cohort Study	
Date of first admission	September 26, 1996
Date of last admission	January 26, 1997
Exclusion discharge date	April 1, 1997
Exclusion dictation date	April 8, 1997
Exclusion survey response date	April 30, 1997
Randomized Trial	
Date of first admission	March 17, 1997
Date of last admission	May 12, 1997
Exclusion discharge date	June 1, 1997
Exclusion dictation date	June 8, 1997
Exclusion survey response date	June 30, 1997

Exhibit 14 Important dates for baseline and randomized portions of the study. Exclusion dates were established prior to data analysis.

Information	*Contribution to Summary Quality*
Pre-Admission Information	
History of presenting illness	6.6 (6.1, 7.1)
Pre-admission medical history limited to active problems	4.1 (3.5, 4.8)
Abnormal findings on admission physical examination	4.7 (4.1, 5.4)
All pre-admission medication information	5.0 (4.4, 5.6)
Hospital Information	
Results of pertinent normal and abnormal investigations	6.8 (6.2, 7.4)
All treatment given in hospital	4.0 (3.3, 4.7)
Complications in hospital	7.1 (6.6, 7.5)
Therapeutic procedures	7.1 (6.7, 7.6)
Discharge Information	
Discharge diagnosis	8.8 (8.4, 9.2)
Discharge medications (with dose, frequency, and duration)	7.9 (7.4, 8.4)
Arranged medical follow-up	6.6 (6.0, 7.1)
Important pending lab results	7.6 (7.1, 8.0)
Community services arranged for patient	6.2 (5.7, 6.7)
Medical or social issues outstanding at DC	6.7 (6.2, 7.2)

Exhibit 15 Fields in the discharge summary database.

The amount that information in each field contributed towards discharge summary quality was measured on a ratio scale from -6.6 to +10, with a higher number indicating greater contribution to summary quality. Survey methods for the survey are described in section 1.4 of the text.

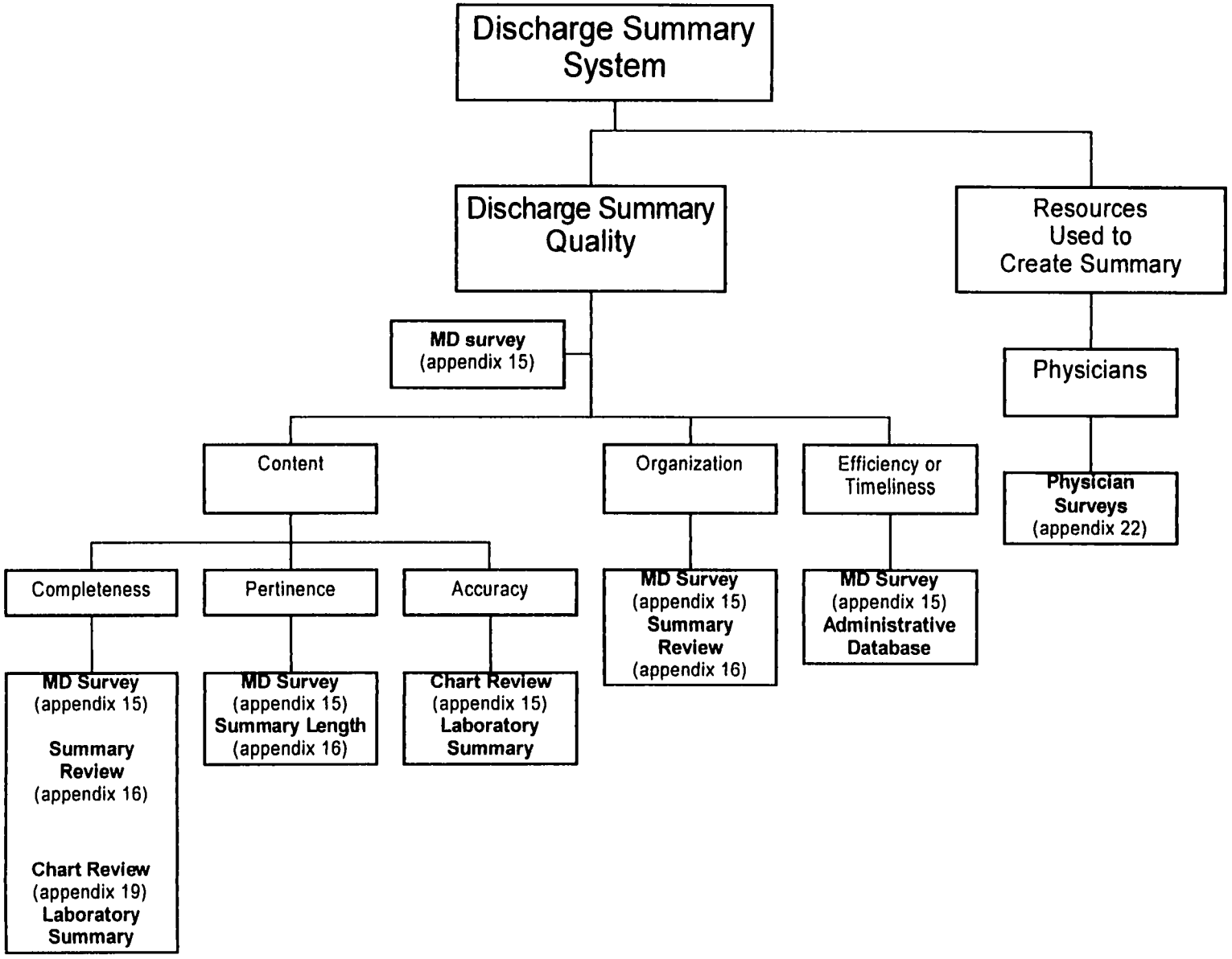


Exhibit 16 Outcomes measured during baseline and randomized portions of the study.

The primary outcome of the study was overall summary quality assessed by physicians receiving the summary.

Line #	Factor	Value
1	Mean dictated summary quality from physicians up to Mar 3/97 (n=443)	74.3
2	Variance for this estimate	297.0
3	Median relative minimal important difference	19%
4	Mean database summary quality being sought	88.4
5	Adjusted mean quality in intervention group	85.0
6	Type 1 error (2-sided)	0.975
7	Z-score for type 1 error	1.96
8	Type 2 error (1-sided)	0.85
9	Z-score for type 2 error	1.04
10	Unadjusted total sample size calculation	93.52
11	Probability that patient will stay < 2 days	0.32
12	Probability that patient staying < 2 days wont have summary done (dictated summary)	0.85
13	Probability that patient staying < 2 days wont have summary done (database - estimated)	0.25
14	Probability that patient stays < 2 days and no summary is done (dictated + database)	0.18
15	Probability that patient staying > 2 days wont have DICTATED summary done within 4 weeks of discharge	0.19
16	Probability that patient staying > 2 days wont have DATABASE summary done within 4 weeks of discharge (estimated)	0.10
17	Probability that patient admitted to CTU won't have summary done within 4 weeks of discharge (dictated + database)	0.32
18	Probability that patient admitted to CTU will die	0.12
19	Probability that summary won't be sent to eligible responder	0.25
20	Probability of no response within 4 weeks of summary printing	0.4
21	Probability that patient admitted to CTU gets transferred to another service	0.06
22	Sample size adjusted for death	106.0
23	Sample size adjusted for death and lack of summary within 6 weeks of d/c	156.5
24	Sample size adjusted for death, lack of summary within 6 weeks of d/c and no eligible CC	210.0
25	Sample size adjusted for death, lack of summary, no eligible CC, and no response to eligible CC's	350.1
26	Sample size adjusted for death, lack of summary, no eligible CC, no response to eligible CC's, and transfers from medicine	372.4

Exhibit 17 Sample size calculation for randomized portion of study.

The highlighted lines (#13, #16, and #21) are estimates. All others were determined from the baseline section of study. Sample size adjustments (lines 22 to 26) were calculated by multiplying the sample size by 1 / (1 - d) where "d" represents the anticipated loss rate.[51]

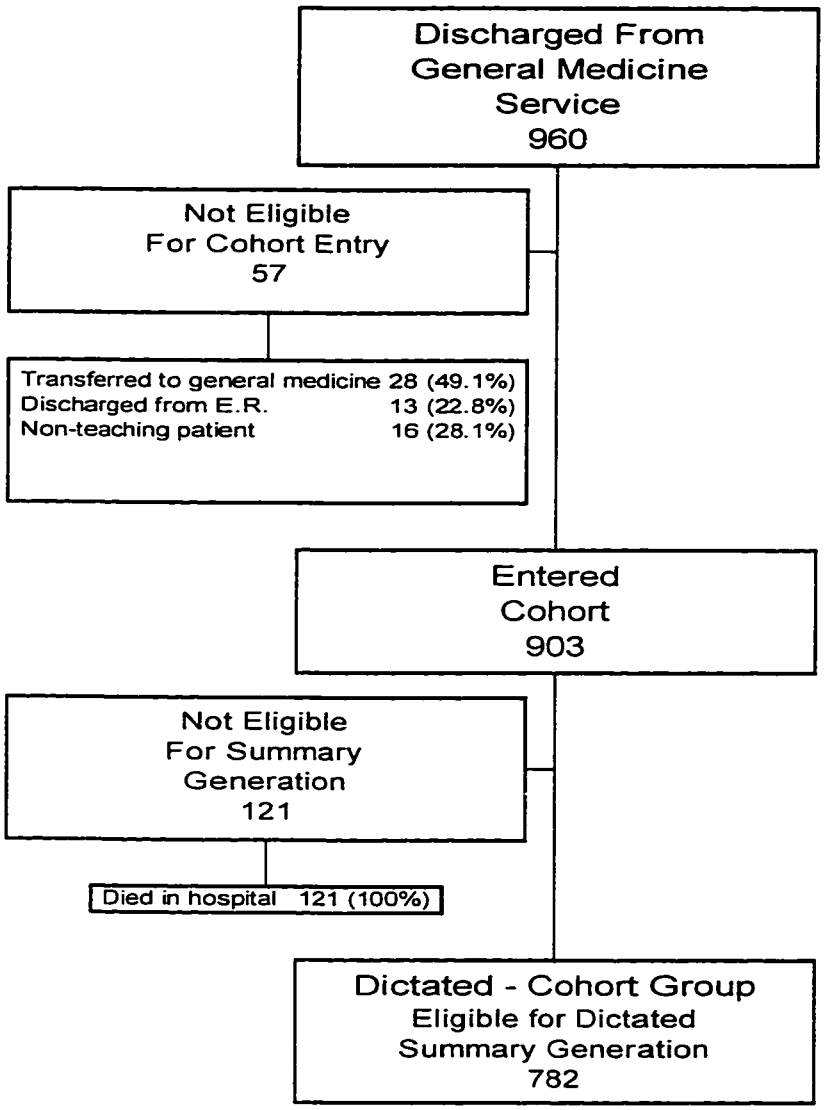


Exhibit 18 Patient flow through baseline portion of study.

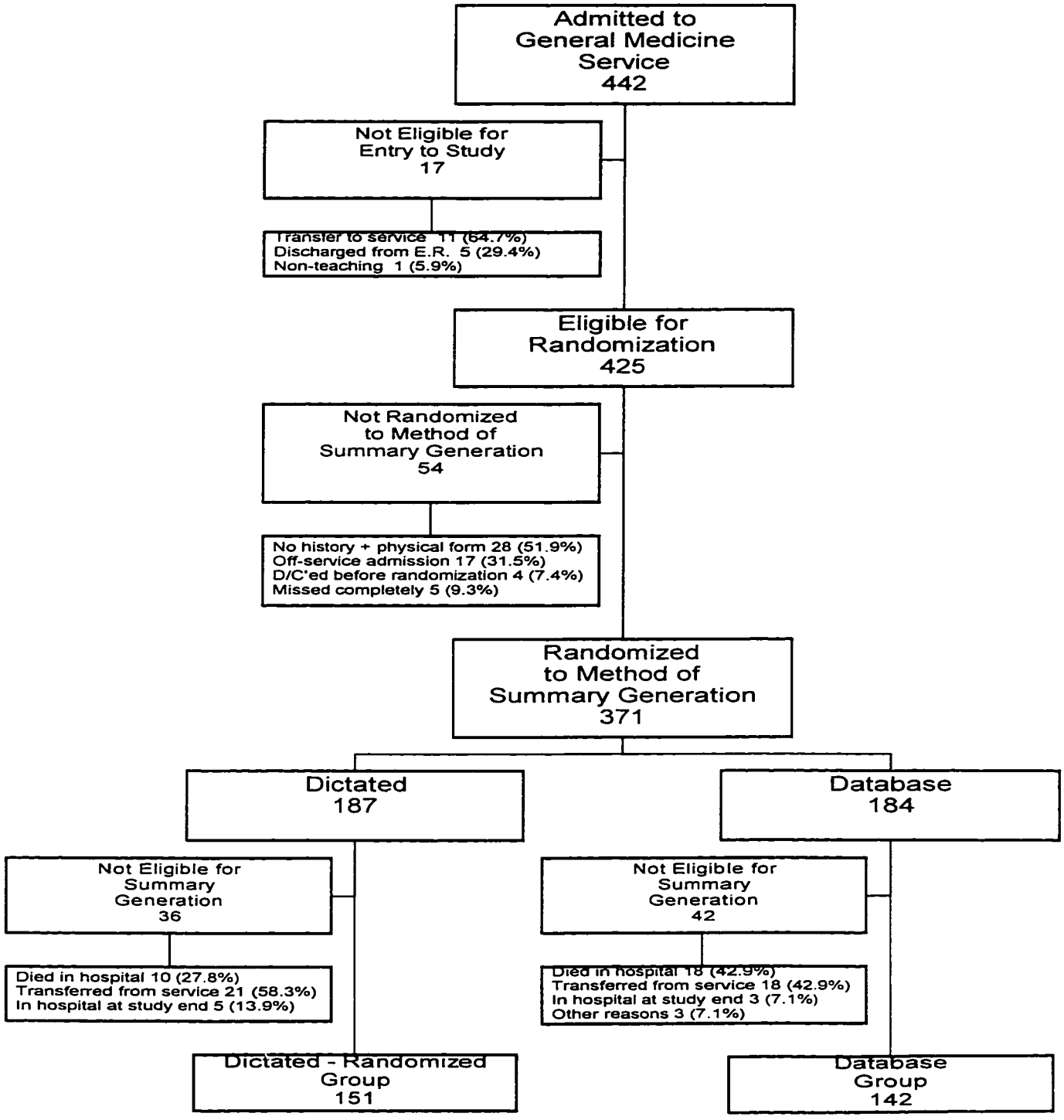


Exhibit 19 Patient flow through randomized portion of study.

Of patients randomized to the dictated and database groups, 86 (57.0%) and 113 (79.6%) had a summary generated by four weeks post discharge.

	Dictated - Cohort (D-C) (n = 782)	*Dictated - Random (D-R) (n = 151)*	*Database (DB) (n = 142)*	*P-value* D-R vs. D-C	D-R vs. DB
Age (SD)	64.4 (19.7)	62.9 (18.5)	65.7 (17.5)		0.18
Female (%)	50.3	46.4	52.8		
Pre-Admit Dx Mean number (SD)	2.5 (1.8)	2.6 (1.7)	2.8 (2.1)		
Hypertension (%)	200 (25.6%)	33 (21.9%)	42 (29.6%)		0.13
Coronary artery disease (%)	139 (17.8%)	27 (17.9%)	32 (22.5%)		
Congestive heart failure (%)	106 (13.6%)	21 (13.9%)	16 (11.3%)		
Asthma / chronic lung disease (%)	138 (17.6%)	26 (17.2%)	25 (17.6%)		
Diabetes +/- complications (%)	169 (21.9%)	33 (21.9%)	29 (20.4%)		
Chronic renal failure (%)	72 (9.2%)	15 (9.9%)	10 (7.0%)		
Cancer (%)	68 (8.7%)	17 (11.3%)	9 (6.3%)		0.14
Length of Stay - days (SD)	6.8 (9.6)	5.5 (5.4)	5.6 (4.7)	0.03	
Admitted to monitored bed - n (%)	172 (22.0%)	18 (11.9%)	32 (22.5%)	0.005	0.02
≥ **1 extreme lab results** - n (%)	456 (58.3%)	82 (54.3%)	81 (57.0%)		
≥ **1 diagnostic tests** - n (%)	694 (88.7%)	132 (87.4%)	132 (93.0%)		0.11
# new therapies - mean (SD)	2.64 (2.4)	2.40 (1.9)	2.30 (1.9)	0.17	
≥ **1 consultations** - n (%)	426 (54.5%)	86 (57.0)	78 (54.9%)		0.12
≥ **1 complications** - n (%)	138 (17.6%)	25 (16.6%)	27 (19.0%)		
≥ **1 procedures** - n (%)	226 (28.9%)	59 (39.1%)	46 (32.4%)	0.01	
# discharge meds - mean (SD)	4.00 (2.7)	3.82 (2.7)	3.90 (2.9)		
1° discharge diagnosis				0.02	0.18
Respiratory system disorders	172 (22.5%)	31 (20.5%)	24 (17.0%)		
Circulatory system disorders	160 (20.9%)	16 (10.6%)	30 (21.3%)		
Digestive system disorders	108 (14.1%)	30 (19.9%)	31 (22.0%)		
Injuries / poisonings / undefined	68 (8.9%)	12 (7.9%)	12 (8.5%)		
Neoplastic / blood disorders	58 (7.6%)	20 (13.2%)	10 (7.1%)		
Genito-urinary system disorders	57 (7.4%)	10 (6.6%)	10 (7.1%)		
Endocrine / nutritional disorders	53 (6.9%)	11 (7.3%)	8 (5.7%)		

Exhibit 20 Comparison of randomized patients for pre-admission and hospitalization factors.

Factors for all patients who were eligible for summary generation are compared. Pre-admission diagnoses were those documented by physician on admission note. See Appendix 23 for definitions of "extreme" and "diagnostic" tests. Only p-values less than 0.2 are shown.

	Dictated - Cohort (D-C) (n = 404)	*Dictated - Random (D-R) (n = 86)*	*Database (DB) (n = 113)*	*P-value* D-R vs. D-C	D-R vs. DB
Age (SD)	65.8 (19.0)	62.2 (19.4)	65.3 (17.5)	0.12	0.25
Female (%)	50.0%	48.8%	53.1%		
Pre-Admit Dx Mean number (SD)	2.53 (1.7)	2.65 (1.7)	2.85 (2.1)		
Hypertension (%)	105 (26.0%)	20 (23.3%)	34 (30.1%)		
Coronary artery disease (%)	82 (20.3%)	15 (17.4%)	29 (25.7%)		0.16
Congestive heart failure (%)	58 (14.4%)	13 (15.1%)	14 (12.4%)		
Asthma / chronic lung disease (%)	73 (18.1%)	15 (17.4%)	20 (17.7%)		
Diabetes +/- complications (%)	83 (20.5%)	13 (15.1%)	25 (22.1%)		
Chronic renal failure (%)	31 (7.7%)	7 (8.1%)	9 (8.0%)		
Cancer (%)	34 (8.4%)	13 (15.1%)	8 (7.1%)		0.08
Length of Stay - days (SD)	7.6 (9.1)	5.8 (4.8)	6.0 (4.9)	0.013	
Admitted to monitored bed - n (%)	95 (23.5%)	12 (14.0%)	26 (23.0%)	0.05	0.1
≥ **1 extreme lab results** - n (%)	250 (61.9%)	48 (55.8%)	66 (58.4%)		
≥ **1 diagnostic tests** - n (%)	144 (35.6%)	29 (33.7%)	43 (38.1%)		
# new therapies - mean (SD)	2.82 (2.4)	2.78 (2.0)	2.31 (1.9)		0.1
≥ **1 consultations** - n (%)	246 (60.9%)	52 (60.5%)	60 (53.1%)		
≥ **1 complications** - n (%)	80 (19.8%)	15 (17.4%)	21 (18.6%)		
≥ **1 procedures** - n (%)	135 (33.4%)	35 (40.7%)	37 (32.7%)		
# discharge meds - mean (SD)	4.27 (2.6)	3.97 (2.7)	3.87 (2.9)		
1° discharge diagnosis				0.04	
Respiratory system disorders	100 (28.3%)	20 (25.6%)	21 (21.2%)		
Circulatory system disorders	76 (21.5%)	8 (10.3%)	21 (21.2%)		
Digestive system disorders	58 (16.4%)	16 (20.5%)	23 (23.2%)		
Injuries / poisonings / undefined	36 (10.2%)	7 (9.0%)	10 (10.1%)		
Neoplastic / blood disorders	28 (7.9%)	15 (19.2%)	9 (9.1%)		
Genito-urinary system disorders	28 (7.9%)	6 (7.7%)	9 (9.1%)		
Endocrine / nutritional disorders	27 (7.6%)	6 (7.7%)	6 (6.1%)		

Exhibit 21 Comparison of patients for whom summaries were generated for pre-admission and hospitalization factors

Factors for all patients having summary generated are compared. Pre-admission diagnoses were those documented by physician on admission note. See Appendix 23 for definitions of "extreme" and "diagnostic" tests. Only p-values less than 0.2 are shown.

Factor	*Dictated - Cohort (A) (n = 782)*	*Dictated - Randomized (B) (n = 151)*	*Database (C) (n = 142)*	*P-value* A vs. B	B vs. C
Summary Generation					
Summary created any time post D/C	513 (65.6%)	92 (60.9%)	116 (81.7%)	NS	****
Summary within 4 weeks if LOS > 2 days	337 / 544 (61.9%)	64 / 100 (64.0%)	86 / 103 (83.5%)	NS	**
⊕ Summary created in 4 wks of discharge	404 (51.7%)	86 (57.0%)	113 (79.6%)	NS	****
Training level of MD creating summary				**	NS
Medical Student	124 (30.7%)	40 (46.5%)	41 (36.3%)		
PGY-1	108 (26.7%)	25 (29.1%)	38 (33.6%)		
PGY-2 +	114 (28.2%)	16 (18.6%)	24 (21.2%)		
Staff	58 (14.4%)	5 (5.8%)	10 (8.8%)		
Summary created "stat"	8/404 (2.0%)	2/86 (2.3%)	1/113 (0.9%)	NS	NS
Summary Survey					
Mean # MDs "cc'ed" per summary (SD)	1.37 (0.84)	1.65 (1.04)	1.41 (0.86)	*	NS
Overall summary survey response rate	406 / 554 (73.3%)	89 / 142 (62.7%)	121 / 160 (75.6%)	*	*
# of responses which were reminder surveys	65 / 406 (16.0%)	32 / 89 (36.0%)	17 / 121 (14.0%)	****	***
MD specialty of respondents				NS	NS
Primary care physicians	258 (63.5%)	48 (53.9%)	73 (60.3%)		
Consultant	139 (34.2%)	39 (43.8%)	47 (38.8%)		
No longer involved with patient	9 (2.2%)	2 (2.2%)	1 (0.8%)		
# summaries sent to at least 1 MD	366 / 404 (90.6%)	79 / 86 (91.9%)	100 / 113 (88.5%)	NS	NS
# summaries with at least 1 summary survey returned	294 / 404 (72.8%)	62 / 86 (70.4%)	88 / 113 (77.9%)	NS	NS

Exhibit 22 General information on discharge summary generation and summary survey response.

Physicians who were involved in the patient's care, but not as the primary-care physician, was classified as a "consultant". A summary created "stat" was transcribed immediately as requested by the dictating physician. (* < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.00000; NS - not significant; cc'ed - copy of summary sent; wks - weeks; PGY - program year; MD - physician; # - number; ⊕ secondary outcome of study)

Training Level	*Author number*	*Summary Type*	
Med Student		***Dictated***	***Database***
	1	0	2
	2	0	1
	3	0	3
	4	0	1
	5	5	2
	6	1	0
	7	1	0
	8	6	3
	9	1	5
	10	2	0
	11	3	5
	12	9	8
	13	1	6
	14	4	2
	15	3	1
	16	1	0
	17	0	1
	18	1	0
	19	2	1
PGY-1			
	1	0	1
	2	0	4
	3	0	1
	4	3	1
	5	3	2
	6	2	3
	7	1	1
	8	5	5
	9	4	6
	10	2	3
	11	1	1
	12	1	4
	13	0	3
	14	1	3
	15	2	0
PGY-2 +			
	1	0	1
	2	1	0
	3	1	2
	4	4	5
	5	8	7
	6	0	6
	7	2	0
	8	0	3
Staff			
	1	0	1
	2	3	6
	3	1	1
	4	1	2

Exhibit 23 Number of summaries produced by each housestaff by summary type and training level

	Dictated - C *(A)*	*Dictated - R* *(B)*	*Database* *(C)*	*P- value* A vs. B	B vs. C
⊕ Mean overall quality (SD)	74.8 (17.4) (n=272)	74.9 (16.6) (n=55)	72.7 (19.3) (n=84)	NS	NS
Physician specialty					
Primary care (SD)	76.7 (16.9) (n=232)	75.2 (19.4) (n=40)	77.6 (16.4) (n=67)	NS	NS
Consultant (SD)	71.2 (20.5) (n=106)	76.2 (13.6) (n=29)	64.6 (24.7) (n=37)	NS	*
Survey response type					
Initial (SD)	75.4 (16.6) (n=239)	74.2 (15.1) (n=35)	73.6 (13.6) (n=76)	NS	NS
Reminder (SD)	71.5 (23.2) (n=53)	77.4 (19.2) (n=25)	68.9 (19.2) (n=15)	NS	NS

Exhibit 24 Discharge summary quality.

The summary survey (Appendix 17) was used to elicit physician assessment of discharge summary quality, ranging from 0 to 100, for summaries in the dictated - cohort, dictated - random, and database groups. Overall summary quality was the study's primary outcome. Respondents classified their relationship to the patient on the summary survey. Responses requiring a repeat mailing were classified as "reminder" survey responses. Each quality score is followed by its standard deviation (* < 0.05; NS - not significant; ⊕ primary outcome of study)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
⊕ Mean overall completeness (SD)	76.3 (17.5)	78.2 (14.9)	73.4 (19.8)	NS	NS
	(n=291)	(n=62)	(n=86)		
Physician specialty					
Primary care (SD)	77.1 (18.3)	76.7 (19.2)	75.9 (20.7)	NS	NS
	(n=255)	(n=48)	(n=73)		
Consulting (SD)	74.9 (17.4)	79.5 (13.5)	68.2 (21.7)	NS	*
	(n=109)	(n=28)	(n=35)		
Survey response type					
Initial (SD)	76.6 (17.2)	77.4 (15.6)	74.1 (19.5)	NS	NS
	(n=258)	(n=38)	(n=77)		
Reminder (SD)	73.9 (20.0)	80.4 (14.8)	71.0 (23.0)	NS	NS
	(n=56)	(n=28)	(n=16)		

Exhibit 25 Discharge summary completeness.

Physicians assessed discharge summary completeness using the survey in Appendix 17. Each completeness score is followed by its standard deviation. The p-values for the comparison of the dictated and randomized groups are given. (* < 0.05; NS - not significant; ⊕ secondary outcome of study)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	**A vs. B**	**B vs. C**
Chief Complaint	395 / 404 (97.8%)	84 / 86 (97.7%)	113 / 113 (100%)	NS	NS
History of presenting illness	374 / 404 (92.6%)	84 / 86 (97.7%)	109 / 113 (96.5%)	NS	NS
Active past medical history	359 / 385 (93.2%)	72 / 83 (86.7%)	106 / 106 (100%)	*	****
Inactive past medical history	176 / 403 (43.7%)	12 / 86 (14.0%)	10 / 113 (8.8%)	*****	NS
Family medical history	14 / 404 (3.5%)	2 / 86 (2.3%)	0 / 100 (0%)	NS	NS
Social history	230 / 404 (56.9%)	32 / 86 (37.2%)	7 / 113 (6.2%)	***	*****
Pre-admission medications	279 / 404 (69.1%)	57 / 86 (66.3%)	113 / 113 (100%)	NS	*****
Medication names	264 / 272 (97.1%)	55 / 56 (98.2%)	97 / 98 (99.0%)	NS	NS
Medication dosages	204 / 272 (75.0%)	44 / 56 (78.6%)	85 / 98 (86.7%)	NS	NS
Medication frequency	203 / 272 (74.6%)	44 / 56 (78.6%)	86 / 98 (87.8%)	NS	NS
Admission physical examination	361 / 404 (88.1%)	76 / 86 (87.2%)	112 / 113 (99.1%)	NS	NS
General appearance	277 / 361 (76.7%)	57 / 76 (75.0%)	94 / 112 (83.9%)	NS	NS
Vital signs	321 / 361 (88.9%)	69 / 76 (90.8%)	112 / 112 (100%)	NS	**
Other physical examination	350 / 361 (97.0%)	71 / 76 (93.4%)	112 / 112 (100%)	NS	**

Exhibit 26 Apparent discharge summary completeness - pre-admission information.

Summaries were abstracted with a standardized form (Appendix 18) using abstraction rules in Appendix 19 and Appendix 20. The denominators vary because categories did not apply to all summaries. The p-values for the comparison of the dictated and randomized groups are given. (* < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.00001; NS - not significant)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
Admission diagnosis	289 / 404 (71.5%)	61 / 86 (70.9%)	1 / 113 (0.9%)	NS	*****
Reason for patient admission	65 / 404 (16.1%)	12 / 86 (14.0%)	0 / 113 (0%)	NS	*****
Reason is implicit	285 / 339 (84.1%)	62 / 74 (83.8%)	99 / 113 (87.6%)	NS	NS
Medical treatment in hospital	348 / 372 (93.5%)	75 / 77 (97.4%)	97 / 99 (98.0%)	NS	NS
Diagnostic procedures	96 / 404 (23.8%)	21 / 86 (24.4%)	31 / 113 (27.4%)	NS	NS
Therapeutic procedures	70 / 404 (17.3%)	15 / 86 (17.4%)	15 / 113 (13.3%)	NS	NS
Complications in hospital	90 / 404 (22.3%)	21 / 86 (24.4%)	40 / 113 (35.4%)	NS	NS
Consultations in hospital	162 / 404 (40.1%)	35 / 86 (40.7%)	21 / 113 (18.6%)	NS	***
Discharge diagnosis	262 / 404 (64.9%)	56 / 86 (65.1%)	113 / 113 (100%)	NS	*****
Discharge medications	360 / 404 (89.1%)	80 / 86 (93.0%)	113 / 113 (100%)	NS	**
Discharge Rx Names	351 / 360 (97.5%)	79 / 79 (100%)	107 / 107 (100%)	NS	-
Discharge Rx Dosage	339 / 359 (94.4%)	77 / 79 (97.5%)	105 / 107 (98.1%)	NS	NS
Discharge Rx Frequency	336 / 357 (94.1%)	77 / 79 (97.5%)	105 / 107 (98.1%)	NS	NS
Discharge Rx Duration	139 / 198 (71.3%)	34 / 39 (87.2%)	34 / 45 (75.6%)	*	NS

Exhibit 27 Apparent discharge summary completeness - hospital and discharge information.

Summaries were abstracted with a form (Appendix 18) using abstraction rules delineated in Appendix 19 and Appendix 20. The denominators vary because categories did not apply to all summaries. The p-values for the comparison of the dictated and randomized groups are given. (* < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.000001; NS - not significant; Rx - medications)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
Fate of admission Rx at D/C	144 / 263 (54.8%)	43 / 52 (82.7%)	89 / 94 (94.7%)	***	*
Medical follow up	337 / 376 (89.6%)	76 / 80 (95.0%)	104 / 105 (99.0%)	NS	NS
MD other than family MD to follow up	200 / 341 (58.7%)	63 / 76 (82.9%)	74 / 103 (71.8%)	****	NS
Name of other follow up MD given	164 / 200 (82.0%)	53 / 63 (84.1%)	62 / 74 (83.8%)	NS	NS
Time of other MD follow up	129 / 200 (64.5%)	46 / 63 (73.0%)	50 / 74 (67.6%)	NS	NS
Date of other MD follow up	25 / 196 (12.8%)	16 / 63 (25.4%)	13 / 74 (17.6%)	*	NS
Prognosis	1 / 404 (0.2%)	0 / 86 (0%)	0 / 113 (0%)	NS	-
Lifestyle modification recommendations	55 / 404 (13.6%)	10 / 86 (11.6%)	6 / 113 (5.3%)	NS	NS
Community services for patient	54 / 404 (13.4%)	18 / 86 (20.9%)	46 / 113 (40.7%)	NS	**
Functional status at discharge	105 / 404 (26.0%)	9 / 86 (10.5%)	1 / 113 (0.9%)	**	**
Pending laboratory investigations	25 / 404 (6.2%)	8 / 78 (9.3%)	46 / 113 (40.7%)	NS	*****
Diagnostic recommendations	105 / 404 (26.0%)	25 / 86 (29.1%)	42 / 113 (37.2%)	NS	NS
Therapeutic recommendations	70 / 404 (17.3%)	13 / 86 (15.1%)	32 / 81 (28.3%)	NS	*

Exhibit 28 Apparent discharge summary completeness - discharge information.

Summaries were abstracted with a form (Appendix 18) using abstraction rules as delineated in Appendix 19 and Appendix 20. The denominators vary between categories because summaries to which category did not apply were nor considered. The p-values for the comparison of the dictated and randomized groups are given. (Rx - therapy; MD - physician; NS - not significant; * < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.000001)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	**A vs. B**	**B vs. C**
Consultations (%)	170 / 389 (43.7%)	37 / 79 (46.8%)	19 / 100 (19.0%)	NS	****
Procedures	121 / 206 (58.7%)	37 / 48 (77.1%)	33 / 46 (71.7%)	*	NS
New medical therapy	451 / 1140 (36.9%)	123 / 239 (51.5%)	128 / 262 (48.9%)	***	NS
Complications	31 / 114 (27.2%)	8 / 19 (42.1%)	16 / 27 (59.6%)	NS	NS
Investigations					
Extreme results	270 / 743 (36.3%)	41 / 136 (30.1%)	63 / 130 (48.5%)	NS	**
Dx'ic - blood	83 / 549 (15.1%)	19 / 114 (16.7%)	39 / 130 (30.0%)	NS	*
Dx'ic - general radiology	294 / 757 (38.8%)	51 / 141 (36.2%)	63 / 140 (45.0%)	NS	NS
Dx'ic - ultrasound	95 / 211 (45.0%)	16 / 46 (34.8%)	20 / 47 (42.6%)	NS	NS
Dx'ic - CT	99 / 221 (44.8%)	19 / 39 (48.7%)	25 / 45 (55.6%)	NS	NS
Dx'ic - nuclear radiology	16 / 28 (57.1%)	4 / 4 (100%)	4 / 6 (66.7%)	NS	NS

Exhibit 29 True discharge summary completeness.

The proportion of observations from chart and laboratory review that were included in the summary is given. Tests and results in the investigation categories are given in Appendix 23. The p-values for the comparison of the dictated and randomized groups are given. (Dx'ic = diagnostic; * < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.000001; NS - not significant)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	**A vs. B**	**B vs. C**
⊕ Mean overall pertinence (n = 601)	76.9 (16.8) (n=291)	79.1 (15.2) (n=62)	77.2 (15.4) (n=87)	NS	NS
Physician specialty					
Family MD (n = 374)	78.5 (16.3) (n=253)	80.9 (14.1) (n=48)	80.6 (13.3) (n=73)	NS	NS
Consultant (n = 226)	73.8 (19.0) (n=110)	73.3 (18.3) (n=28)	70.1 (21.3) (n=37)	NS	NS
Survey response type					
Initial (n = 490)	77.1 (16.8) (n=257)	78.8 (14.8) (n=38)	78.0 (14.5) (n=78)	NS	NS
Reminder (n = 111)	75.4 (17.8) (n=56)	79.9 (16.5) (n=28)	73.0 (21.8) (n=16)	NS	NS
Lines of text in summary (SD)					
Total	-	64.8 (26.6)	57.3 (17.1)	-	*
Pre-Admission information	-	27.7 (12.6)	24.4 (7.5)	-	*
Hospital information	-	22.1 (14.8)	13.5 (5.8)	-	*****
Discharge information	-	14.9 (8.0)	19.4 (7.1)	-	*****
Dictation Time (minutes)	7.17 (3.25)	7.68 (3.45)	-	NS	-

Exhibit 30 Discharge summary pertinence.

The survey in Appendix 17 was used to elicit physician assessment of discharge summary pertinence. Each pertinence score is followed by its standard deviation. For summaries in the randomized portion of the study, the number of lines of text in the pre-admission, hospital, and discharge information is given. For the dictated summaries, the time needed for the physician to dictate the summary is provided for comparison of summary length. ("-" - not measured or not comparable; * < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.000001; NS - not significant; ⊕ secondary outcome of study)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
Consultations (%)	170 / 196 (86.7%)	37 / 43 (86.0%)	19 / 23 (82.6%)	NS	NS
Procedures	165 / 219 (75.3%)	40 / 43 (93.0%)	36 / 54 (66.7%)	*	**
Complications	42 / 168 (25.0%)	6 / 29 (20.7%)	13 / 61 (21.3%)	NS	NS
Investigations					
Extreme results	279 / 318 (87.7%)	43 / 50 (86.0%)	70 / 76 (92.1%)	NS	NS
Dx'ic - blood	83 / 84 (98.8%)	19 / 21 (90.5%)	39 / 39 (100%)	-	-
Dx'ic - general radiology	294 / 303 (97.0%)	51 / 54 (94.4%)	63 / 64 (98.4%)	NS	NS
Dx'ic - ultrasound	95 / 103 (92.2%)	16 / 18 (88.9%)	20 / 22 (90.9%)	NS	NS
Dx'ic - CT	99 / 103 (96.1%)	19 / 20 (95%)	25 / 28 (89.3%)	-	NS
Dx'ic - nuclear radiology	16 / 16 (100%)	4 / 4 (100%)	4 / 4 (100%)	-	-

Exhibit 31 Discharge summary accuracy.

The proportion of observations from summaries which were identified at chart and laboratory review are given. For definition of tests and results for investigation categories, see Appendix 23. ("-" - not comparable; Dx'ic = diagnostic; * < 0.05; ** < 0.01; NS - not significant)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
⊕ Mean overall organization (SD)	78.6 (14.6)	79.3 (17.2)	77.4 (16.3)	NS	NS
	(n=79.2)	(n=62)	(n=87)		
Physician specialty					
Primary care (SD)	79.5 (15.0)	80.7 (16.8)	80.7 (16.3)	NS	NS
	(n=251)	(n=48)	(n=73)		
Consulting (SD)	76.5 (15.1)	76.0 (16.6)	69.4 (23.6)	NS	*
	(n=110)	(n=28)	(n=37)		
Survey response type					
Initial (SD)	79.1 (14.4)	78.8 (17.7)	78.0 (15.0)	NS	NS
	(n=255)	(n=38)	(n=78)		
Reminder (SD)	75.8 (17.1)	80.2 (16.3)	72.5 (26.1)	NS	NS
	(n=56)	(n=28)	(n=16)		

Exhibit 32 Discharge summary organization.

The survey in Appendix 17 was used to elicit physician assessment of discharge summary organization. Each organization score is followed by its standard deviation. (* < 0.05; NS - not significant; ⊕ secondary outcome of study)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
Mean number of headings (SD)	8.19 (3.0)	8.23 (3.0)	13.14 (2.4)	NS	****
Content items under headings					
Chief complaint	255 / 395 (64.6%)	44 / 84 (52.4%)	112 / 113 (99.1%)	*	*****
Active medical problems	307 / 359 (85.5%)	69 / 72 (95.8%)	106 / 106 (100%)	*	NS
Admission medications	253 / 279 (90.7%)	53 / 57 (93.0%)	104 / 112 (92.9%)	NS	NS
Admission physical exam	351 / 356 (98.9%)	71 / 75 (94.7%)	112 / 112 (100%)	NS	*
Admission diagnosis	253 / 289 (87.5%)	60 / 61 (98.4%)	1 / 1 (100%)	*	-
Reason for admission	46 / 65 (70.8%)	7 / 12 (58.3%)	0 / 0	NS	-
Treatment in hospital	169 / 348 (45.6%)	43 / 75 (57.3%)	83 / 97 (85.6%)	NS	***
Procedures	71 / 166 (42.8%)	24 / 36 (66.7%)	39 / 46 (84.8%)	**	***
Complications	34 / 90 (37.8%)	11 / 21 (52.4%)	39 / 40 (97.5%)	NS	*****
Consultations	57 / 162 (35.2%)	14 / 35 (40.0%)	10 / 21 (47.6%)	NS	NS
Discharge diagnosis	255 / 262 (97.3%)	56 / 56 (100%)	112 / 113 (99.1%)	NS	-
Discharge medications	321 / 360 (89.2%)	78 / 80 (97.5%)	111 / 113 (98.2%)	*	NS
Medical follow-up	297 / 349 (85.1%)	75 / 78 (96.2%)	110 / 110 (100%)	**	NS
Pending lab results	6 / 25 (24.0%)	0 / 8 (0%)	37 / 46 (80.4%)	NS	****
Dx'ic recommendations	35 / 105 (33.3%)	8 / 25 (32.0%)	24 / 42 (57.1%)	NS	*
Rx'ic recommendations	15 / 70 (21.4%)	1 / 13 (7.7%)	24 / 32 (75.0%)	NS	****
Mean # misclassifications (SD)	0.30 (0.7)	0.09 (0.4)	0.01 (0.1)	*	NS
Mean # dyschronologies (SD)	0.19 (0.5)	0.06 (0.2)	0.00 (0.00)	****	*

Exhibit 33 Further assessment of discharge summary organization.

All summaries were reviewed using the form displayed in Appendix 18. Content items were considered to have a heading if it was within the first two sentences under a heading or the first sentence without a heading. Definitions for "misclassification" and "dyschronology" are given in Appendix 20. ("-" - not comparable; * < 0.05; ** < 0.01; *** < 0.001; **** < 0.0001; ***** < 0.000001; NS - not significant)

	Dictated - C	*Dictated - R*	*Database*	*P- value*	
	(A)	*(B)*	*(C)*	A vs. B	B vs. C
⊕ Mean overall timeliness (n = 592)	62.9 (26.5) (n=291)	66.2 (25.6) (n=61)	70.3 (21.9) (n=86)	NS	NS
Physician specialty					
Primary Care (n = 373)	61.3 (1.77) (n=254)	62.6 (28.2) (n=47)	72.2 (22.7) (n=72)	NS	*
Consultant (n = 219)	69.4 (21.6) (n=107)	76.7 (19.2) (n=26)	66.8 (27.1) (n=37)	NS	NS
Survey response type					
Initial (n = 483)	61.6 (26.5) (n=257)	67.2 (21.7) (n=38)	73.5 (73.5) (n=77)	NS	NS
Reminder (n = 99)	71.6 (26.7) (n=55)	66.7 (31.6) (n=27)	55.7 (30.1) (n=16)	NS	NS

Exhibit 34 Discharge summary timeliness.

The survey in Appendix 17 was used to elicit physician assessment of discharge summary completeness. Scales were formatted so that higher scores were better. Therefore, the less time taken for summary generation and the less burdensome was summary generation, the higher the score. Each timeliness score is followed by its standard deviation. (* < 0.05; NS - not significant; ⊕ secondary outcome of study)

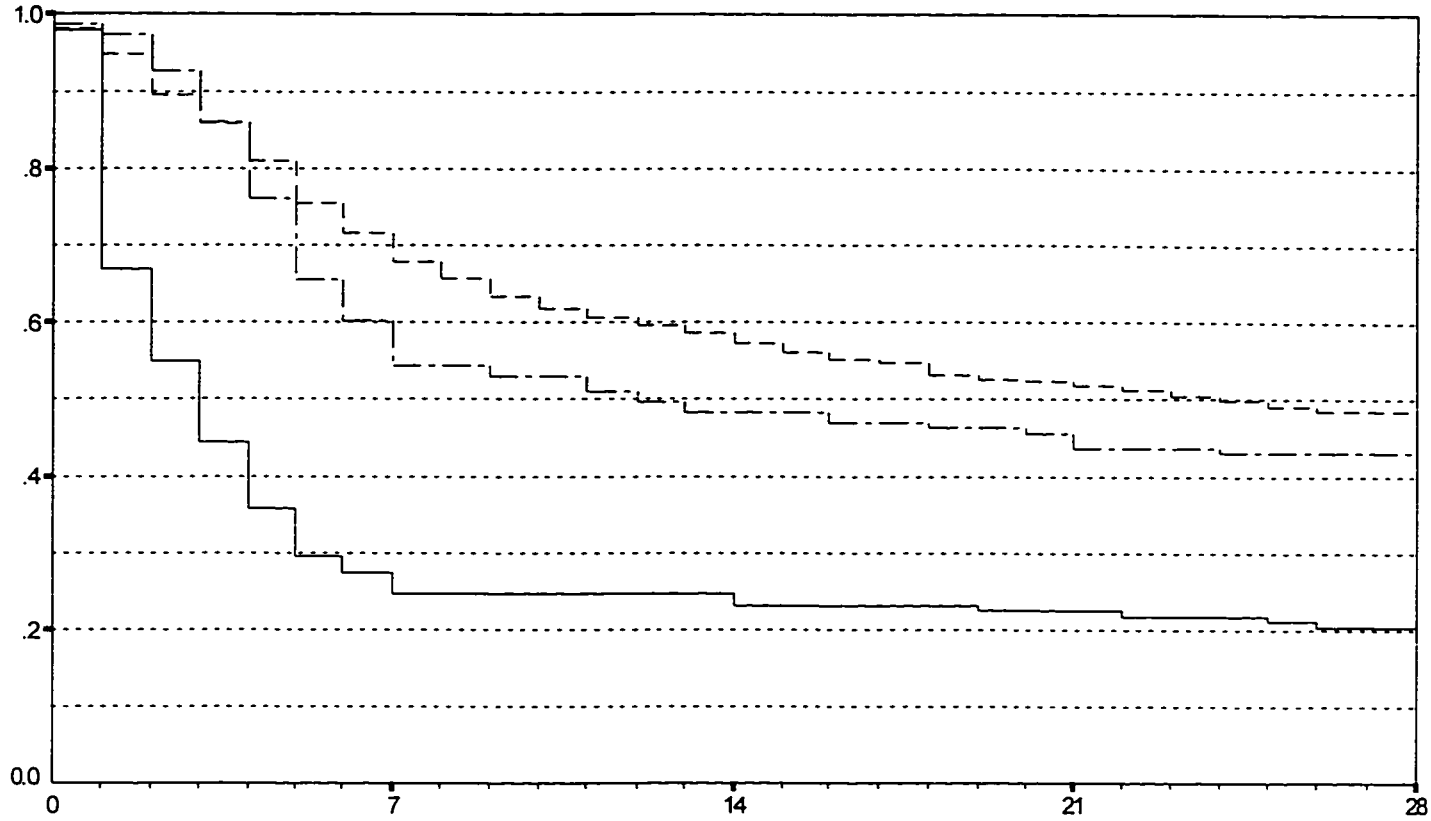


Exhibit 35 Time to discharge summary generation (in days) for all patients eligible for summary generation.

Dictated-cohort summaries (- - - - - - - -) are represented by dashed line; dictated-randomized summaries (- . - . - . - . -) are represented by dash-dot line; database summaries (_____) are represented by solid line. The vertical axis represents the proportion of discharges without a discharge summary. The horizontal axis represents time in days. The Log - Rank test revealed a significant difference between the dictated-randomized and database group ($p<0.0001$). No significant difference was found between the two randomized summaries.

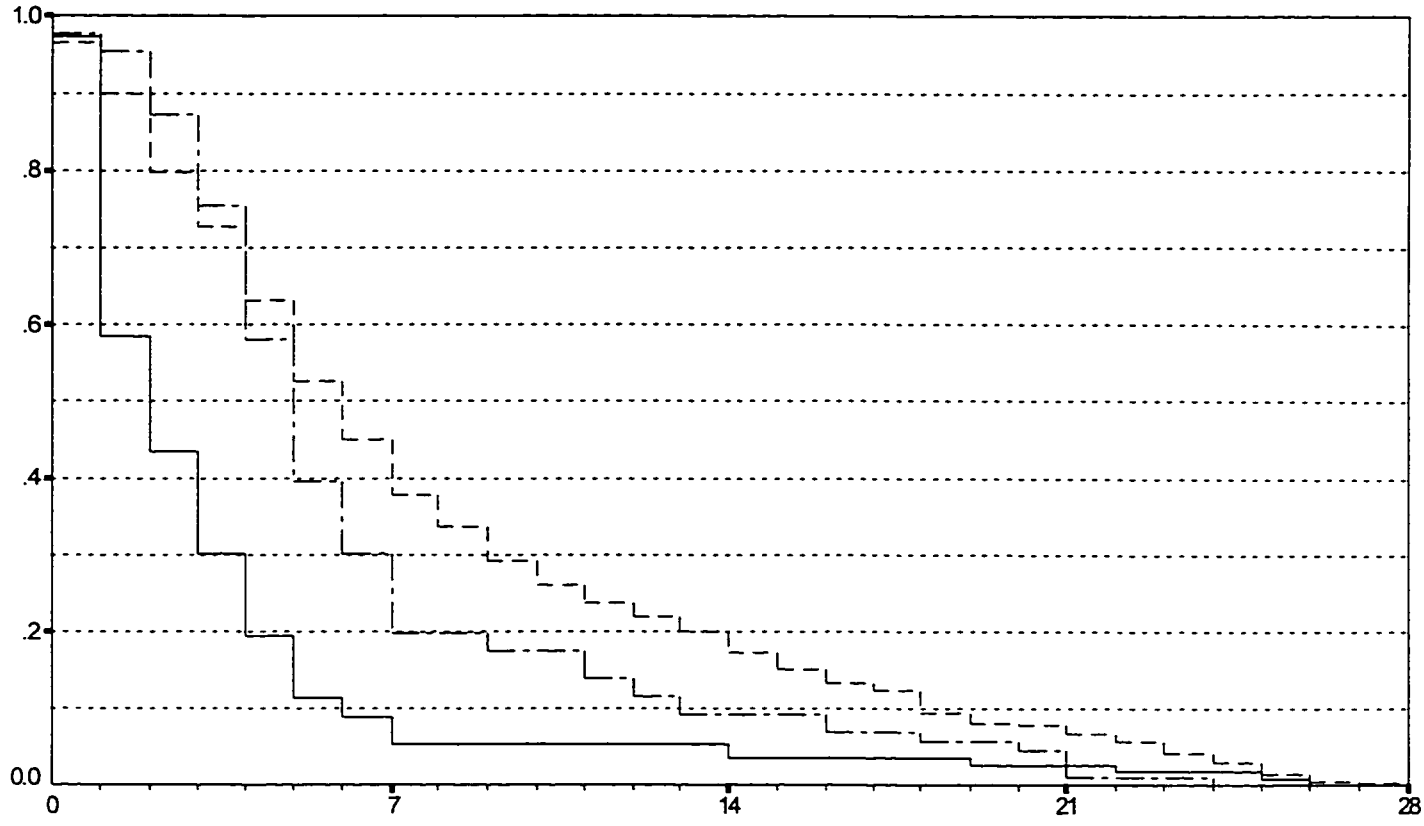


Exhibit 36 Time to discharge summary generation for patients who actually had a discharge summary generated.

Dictated-cohort summaries (- - - - - - - -) are represented by dashed line; dictated-randomized summaries (- . - . - . - . -) are represented by dash-dot line; database summaries (_____) are represented by solid line. The vertical axis represents the proportion of discharges without a discharge summary. The horizontal axis represents time in days. Log - Rank test revealed significant differences between the dictated-randomized and database group ($p<0.0001$), as well as between the dictated - randomized and dictated - cohort group ($p < 0.05$).

	Dictated - Start vs. Dictated - End		Dictated - End vs. Database	
	Scores	P-value	Scores	P-value
Physician Resources				
Time required	44.9 (20.7) vs. 44.5 (23.0)	NS (df - 31)	46.3 (22.4) vs. 65.3 (19.8)	** (df -29)
Burden	45.0 (23.0) vs. 41.8 (22.8)	NS (df - 30)	43.0 (22.4) vs. 65.2 (20.0)	** (df - 28)
Summary Assessment				
Completeness	55.3 (12.7) vs. 64.2 (16.5)	* (df - 28)	67.5 (16.2) vs. 65.8 (17.1)	NS (df - 25)
Pertinence	51.2 (14.2) vs. 58.5 (14.3)	* (df - 28)	57.4 (17.8) vs. 72.7 (15.9)	**** (df - 25)
Organization	51.8 (13.9) vs. 58.9 (15.5)	NS (df - 28)	61.1 (17.0) vs. 72.7 (13.4)	** (df - 25)

Exhibit 37 Attitudes of housestaff participating in randomized portion of study.

The form displayed in Appendix 4 was used to elicit physician opinions prior to being exposed to the database method of summary generation (Dictated - Start). The form displayed in Appendix 24 was used to elicit physician opinions at study end (Dictated - End and Database). Physician resources were measured on a scale from 0 to 100, with a higher number indicating *less* resources were needed. Therefore, physician resources ratings were similar to summary assessment ratings in that "higher is better". All comparisons were made with Student's paired sample t-test. For each comparison, the group's mean score is given with standard deviation. In the next column, the p-value for the comparison is provided along with the number of degrees of freedom for the comparison. The value for the "Dictated - End" scores changes slightly for comparisons with the Dictated - Start and Database groups because scores are not considered if an associated value in the comparitor group is not available. (* $P<0.05$; ** $P<0.01$; *** $P<0.001$; NS - not significant; df - degrees of freedom)

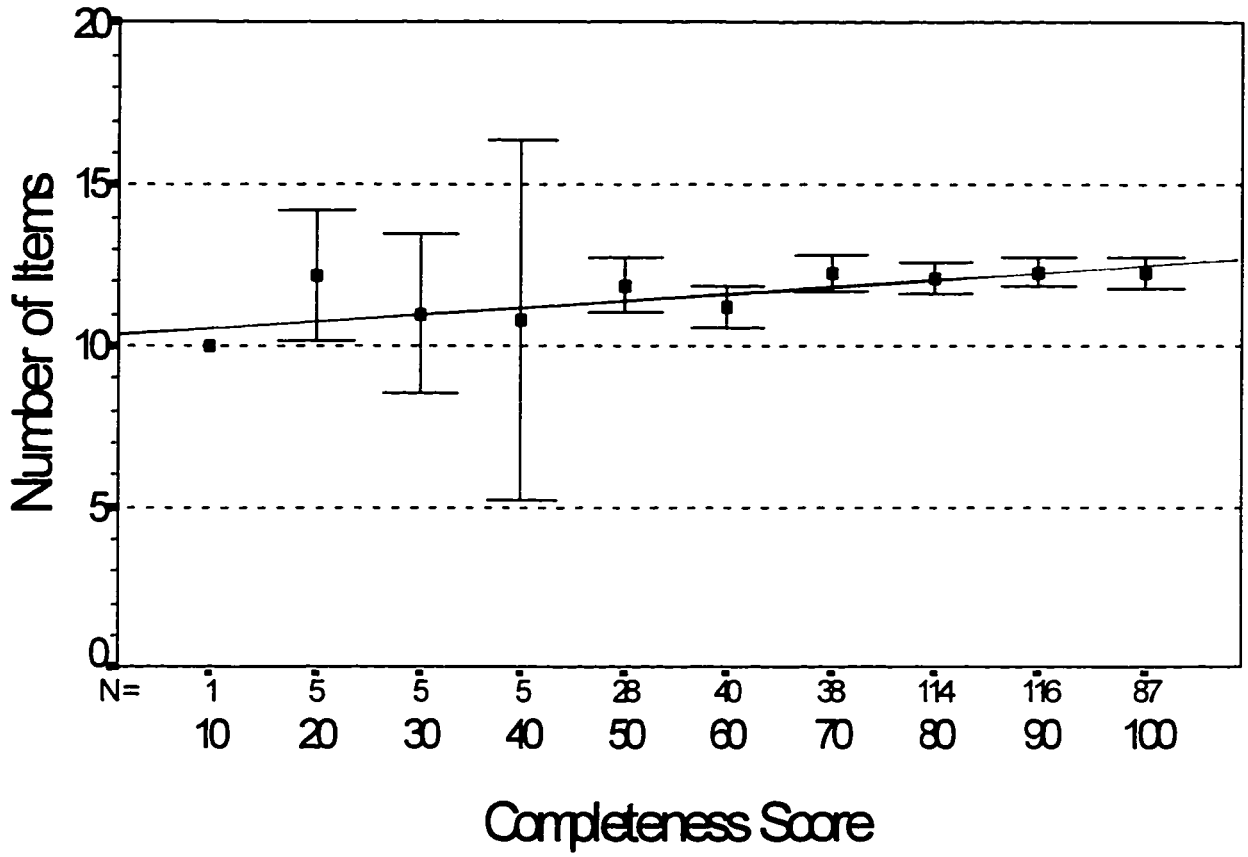


Exhibit 38 Association between completeness score and the number of information items in the discharge summary.

Summaries were grouped so that each category had a score width of 10. The number of summaries in each category is given under the horizontal axis. The mean number of items in each category is given along with the 95% confidence interval. The regression equation line is also provided and its equation is: number of items in the summary = 0.014*(completeness score) +10.96. The P-value of the regression coefficient is 0.02 and the model has an R-square value of 0.01.

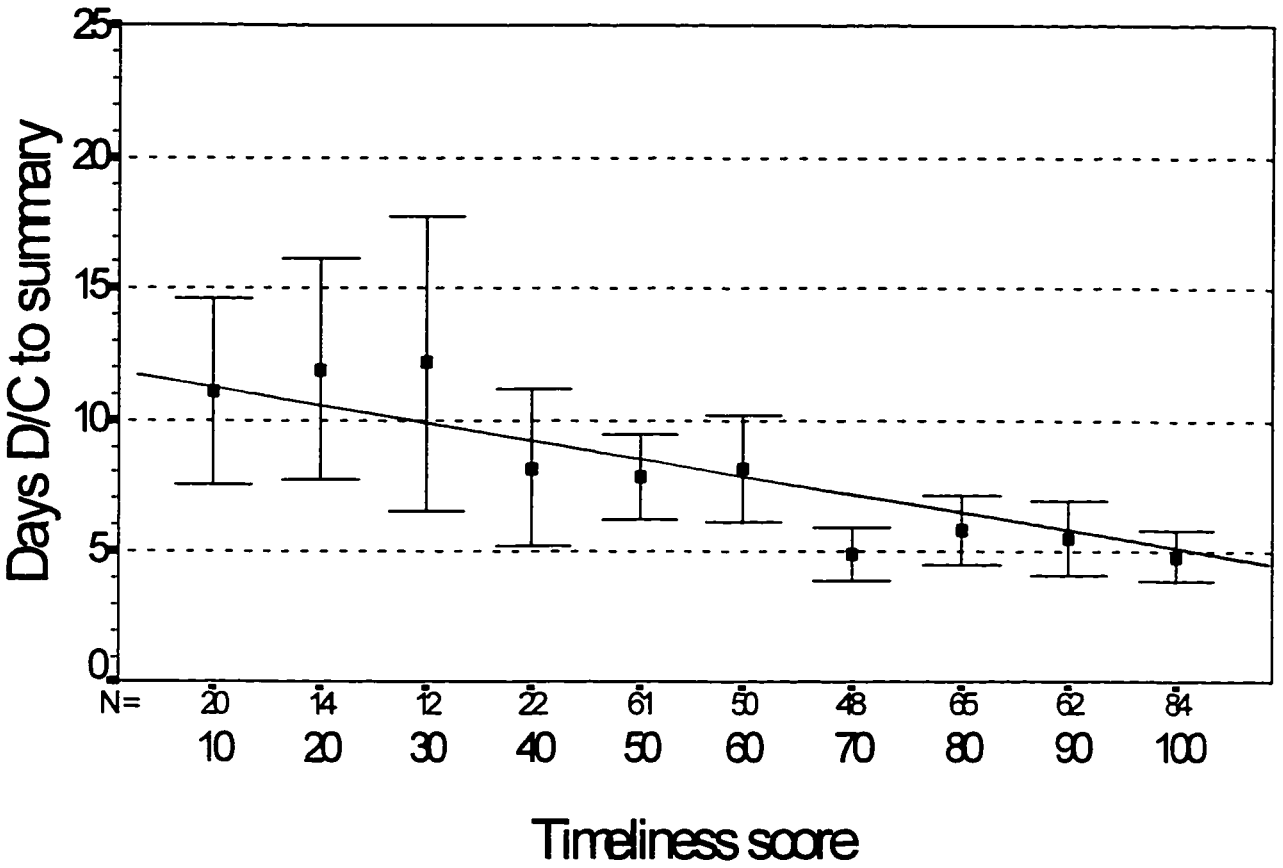


Exhibit 39 Association between timeliness score and the delay between patient discharge and summary creation.

Summaries were grouped so that each category had a score width of 10. The number of summaries in each category is given under the horizontal axis. The mean delay in each category is given along with the 95% confidence interval. The regression equation line is shown and its equation is: delay in summary generation = -0.07*(timeliness score) + 11.62. The P-value of the regression coefficient is less than 0.00001 and the model has an R-square value of 0.1.

Outcome	*Result (DB vs. D-R)*	*Significance*
Probability of summary created within 4 weeks of discharge	79.6% vs. 57.0%	↑↑
Overall quality score - consultants only	64.6 vs. 76.2	↓
Completeness		
Completeness score - consultants only	68.2 vs. 79.5	↓
Apparent summary completeness (% summaries containing information)		
Active past medical history	100% vs. 86.7%	↑↑
Social history	6.2% vs. 37.2%	↓↓
Pre-Admission medications	100% vs. 66.3%	↑↑
Admission vital signs	100% vs. 90.8%	↑↑
Physical examination findings other than vitals and appearance	100% vs. 93.4%	↑↑
Admission diagnosis	0.9% vs. 70.9%	↓↓
Reason for patient admission	0% vs. 14.0%	↓↓
Consultation in hospital	18.6% vs. 40.7%	↓↓
Discharge diagnosis	100% vs. 65.1%	↑↑
Discharge medications	100% vs. 93.0%	↑↑
Fate of admission medications at discharge	94.7% vs. 82.7%	↑
Community services arranged for patient	40.7% vs. 20.9%	↑↑
Functional status at discharge	0.9% vs. 10.5%	↓↓
Pending laboratory investigations	40.7% vs. 9.3%	↑↑
Therapeutic recommendations	28.3% vs. 15.1%	↑
True summary completeness		
Consultations found on chart review in summary	19.0% vs. 46.8%	↓↓
Extreme lab results found on lab review in summary	48.5% vs. 30.1%	↑↑
Diagnostic blood tests found on lab review in summary	30.0% vs. 16.7%	↑
Pertinence		
Lines of text - total number	57.3 vs. 64.8	↓
Lines of text - pre-admission information	24.4 vs. 27.7	↓↓
Lines of text - hospital information	13.5 vs. 22.1	↓↓
Lines of text - discharge information	19.4 vs. 14.9	↑↑
Accuracy		
Procedures in summary found on chart review	66.7% vs. 93.0%	↓↓
Organization		
Organization score - consultants only	69.4 vs. 76.0	↓
Total number of headings	13.1 vs. 8.63	↑↑
% of information items under headings		
Chief complaint	99.1% vs. 52.4%	↑↑
Admission physical examination	100% vs. 94.7%	↑
Treatment in hospital	85.6% vs. 57.3%	↑↑
Procedures	84.8% vs. 66.7%	↑↑
Complications	97.5% vs. 52.4%	↑↑
Pending lab results	80.4% vs. 0%	↑↑
Diagnostic recommendations	57.1% vs. 32.0%	↑
Therapeutic recommendations	75.0% vs. 7.7%	↑↑
Efficiency or Timeliness		
Time to summary generation at 4 weeks	-	↓↓
Housestaff Ratings		
Time required for summary generation *	65.3 vs. 46.3	↑↑
Burden **	65.2 vs. 43.0	↑↑

Exhibit 40 Statistically significant differences between database and dictated - random discharge summaries.

Housestaff ratings were compared with the paired t-test. (* higher rating indicates less time required ** higher rating indicates less burden involved with summary generation) (↑↑ = significantly increased, $P < 0.01$; ↑ = significantly increased, $P < 0.05$; ↓↓ = significantly decreased, $P < 0.01$; ↓ = significantly decreased, $P < 0.05$).

Outcome	*Result (D-R vs. D-C)*	*Significance*
Apparent summary completeness (% summaries containing information)		
Active past medical history	86.7% vs. 93.2%	↓
Inactive past medical history	14.0% vs. 43.7%	↓↓
Discharge medication duration	87.2% vs. 71.3%	↑
Fate of admission medications at discharge	82.7% vs. 54.8%	↑↑
Date of MD follow up (not family MD)	25.4% vs. 12.8%	↑
Functional status at discharge	10.5% vs. 26.0%	↓↓
True Summary Completeness		
Procedures found in chart review in summary	77.1% vs. 58.7%	↑
New medical Rx found in chart review in summary	51.5% vs. 36.9%	↑↑
Accuracy		
Procedures in summary found in chart review	93.0% vs. 75.3%	↑
Organization		
Mean number of headings	8.63 vs. 8.19	↑
% of information items under headings		
Chief complaint	52.4% vs. 64.6%	↓
Active medical problems	98.8% vs. 85.5%	↑
Admission diagnosis	98.4% vs. 87.5%	↑
Discharge medications	97.5% vs. 89.2%	↑
Medical follow-up	96.2% vs. 85.1%	↑
Mean number of misclassifications	0.09 vs. 0.3	↓
Mean number of dyschronologies	0.06 vs. 0.19	↓
Time to actual summary dictation	-	↓

Exhibit 41 Statistically significant differences between dictated - random and dictated - cohort discharge summaries.

(↑↑ = significantly increased, $P < 0.01$; ↑ = significantly increased, $P < 0.05$; ↓↓ = significantly decreased, $P < 0.01$; ↓ = significantly decreased, $P < 0.05$).

Line #	Factor	Estimated Value	Observed Value
1	Mean dictated summary quality up to Mar 3, 1997	74.32	74.9
2	Variance for this estimate	296.95	278.06
3	Median relative minimal important difference	19%	19%
4	Mean database summary quality being sought	88.44	88.44
5	Adjusted mean quality in intervention group	85.00	85.00
6	Type 1 error (2-sided)	0.975	0.975
7	Z-score for type 1 error	1.96	1.96
8	Type 2 error (1-sided)	0.85	0.85
9	Z-score for type 2 error	1.04	1.04
10	Unadjusted total sample size calculation (# summaries with ≥ 1 quality assessment)	93.52	97.89
11	Probability that patient will stay less than or equal to 2 days	0.32	0.25
12	Probability that patient staying ≤ 2 days won't have summary done (dictated summary)	0.85	0.57
13	Probability that patient staying ≤ 2 days won't have summary done (database - estimated)	0.25	0.30
14	Probability that patient stays ≤ 2 days AND no summary done (dictated + database)	0.18	0.11
15	Probability that patient staying > 2 days wont have DICTATED summary done	0.19	0.36
16	Probability that patient staying > 2 days wont have DATABASE summary done (estimated)	0.10	0.17
17	Probability that patient admitted to CTU won't have summary done within 4 weeks of discharge (dictated + database)	0.32	0.375
18	Probability that patient admitted to CTU will die	0.12	0.094
19	Probability that summary won't be sent to eligible responder	0.25	0.11
20	Probability of no response to survey within 4 weeks of summary printing	0.4	0.30
21	Probability that patient admitted to CTU gets transferred to another service	0.06	0.12
22	Sample size adjusted for death	106.0	108.1
23	Sample size adjusted for death and lack of summary	156.5	172.5
24	Sample size adjusted for death, lack of summary and no eligible CC	210.0	193.9
25	Sample size adjusted for death, lack of summary, no eligible CC, and no response to eligible CC's	350.1	276.9
26	Sample size adjusted for death, lack of summary, no eligible CC, no response to eligible CC's, and transfers from medicine	372.4	314.7

Exhibit 42 Comparison of estimates used for the randomized trial sample size calculation and probabilities actually observed during the study.

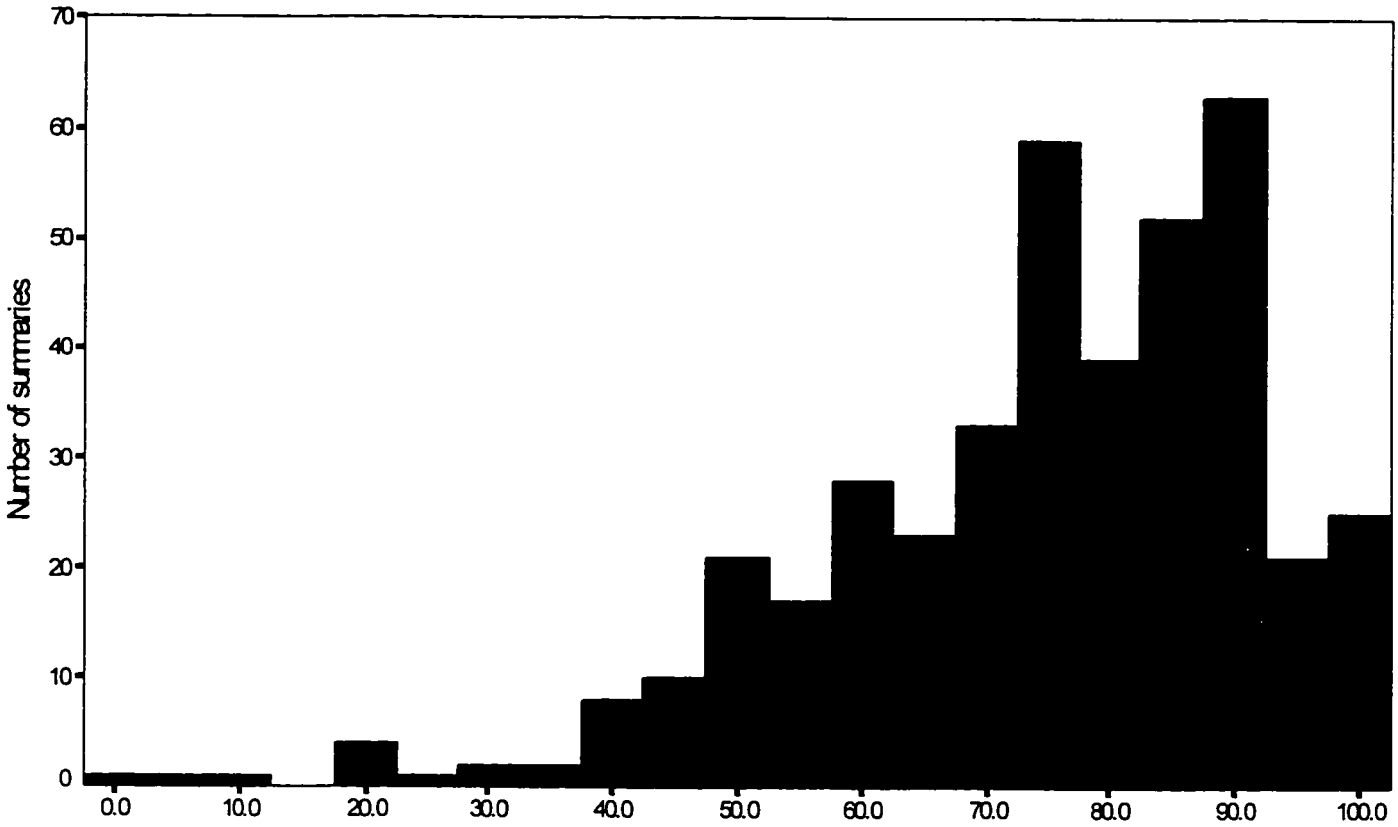


Exhibit 43 Histogram delineating frequency of quality ratings for discharge summaries.

Quality ratings are given on the horizontal axis (divided into categories of 5 mm width) and the number of summaries within each quality rating group is shown. Quality assessments were elicited using the questionnaire shown in Appendix 17. For summaries with more than one assessment, the mean quality rating is given. A sharp drop in summary frequency is seen at a quality of 90 mm.

Author	*Setting*	*Method*	*Design*	*Outcomes*	*Results*
Brazy (1993)	Nursery	Housestaff enter information directly into database.	Survey sent with each CDS asking family MD to compare CDS to DDS	1. Overall preference ordinal scale. 2. Promptness. 3. Ease of data abstraction. 4. Relevance of info for continued patient care.	1. 33/58 family MDs preferred CDS ($p<0.001$) 2. CDS perceived as more prompt, easier to abstract data from, and having improved content.
Adams (1993)	Surgical service	Not described	Survey (without summary) asking family MD to rate CDS and DDS	1. Rating of summary content as "adequate", "inadequate" or "excessive"	1. CDS: content adequate - 62%; inadequate 8%; 2. DDS: content adequate - 52%; inadequate - 35%.
Castledon (1992)	Surgical service	Housestaff complete forms, dx's coded and entered into DB by secretary	Survey to all family MD's receiving > 5 CDS	1. % family MDs noticing change in summary or summary improvement.	1. 64/86 noted change in summary. 2. 56/64 (87.5%) thought CDS was improvement.
Smith (1989)	Obstetrics / Gyne ward	Housestaff complete "tick-off" form and reviewed by staff; data entry by secretary.	Analyzed >100 consecutive D/C's before and after database introduced	1. Time to summary generation	1. DDS 20.9 days vs. CDS 3.8 days ($p<0.001$). 2. 22/104 (21.1%) charts had no CDS; all charts had DDS
Lissauer (1990)	Nursery	Housestaff enter data into database; ICD codes attached to dx'es and ranked for importance by MD.	CDS compared to DDS created by senior registrar; summaries reviewed by study author; CDS not sent to patients.	1. % summary completion. 2. Summary content compared to a-priori list. 3. Chart reviewed to determine most important Dx'es. 4. "Readability" on 10 point scale. 5. Suitability of CDS for parents (subjective)	1. Summary completion: CDS: 130/133 (97.7%); DDS 94/133 (71%) 2. # incomplete content categories / summary: CDS 5.38; DDS 0.72 3. CDS less readable (6/10 vs. 8/10). 4. 88% of DDS suitable for parents

Exhibit 44 Summary of published studies comparing computer (CDS) and dictated (DDS) discharge summaries.

All studies collated information from a database into a discharge summary. The setting, design, outcomes, and results of each study is provided. P-values are not provided if study did not perform statistical analysis. (Dx - Diagnosis; MD - physician).

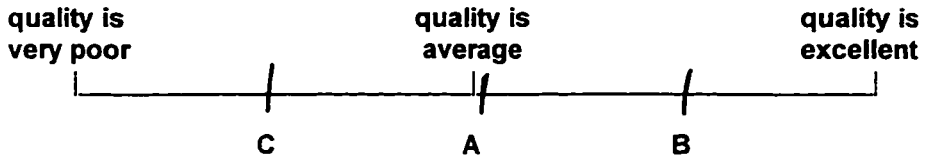
We've enclosed 3 discharge summaries and would like you to rate their quality.

The line below represents discharge summary quality and extends from "**quality is very poor**" on the left, through "**quality is average**" in the middle, to "**quality is excellent**" on the right.

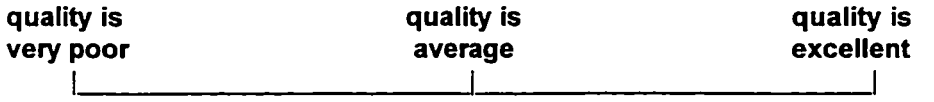
For example, assume that the summaries in your package are labeled A, B, and C. After reading them you think that:

- A's quality is slightly above average
- A's quality is not as good as B's quality (which is almost excellent)
- A's quality is definitely better than C's quality (which is below average).

Your scalings would look like this:



Please read the enclosed summaries and indicate their quality on the line below. Remember, ***a high-quality discharge summary efficiently communicates information necessary for ongoing care by the patient's family physician.***



Thanks for your time taken in completing this survey.

Appendix 1: Form used for rating quality of discharge summaries.

The survey is described in section 1.5. The form accompanied three discharge summaries. Respondents read the summaries and rated their quality on the visual analogue scales.

- The scales below allow you to rate 3 attributes - content, length, and organization - for your summary.
- Each scale goes from 0 (**TERRIBLE**) through 50 (**ACCEPTABLE**) to 100 (**EXCELLENT**). Our definitions of these qualifiers are:
    - **TERRIBLE** = attribute could not be worse
    - **ACCEPTABLE** = attribute is at an expected or average level
    - **EXCELLENT** = attribute could not be better
- Place a vertical mark across the line to rate each attribute of ***this*** discharge summary:

	TERRIBLE 0	ACCEPTABLE 50	EXCELLENT 100
summary content	|_____	_____|_____	_____|
summary length	|_____	_____|_____	_____|
summary organization	|_____	_____|_____	_____|

This is our definition of discharge summary '**quality**':

A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician

Using the same definitions of terrible, acceptable and excellent, rate the **quality** of your summary on the scale below:

QUALITY IS TERRIBLE 0	QUALITY IS ACCEPTABLE 50	QUALITY IS EXCELLENT 100
|_____	_____|_____	_____|

We need to determine the **smallest** improvement in discharge summary quality that is clinically important. Mark an **X** on the above scale to show the smallest increase in quality that you consider important.

Appendix 2: Form used to measure overall summary quality and its components.

This form was used in second survey described in section 1.5. The form was modified from Appendix 1 after results from that survey were considered. One of five discharge summaries accompanied the survey. Respondents read the summary and rated the content, length, organization, and quality. The minimal important difference was the smallest increase in summary that the respondent considered important.

REPORT REQUIREMENTS	* 1	* 2,4,	* 3,6,8
Name of person dictating (if not a staffman, state for whom you are dictating).	✓	✓	✓
Identify Work Type.	✓	✓	✓
Patient's Unique Number and patient's full name (AND SPELL) slowly.	✓	✓	✓
Location of patient (Ward, Surgical Day Care, ACU Clinic, G.I. Unit, etc.). This is important so that report gets to the right location and on the right chart.		✓	✓
Date of Admission and of Discharge.	✓		
Date of Surgery.		✓	
Date of Consultation.			✓
Number of copies and to whom. (Please include name and address, if physician is not on staff).	✓	✓	✓
Surgeon's Name, Assistant's Name (if applicable) and Anesthetist's Name		✓	
Pre-operative Diagnosis		✓	
Post-operative Diagnosis		✓	
Operative Procedure (s)		✓	
Most Responsible Diagnosis - This is defined as the one diagnosis which causes the greatest length of stay in hospital for the patient.	✓		
Primary Diagnosis (es) - This describes another managed condition of the patient which had an influence on the patient's length of stay.	✓		
Complication (s) - This describes a condition arising after the beginning of hospital observation and/or treatment (having an influence on the patient's length of stay).	✓		
Principal Procedure - The procedure considered to be the most significant during the patient's hospital stay.	✓		
Pertinent History.	✓		
Clinical Note.		✓	
Description of Procedure - Should include the course and condition of patient at the conclusion.		✓	
Physical Examination.	✓		
Investigations - Laboratory and radiological findings which are proof of diagnosis and/or complications, etc.	✓		
Course in Hospital - Treatment Instituted and/or Surgery Performed.	✓		
Body of report (procedures, findings, impression and plan)			✓
Medications on Discharge and plans for ongoing care.	✓		
Condition on Discharge.	✓		
Impression and Plan		✓	

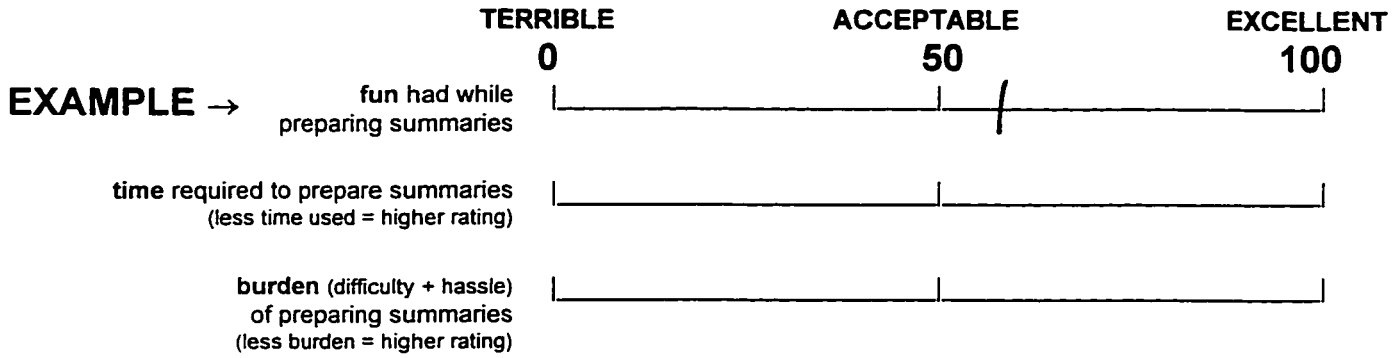
* WORK TYPES:
1 - Discharge Summary
2 - Operative Reports (Other than ACU)
3 - ACU Consultations
4 - ACU Operative Reports
6 - G.I. 100 000 0 Consultations
8 - Consultations (Other than ACU)

Appendix 3: Information sheet given to housestaff suggesting content for narrative summaries.

Information on the dictation system used for the summary's production was also provided.

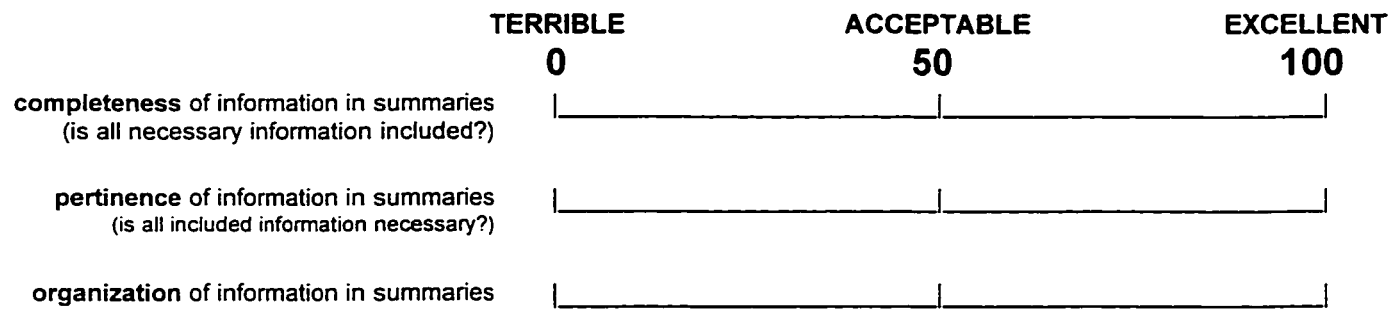
2. PREPARING DISCHARGE SUMMARIES

- The scales below let you rate 2 attributes of *medical* discharge summary preparation .
- The attributes are **time used** and the **burden of** preparing summaries.
- Each scale goes from 0 (**TERRIBLE**) through 50 (**ACCEPTABLE**) to 100 (**EXCELLENT**). Our definitions of these qualifiers are:
  - **TERRIBLE** = attribute could not be worse
  - **ACCEPTABLE** = attribute is at an expected or average level
  - **EXCELLENT** = attribute could not be better
- Use a vertical line | to give an **OVERALL** rating of the discharge summaries you've done.



3. ASSESSING DISCHARGE SUMMARIES

- How many medical summaries have you read in the last month: _____
- Use a vertical line (|) to rate the completeness, pertinence, and organization of medical discharge summaries. Use the same definitions of TERRIBLE, ACCEPTABLE, and EXCELLENT.



Appendix 4: Questionnaire completed by housestaff prior to participating in the randomized portion of the study.

Survey was administered to assess their current attitudes to discharge summaries.

OTTAWA CIVIC HOSPITAL
1053 CARLING AVENUE
OTTAWA, ONTARIO
K1Y 4E9

XX DISCHARGE SUMMARY
OPERATIVE NOTE
CONSULTATION
DATE FORMAT = YY/MM/DD

UNIQUE No.: [redacted]
REGISTER No.:
PATIENT NAME: [redacted]
LOCATION: [redacted]
ADMISSION DATE: 1997/[redacted]
DISCHARGE DATE: 1997/[redacted]
SURGERY/CLINIC DATE:
SERVICE/CLINIC:
PHYSICIAN: [redacted]

COPY SENT: Dr. [redacted], Queensway-Carleton Hospital

MOST RESPONSIBLE DIAGNOSIS: COPD exacerbation, complicated by multifocal atrial tachycardia and right heart failure.

HISTORY:
Mr. [redacted] is an [redacted]-year-old white man who has worked 32 years as a smelter, has had a past history of COPD for three years, peptic ulcer disease for four years and a recent osteoarthritis in the right hand. He was admitted to the Queensway-Carleton Hospital two weeks ago for increasing shortness of breath. He was given Ventolin masks but no antibiotics. This was discontinued after three days but things did not get any better. He went to see Dr. [redacted] who started him on Theo-Dur 200 mg b.i.d. for a few days.

He presented to us with the same complaint of shortness of breath on exertion, not getting any better. The patient had been on home O_2 for three years, on bronchodilators and on Prednisone. The patient had shortness of breath on exertion, no orthopnea, no PND. There was no cough or productive sputum. There were no fevers or chills, no chest pain, no past medical history of asthma or allergies. He did smoke two packs a week for many years. There was no history of any infectious contacts or any history of aspiration.

PHYSICAL EXAMINATION:
He was afebrile with a normal blood pressure. His pulse was 120 and his respirations were 40. He was satting at 65% on room air and satting 89% on 5 liters per minute of oxygen. He was alert and oriented x 3. Head and neck was unremarkable. He had a barrel chest but was not using any accessory muscles. There was a decreased lung and chest expansion, decreased breath sounds bilaterally. There were no inspiratory crackles or expiratory wheeze, although this was post Ventolin mask. His pulse was at 120 with an irregularly irregular rhythm and no murmurs. JVP was normal. There was some peripheral edema. Peripheral pulses were present. The abdomen was unremarkable and the digital exam was normal. MSK revealed no real osteoarthritic changes. Examination of the skin revealed a nevus on the back and front of the chest showing some irregularity. There was nail clubbing on both hands.

LABORATORY DATA:
CBC was normal. There was a slightly elevated glucose of 8.9. ABG showed acidemia due to respiratory acidosis which was compensated. The EKG showed a multifocal atrial tachycardia. Spirometry post Ventolin revealed an FVC of 37%, FEV1 14%, FEV1/FVC 37%. An x-ray showed calcified lymph nodes with a right middle lobe collapse. CT scan didn't show any malignancy.

COURSE IN HOSPITAL:
This showed a slow recovery from his COPD exacerbation which was treated with Salbutamol and Ipratropium used by nebulizer q.4h. straight and using IV Solu-Medrol for a few days, then turning to Prednisone per os.

MEDICATIONS ON DISCHARGE:
Prevacid, 30 mg once daily.

Appendix 5: Example of a dictated discharge summary (first page).
The patient's unique identifiers have been removed.

OTTAWA CIVIC HOSPITAL
1053 CARLING AVENUE
OTTAWA, ONTARIO
K1Y 4E9

XX DISCHARGE SUMMARY
OPERATIVE NOTE
CONSULTATION
DATE FORMAT = YY/MM/DD

UNIQUE No.: [redacted]
REGISTER No.:
PATIENT NAME: [redacted]
LOCATION: [redacted]
ADMISSION DATE: 1997/[redacted]
DISCHARGE DATE: 1997/[redacted]
SURGERY/CLINIC DATE:
SERVICE/CLINIC:
PHYSICIAN: DR. D. L. O'KEEFE

Septra, 2 tabs b.i.d. x 7 days.
Ventolin, 5 mg.
Atrovent, 500 micrograms by nebulizer mask every four hours while awake.
Per os Prednisone 40 mg once daily every morning, tapering dose.
Losec, 30 mg once daily per os.
Home oxygen was organized at 2.5 liters per minute titrated between 88 and 92%.
Lorazepam, 0.5 mg q.h.s. prn for sleep.

PLAN:
He is to follow-up with Dr. [redacted].

Dictated by: [redacted]/jb
D: 1997/05/06
T: 1997/05/09 [redacted]

THIS DOCUMENT HAS BEEN DICTATED BUT NOT READ. PHYSICIAN AUTHENTICATION WILL OCCUR WITHIN 10 DAYS OF TRANSCRIPTION DATE.

Job Id: 8677

Page 2 of 2

Appendix 6: Example of a dictated discharge summary (second page).

The patient's unique identifiers have been removed.

HISTORY AND PHYSICAL EXAMINATION
Medicine

Date (d/m/y) Time :

Name : Age :

ACTIVE *PRE-ADMISSION* MEDICAL PROBLEMS

Year of Onset	Problem

HISTORY OF PRESENTING ILLNESS *SUMMARY*

Chief complaint:

Duration of complaint:

Associated symptoms (with duration):

HISTORY OF PRESENTING ILLNESS

CH-FM (11/96) TRIAL CHART COPY

Appendix 7: First page of the admission history and physical form.

Data in the following fields were entered into corresponding fields in the database: active past medical history; presenting complaint; duration, and associated symptoms.

MEDICATIONS ON ADMISSION

Medication (include dose and freqency)	Medication (include dose and freqency)

RESOLVED MEDICAL PROBLEMS AND SURGERIES

ADVERSE REACTIONS/ALLERGIES

SOCIAL + FAMILY HISTORY

FUNCTIONAL INQUIRY / REVIEW OF SYSTEMS

General/Habits

Head + Neck

Respiratory

Cardiovascular

Gastrointestinal

Genito-urinary

Musculoskeletal

Neurological

Endocrine

Skin

CH-FM Page 2

Appendix 8: Second page of the history and physical form.
Data in the following fields were entered into corresponding fields in the database: medications on admission.

PHYSICAL EXAMINATION

Temp _____ °C | B.P ☐ Lying ☐ Sitting Right _____/_____ Left _____/_____ ☐ Sitting ☐ Standing _____/_____ | Pulse _____ / min Rhythm _____ | Resp. _____ / min FiO_2 _____ O_2 Sat _____ % | Wt. _____ kg Ht. _____ m

GENERAL APPEARANCE AND BEHAVIOUR

CHECK BOX IF EXAMINED AND NORMAL

HEAD + NECK

☐ Sclera ☐ Pupils
☐ Conjunctiva ☐ Fundi
☐ Teeth ☐ Pharynx
☐ Ears
☐ Lymph nodes ☐ Thyroid

CHEST

☐ Shape ☐ Movement
☐ Percussion ☐ Auscultation
☐ Axillary nodes ☐ Breasts

CARDIOVASCULAR

☐ Internal jugular veins
☐ Carotid artery
☐ Precordial movement
☐ Apex ☐ Heart sounds
☐ Peripheral pulses ☐ Peripheral veins

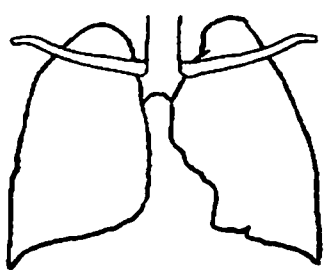
ABDOMEN

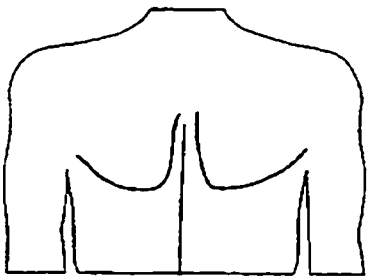
☐ Inspection ☐ Bowel sounds
☐ Palpation ☐ Percusion
☐ Inguinal nodes ☐ Digital recta

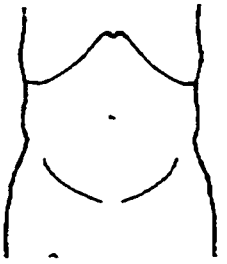
GENITO-URINARY

☐ Penis ☐ Vagina
☐ Testes ☐ Cervix
☐ Prostate ☐ Bimanual exam

DESCRIPTION OF ABNORMAL FINDINGS







CH-FM Page 3

Appendix 9: Third page of the history and physical form.
Data in the following fields were entered into corresponding fields in the database: vital signs; general appearance; abnormal physical findings.

CHECK BOX IF EXAMINED AND NORMAL

MUSCULOSKELETAL

- ☐ Hands
- ☐ Wrists
- ☐ Elbows
- ☐ Shoulder
- ☐ Spine
- ☐ Hips
- ☐ Knees
- ☐ Feet

NERVOUS SYSTEM

- ☐ Orientation
- ☐ Memory
- ☐ Concentration
- ☐ Speech
- ☐ Mood
- ☐ Behaviour

CRANIAL NERVES ☐ Visual Fields

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12

MOTOR

- ☐ Bulk
- ☐ Tone
- ☐ Power
- ☐ Coordination
- ☐ Gait

REFLEXES R L

- ☐ Triceps
- ☐ Biceps
- ☐ Knee
- ☐ Ankle
- ☐ Plantar

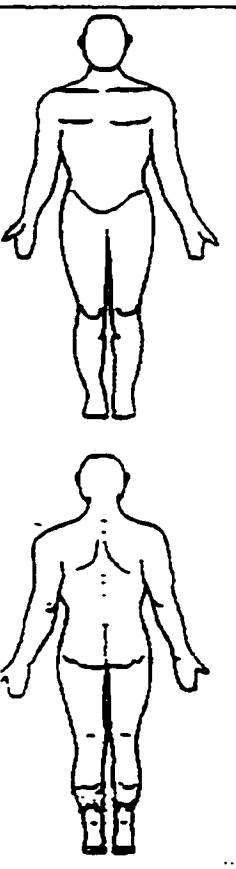
SENSATION

- ☐ Pain
- ☐ Temp.
- ☐ Light touch
- ☐ Position
- ☐ Vibration
- ☐ Other

SKIN

- ☐ Hair
- ☐ Nails
- ☐ Color

DESCRIPTION OF ABNORMAL FINDINGS



INVESTIGATIONS (write numbers on watermark)

Glu
Urea
Cre

INR : _____
PTT : _____
MCV : _____

ABG : pH / pCO_2 / pO_2 / HCO_3 / % sat / FiO_2

CXR :

ECG :

SPIROMETRY :

URINALYSIS

OTHER INVESTIGATIONS

CH-FM Page 4

Appendix 10: Fourth page of the history and physical form.

Data in the following fields were entered into corresponding fields in the database: abnormal physical findings.

Ottawa Civic Hospital
Division of General Internal Medicine
Database Discharge Summary - Hospital Info

WHEN PATIENT IS DISCHARGED, COMPLETE THIS FORM + SIGN	
NAME	DATE:
SIGN	

A. PROBLEMS AT ADMISSION → TREATMENT
1) →
2) →
3) →
4) →

B. PROBLEMS AFTER ADMISSION / COMPLICATIONS → TREATMENT
1) →
2) →
3) →

C. PERTINENT **INVESTIGATIONS** DONE DURING ADMISSION (INCLUDE TEST DATES IF NECESSARY)

BIOCHEMISTRY:	HEMATOLOGY:	MICROBIOLOGY:
TEST + RESULT	TEST + RESULT	TEST + RESULT
	CXR:	
	ECG:	
	OTHER INVESTIGATIONS:	

D. OTHER IMPORTANT INFORMATION:

Appendix 11: Hospital summary form.

Housestaff documented hospital information which they felt was important for the discharge summary in the appropriate section of the form. The form was printed on heavy grade yellow paper and measured 8.5 by 11 inches.

Ottawa Civic Hospital
Division of General Internal Medicine
Dear Doctor Letter and
Database Discharge Summary - Discharge Info

1. Give carbon of completed form to patient as Dear Doctor Letter.
2. ***Make sure*** yellow Hospital Info form is complete and signed.

MOST RESPONSIBLE DIAGNOSIS:		
OTHER DX'S THAT INCREASED PATIENT'S LENGTH OF STAY	1.	3.
	2.	4.
	3.	6.
OTHER DX'S TREATED OR MONITORED IN HOSPITAL	1.	4.
	2.	5.
	3.	6.
PROCEDURES + SURGERIES	1.	3.
	2.	4.
DISCHARGE MEDICATIONS (W DURATION)	1.	8.
	2.	9.
	3.	10.
	4.	11.
	5.	12.
	6.	13.
	7.	14.
ARRANGED MEDICAL - :	1.	
	2.	
	3.	
ARRANGED COMMUNITY SERVICES:		
PENDING INVESTIGATIONS:		
RECOMMENDATIONS OR ISSUES THAT MAY NEED ATTENTION AFTER DISCHARGE:		
SEND COPY OF SUMMARY TO: (GIVE NAME + ADDRESS)	1.	
	2.	
	3.	
NAME (PRINT):	SIGNATURE:	DATE:

Appendix 12: Database "Dear Doctor" Letter.

It was printed on carbonless paper and measured 8.5 by 11 inches. Housestaff completed the form when the patient was discharged and gave the carbon to the patient for hand delivery to the family physician.

OTTAWA CIVIC HOSPITAL
1053 CARLING AVENUE
OTTAWA, ONTARIO
K1Y 4E9

XX DISCHARGE SUMMARY
OPERATIVE NOTE
CONSULTATION
DATE FORMAT = DD/MM/YY

UNIQUE NO: [redacted]
REGISTER NO:
PATIENT NAME: [redacted]
LOCATION
ADMISSION DATE [redacted]
DISCHARGE DATE: [redacted]
SURGERY/CLINIC DATE:
SERVICE/CLINIC:
PHYSICIAN [redacted]

COPY SENT [redacted]

HISTORY OF PRESENTING ILLNESS: This is a 72 year old female who presented to the Ottawa Civic Hospital on 22 March 1997 with decreased appetite x 1-2 weeks. Associated symptoms: confusion x 3-4 days.

ACTIVE PRE-ADMISSION MEDICAL PROBLEMS:
Hypothyroidism
Leg swelling

MEDICATIONS ON ADMISSION:
Eltroxin 0.1 mg o.d.
Lasix

PERTINENT FINDINGS ON PHYSICAL EXAMINATION:
Vitals: Temp: 35.4°C. B.P. 112/056 mmHg in the right arm . Pulse: 069/min. RR: 020/minute
Head & Neck: marked stare; pupils slightly proptatic; neck supple.
Abdomen: normal bowel sounds; no rigidity or guarding but diffusely tender.
Musculoskeletal: diffuse tenderness in both legs with venous stasis; no ulcer or cellulitis.
Nervous System: alert but oriented x 1 only; memory 1/3; able to follow simple commands; EOM normal; pupils equal and reactive to light.

PERTINENT INVESTIGATIONS IN HOSPITAL:
Biochemistry. TSH 38.8; Na 144; K 3.1 (admit); HCO3 34 (admit); albumin 26; AST 92; ALP 184.
Hematology: WBC 16.4; Hg 107; MCV 116.
Microbiology: Urine C+S - E. coli; stool C diff +ve; sputum C+S - Moraxella catarahallis.
CXR: normal.
ECG: old inferior MI.
Other investigations: vit B12 422; RBC folate 347.

PROBLEMS AT ADMISSION & TREATMENT:
Dehydration: volume replacement with IV fluids; lasix discontinued.
Hypothyroidism: L-thyroxine dose increased.
Hypokalemia: K+ replacement.
? Early Korsakoff's: no treatment.

PROBLEMS AFTER ADMISSION & TREATMENT:
C. difficile colitis: Flagyl 500 mg TID x 10 days.
Hyperkalemia: insulin IV, D50W (glucose), kayexalate.

MOST RESPONSIBLE DIAGNOSIS:
Volume depletion.

OTHER DIAGNOSES THAT INCREASED PATIENT'S LENGTH OF STAY:
C. difficile colitis
Bronchitis
? Early Korsakoff's
Urinary tract infection

Appendix 13: Example of a database discharge summary (first page).

The patient's unique identifiers have been removed.

OTTAWA CIVIC HOSPITAL
1053 CARLING AVENUE
OTTAWA, ONTARIO
K1Y 4E9

XX DISCHARGE SUMMARY
OPERATIVE NOTE
CONSULTATION
DATE FORMAT = DD/MM/YY

UNIQUE NO: [redacted]
REGISTER NO:
PATIENT NAME: [redacted]
LOCATION:
ADMISSION DATE: [redacted]
DISCHARGE DATE: [redacted]
SURGERY/CLINIC DATE:
SERVICE/CLINIC:
PHYSICIAN: [redacted]

OTHER DIAGNOSES TREATED IN HOSPITAL:
Hypothyroidism

DISCHARGE MEDICATIONS:
Eltroxin 0.15 mg o.d.
Flagyl 500 mg t.i.d. x 3 days
Multivits 1 tablet o.d.
Folic acid 5 mg o.d.

MEDICAL FOLLOW-UP:
To be seen by GAU as outpatient, outreach team arranged.

ARRANGED COMMUNITY SERVICES:
Home care.

PENDING INVESTIGATIONS:
None.

RECOMMENDATIONS or MEDICAL ISSUES POTENTIALLY NEEDING ATTENTION:
TSH should be recheced in 4 weeks; alcohol use; vitamin B12 injection; Anorexia; patient should be checked for C diff. toxin if diarrhea recurs.

Completed By [redacted]
Date Printed 4 April 1997 [redacted]

THIS DOCUMENT HAS BEEN ELECTRONICALLY GENERATED BUT NOT READ. PHYSICIAN AUTHENTICATION WILL OCCUR WITHIN 10 DAYS OF PRINTED DATE.

Appendix 14: Example of a database discharge summary (second page).

The patient's unique identifiers have been removed.

THIS PATIENT
HAS BEEN RANDOMIZED
TO A

DICTATED

DISCHARGE SUMMARY

Make sure you:

1. Dictate the summary when you discharge the
2. Send a copy of the summary to <u>all</u> physicians in the patient's care.
3. Only include information in the summary that you necessary to continue the patient's care.
4. Complete the front sheet.

Appendix 15: Form placed in chart of patients randomized to a narrative discharge summary.

Form was printed on paper identical to that of Appendix 11 and measure 8.5 by 11 inches.

INTERIM DISCHARGE REPORT
OTTAWA CIVIC HOSPITAL
1053 Carling Avenue
Ottawa, Ontario
K1Y 4E9

Date: _____

Dear Doctor _____ :

_____ was a patient at the Ottawa Civic Hospital

from _____ to _____ . The following is a summary of his / her admission under

the service of Dr. _____

DISCHARGE DIAGNOSIS: _____

_____

_____

MANAGEMENT AND INVESTIGATIONS:

_____

_____

_____

DISCHARGE MEDICATIONS:

1. _____ 5. _____

2. _____ 6. _____

3. _____ 7. _____

4. _____ 8. _____

RECOMMENDED FOLLOW-UP:

_____

_____

_____

_____

A detailed summary will follow.

_____
(Signed)

_____
(Print Name)

74011 (REV 11 90)

Appendix 16: Interim discharge letter used for patients randomized to a dictated discharge summary.

Form was printed on non-carbonless paper to allow a copy to be hand delivered by the patient to their family physician.

1. What is your relationship with this patient?

|__| I am this patient's **primary-care physician**

|__| I am involved in this patient's care but I am **not** his / her primary-care physician

|__| I am **not involved** in this patient's care

2. The scales below allow you to rate 4 attributes of this discharge summary:

- The attributes are **completeness**, **pertinence** and **organization** of information, and **time from patient discharge to summary receipt**.
- Each scale goes from 0 (**TERRIBLE**) through 50 (**ACCEPTABLE**) to 100 (**EXCELLENT**). Our definitions of these qualifiers are:
  - **TERRIBLE** = attribute could not be worse
  - **ACCEPTABLE** = attribute is at an expected or average level
  - **EXCELLENT** = attribute could not be better
- Place a vertical mark across the line to rate each attribute of ***this*** discharge summary:

	TERRIBLE 0	ACCEPTABLE 50	EXCELLENT 100
EXAMPLE → **font-style used for typing summary**	|———	———	——|
completeness of information in summary (was all necessary information included?)	|———	———	——|
pertinence of information in summary (was all included information necessary?)	|———	———	——|
organization of information in summary	|———	———	——|
time from patient discharge to summary receipt	|———	———	——|

3. We need a rating of this summary's overall quality. This is our definition of discharge summary '**quality**':

A high-quality discharge summary efficiently communicates information necessary for continuing patient care by another physician

Using the same definitions of TERRIBLE, ACCEPTABLE and EXCELLENT as per question **2**, please rate the **overall quality** of ***this*** discharge summary:

QUALITY IS TERRIBLE 0	QUALITY IS ACCEPTABLE 50	QUALITY IS EXCELLENT 100
|———	———	——|

Appendix 17: Physician questionnaire used to measure discharge summary quality and its components.

The questionnaire was printed on 8.5 by 11 sized paper. For each visual analogue scale, the distance from 0 to the responders mark was measured in millimeters for that domain's score. Question #3 (summary quality) was the study's primary outcome.

Last Name	Unique #	D/C date:			
		NO	YES	DNA	Heading?
chief complaint / presenting clinical problem / reason for referral					n y
history of presenting illness (HPI)					
active medical problems on admission					n y
#1	#2	#3			
ORGANIZATION	inactive med or surg problems included?				
Total # of Headings:	family medical history				
ϕ Total # Misclassifications:	social history				
Δ Total # Dyschronologies:	meds on **Any Mention?**				n y
	Name				
Adm Dx:	**Dose**				
	Frequency				
	P/E on admission: **Any Mention?**				n y
All Rx in Hosp:	**Appearance**				
	Vital Signs				
	Rest of Exam				
	← admitting Dx				n y
	reason for admission is stated				n y
	reason for adm. implicit given hpi + p/e				
	treatment in hospital				n y
← **diagnostic** procedures in hospital					n y
← **therapeutic** procedures in hospital					n y
complications in hospital					n y
#1	#2				
consultations in hospital					n y
#1 **staffname?** n y	#2 **staffname?** n y				
#3 **staffname?** n y	#4 **staffname?** n y				
discharge diagnosis (not listed as active medical problems)					n y
#1	#2				
discharge medications **Any?**					n y
Name					
Dose					
Frequency					
(only if at least one of d/c meds is antibiotic or anticoagulant) **Duration**					
Was fate of all pre-admission medications accounted for at D/C?					
was pt. transferred to another inpatient facility other than nursing home?					
medical follow-up					n y
was pt to get f/u with MD other than fam MD?					
name of other follow-up MD given?					
approximate time of other follow-up appt.					
actual date of other follow-up appt. given?					
patient prognosis given?					
did summary indicate whether patient prognosis was given to patient					
were recommendations other than medication and f/u compliance given to pt?					
community services arranged for patient					
patient's functional ability at discharge (any mention of physical or cognitive function)					
pending laboratory information					n y
diagnostic recommendations					n y
therapeutic recommendations					n y

Appendix 18: Form used for discharge summary abstraction.

Each summary was reviewed using the abstraction rules in Appendix 19 and Appendix 20. The form was printed on 8.5 by 11 inch paper.

Field	Instructions
Heading	Y = item has its own title and is in the first two sentences of the paragraph ***or*** is in the first sentence of an untitled paragraph **N** = otherwise Leave blank if item is not present in summary
chief complaint / presenting clinical problem / reason for referral	Y = any mention in HPI of symptom that is likely to be new **N** = otherwise
history of presenting illness	Y = *any* description or qualifier of the chief complaint or reason for referral **N** = CC or reason for referral not described or qualified
active medical problems on admission	**INACTIVE** = pathological process is inactive OR not ongoing AND is not being treated AND does not have significant implications for the patient's health Y = any active problem mentioned or **N** = no active problem mentioned **DNA** = summary specifies that patient was healthy and no active medical problems mentioned
inactive medical or surgical problems	Y = inactive medical or surg probs (as defined above) mentioned **N** = none mentioned
family medical history	Any aspect of the health of any first relation Y = mentioned **N** = not mentioned
social history	Any mention of **living** or **employment** situation or of patient's personal **habits** (including alcohol, smoking, or sexual activity)
medications on admission - ANY MENTION	**MEDS** = only prescribed meds and over-the-counter medications (excluding vitamins) **N** = no mention of medications at admission Y = medications at admission are mentioned
p/e an admission VITAL SIGNS	Y = any mention of temperature, respiratory rate, heart rate, or blood pressure; numerical value not necessary
admitting diagnosis	Y = diagnosis explaining presenting problem is mentioned; must specify that diagnosis was admitting diagnosis *or* the diagnosis following emergency investigations is obviously the admitting diagnosis.
reason for admission is stated	Y = summary states **why** patient was admitted to hospital; must state phrases like "..because..", "... in order...", "... so that...", etc. Reason does not necessarily have to be valid
reason for admission implicit	Y = patient has significantly abnormal vitals OR needs external apparatus (oxygen, chest tube, etc) OR patient delirious OR patient unable to walk OR course of acute illness unpredictable enough that discharge home was unsafe.

Appendix 19: Rules for discharge summary abstraction using Appendix 18.

The rest of the rules are given in Appendix 20.

Field	Instructions
treatment in hospital	**Y** = any medications used in hospital; does not count if actual medications are not listed (i.e. "diuresed" as opposed to "furosemide") **N** = no treatment is mentioned **DNA** = admitting diagnosis may not require treatment (e.g. failure to thrive).
procedures in hospital	**PROCEDURE** = any device that broaches pt's skin or is inserted into orifice excluding peripheral intravenous catheters, bladder catheters, and nasogatric tubes.
complications in hospital	**COMPLICATION** = any occurrence in hospital that one would not predict to happen given the admitting diagnosis **OR** is a *significant* result of admitting diagnosis AND was not mentioned to be present prior to admission E.g. Hyponatremia of 124 with pneumonia is not considered to be a complication whereas hyponatremia to 110 and severe delirium with pneumonia is considered a complication.
consultations in hospital	**Y** = service **or** MD name is mentioned
discharge diagnosis	**Y** = summary specifies the discharge diagnosis.
discharge medications	Same as admission medications except *duration* applies only to antibiotics and anticoagulants
fate of admission meds given	**Y** = discharge medication list includes *at least one* admission medication OR specifies that listed medications are added to admission medications **N** = fate of pre-admit meds not specified **DNA** = no pre-admit meds listed
was pt transferred to	**Y** = summary mentions that pt transfer to another inpatient medical care facility that is not a nursing OR residential home
medical follow-up	**Y** = summary mentions any medical contact following discharge.
was pt to get f/u with MD other than fam MD	**Y** = self explanatory
prognosis	**Y** = expected duration of living specified (with actual number OR qualifier)
community services arranged for patient	**Y** = summary mentions that **any of the following** was arranged for patient (VON, Home-Care, Home Occupational Therapy or Physio-Therapy).
pts functional status at D/C	**Y** = any mention of physical or cognitive function post stabilization in hospital OR stated that pt has returned to baseline function. **IF NO COMPARISON TO BASELINE IS MADE**, must include a VERB (e.g. walking, breathing, thinking, etc) with descriptor (e.g. well, back at baseline, improving, with grunting, etc.). Therefore "in good condition" is not adequate.
pending laboratory information	**Y** = any investigation already ordered and performed with result pending (e.g. HIV serology) OR any investigation ordered but not yet completed (e.g. cardiac echocardiogram)
RECOMMENDATION =	Any intervention that is suggested in summary that was not started in hospital and not actually ordered or organized by hospital physicians.
ORGANIZATION	
Total # of Headings	Count the total number of UPPER CASE headings in summary
Total # of Misclassifications	**Misclassification** = information is placed in an inappropriate section of summary; information that should be in one section of summary (e.g. family medical history) is ***FLANKED*** by information from another section of summary (e.g.HPI).
Total # of Dyschronologies	**Dischronology** = information with time / chronological aspect (e.g. HPI, course in hospital) is placed ***AFTER*** other time-sensitive information which it chronologically ***PRECEDES***; applies only to **HPI** and **course in hospital.**
Admitting Dx	Admitting diagnosis given in summary
Rx IN HOSPITAL	List all medical therapy given in hospital mentioned in summary as described in "treatment in hospital"

Appendix 20: Rules for discharge summary abstraction using Appendix 18.

The rest of the rules are given in Appendix 19.

Pt Name:	Unique:	Admit Date:

1. **ORDERS** family MD on facesheet?

a. Admitting Dx: not given

b. Rx

Rx	Rx	Rx

2. **DEAR DR. LETTER** not in chart

a. Discharge Dx not given

b. Rx

c. D/C meds

d. F/U plans

3. **PHYSICIAN CONSULTS** none in chart

Service	*Staffperson*	*Service*	*Staffperson*

4. **ADMISSION NOTE** none in chart standard admit form in-hosp summ? stand D/C orders?

a. Admission Dx: not given

b. Reviewer's Admission Dx:

c. Active Medical Problems
DON'T FORGET TO CROSS OUT MEDS PT WAS ON PRE- ADMIT!

5. **PROGRESS NOTES** Is there progress note from patient's Family MD **YES** **NO**

a. Complications

b. Procedures:

c. D/C Dx: not given

Appendix 21: Form used for abstracting medical records.

Each medical record was reviewed in the following order: "Dear Doctor" letter (if present); orders; physician consults (if present); admission note; and progress notes. Abstraction rules provided in Appendix 22 were used. Form's formatting was slightly modified to fit page.

RULES FOR CHART ABSTRACTION:

1. ORDERS:

- Family MD: write the name of the family MD
- Rx: only list medication names (without doses or frequencies)
    - NO prn medications
    - NO vitamins
    - NO chemotherapy
    - NO elements (e.g. potassium: iron; etc)
    - NO inorganic solvents (e.g. kayexalate; calcium resonium)
    - NO 1 time only meds
    - NO diet supplements
    - NO colloid or crystalloid intravenous solutions
    - NO artificial tears or saliva
    - NO eyedrops
    - NO laxatives
- Following review of patient's admission note, **cross out those which patient was taking prior to admission**
- If discharge medications or follow up data are listed is discharge orders AND no "Dear Doctor" letter is in the chart, complete the appropriate sections of section 2 with information from the discharge orders.

2. DEAR DR. LETTER

- Rx: document all therapy listed on letter
- D/C Meds: list **name, dose, frequency,** and **duration** of medications. List non-medical D/C therapy
- F/U: document **f/u plans** or **recommendations** or **tests** for patient

3. PHYSICIAN CONSULTS

- list only medical and surgical consults.

4. ADMISSION NOTE

- if one diagnosis explains another, list only the causative diagnosis (e.g. if patient has admission diagnosis of "intracranial hemmorhage", exclude "headache" as other admission diagnosis.)
- exclude diagnoses which are listed in patient's active medical problems as admission diagnosis unless a qualifier is provided with dx (e.g. "Progression of CHF" okay but "CHF" isn't).

5. PROGRESS NOTES

- indicate beside the title whether there are any progress notes from the family MD indicating they visited the patient in hospital.
- "**Complication**" = any occurrence in hospital that one would not predict to happen given the admitting dx **OR** is a significant result of admitting dx AND was not mentioned to be present prior to admission. (E.g. Hyponatremia to 124 with pneumonia - **NOT A COMPLICATION;** Hyponatremia to 110 with severe delirium with pneumonia - **COMPLICATION)**
- "**Procedure**" = any device that broaches pt's skin or is inserted into orifice that is ***not*** simple I.V. or foley or N.G.

Appendix 22: Rules used for abstracting medical record using Appendix 21.

Extreme Results - Tests Indicating Severity of Patient Illness	
Hematology	White Blood Count < 2.0 or > 15.0 x 10^9
	Hemoglobin < 100 g / L or > 180 g / L
	International Normalized Ratio > 5.0
Serum Biochemistry	Sodium < 125 mmol / L or > 150 mmol / L
	Sodium bicarbonate < 15 mmol / L
	Creatinine > 300 μmol / L
	Total calcium > 3.0 mmol / L
	Creatine Kinase > 200 IU /L with MB isoenzyme > 5%
Microbiology	Blood culture (except Streptococcus viridans)
	Urine culture (> 100 million colony forming units per litre of urine
	Cerebrospinal Fluid (any organism)
Diagnostic Tests - Tests Helpful for Continuing Patient Care	
Protein Based Tests	Thyroid Stimulating Hormone
	Parathyroid Hormone
	Cholesterol
	Serum vitamin B12 (cobalamin)
	Serum or red blood cell folate
	Ferritin
	Hemoglobin A1C
Serology	Human Immunodeficiency Virus
	Hepatitis A
	Hepatitis B
	Hepatitis C
Radiology	Radiograph of chest, abdomen, or extremity
	Ultrasound of abdomen or pelvis
	Doppler ultrasound of carotid arteries or leg veins
	Computed tomography of head, chest, abdomen, or pelvis
Nuclear	Ventilation / Perfusion scan

Appendix 23: Laboratory and radiological data abstracted from each patient's discharge summary, summarative laboratory report, and radiological data summary.

- How many medical **DICTATED** summaries did you create in the last month: _____
- How many medical **DATABASE** summaries did you create in the last month: _____
- The scales below let you rate 2 attributes of *medical* discharge summary preparation .
- The attributes are **time required** and the **burden of** preparing summaries.
- Each scale goes from 0 (**TERRIBLE**) through 50 (**ACCEPTABLE**) to 100 (**EXCELLENT**). Our definitions of these qualifiers are:
  - **TERRIBLE** = attribute could not be worse
  - **ACCEPTABLE** = attribute is at an expected or average level
  - **EXCELLENT** = attribute could not be better
- Use a vertical line | to give an **OVERALL** rating of the **DICTATED** discharge summaries you've done.
- Use an **X** to give an **OVERALL** rating of the **DATABASE** discharge summaries you've done.

		TERRIBLE 0	ACCEPTABLE 50	EXCELLENT 100
EXAMPLE →	**fun** had while preparing summaries	|_____|_____|		
	time required to prepare summaries (less time used = higher rating)	|_____|_____|		
	burden (difficulty + hassle) of preparing summaries (less burden = higher rating)	|_____|_____|		

- How many medical **DICTATED** summaries have you read in the last month: _____
- How many medical **DATABASE** summaries have you read in the last month: _____
- Rate the completeness, pertinence, and organization of DICTATED (|) and DATABASE summaries (**X**). Use the same definitions of TERRIBLE, ACCEPTABLE, and EXCELLENT.

	TERRIBLE 0	ACCEPTABLE 50	EXCELLENT 100
completeness of information in summaries (is all necessary information included?)	|_____|_____|		
pertinence of information in summaries (is all included information necessary?)	|_____|_____|		
organization of information in summaries	|_____|_____|		

- Place a single mark on the scale below to indicate which discharge summary system you prefer and by how much:

DICTATED SUMMARY SYSTEM		DATABASE SUMMARY SYSTEM
|_____|_____|		
VERY STRONGLY PREFERRED	NEITHER PREFERRED	VERY STRONGLY PREFERRED

Appendix 24: Questionnaire used for follow-up survey of physicians-in-training participating in the randomized portion of the study.
Questionnaire is reformatted slightly to fit page.

Ottawa Civic Hospital
Division of General Internal Medicine
Database Discharge Summary - Hospital Info

WHEN PATIENT IS DISCHARGED, COMPLETE THIS FORM + SIGN	
NAME (PRINT)	
SIGNATURE:	

Dx # 1	COMPLICATION? ☐ YES ☐ NO	ETIOLOGY:
INVESTIGATIONS:		
Rx + OUTCOME:		

Dx # 2	COMPLICATION? ☐ YES ☐ NO	ETIOLOGY:
INVESTIGATIONS:		
Rx + OUTCOME:		

Dx # 3	COMPLICATION? ☐ YES ☐ NO	ETIOLOGY:
INVESTIGATIONS:		
Rx + OUTCOME:		

Dx # 4	COMPLICATION? ☐ YES ☐ NO	ETIOLOGY:
INVESTIGATIONS:		
Rx + OUTCOME:		

Dx # 5	COMPLICATION? ☐ YES ☐ NO	ETIOLOGY:
INVESTIGATIONS:		
Rx + OUTCOME:		

D. OTHER IMPORTANT INFORMATION:

Appendix 25 Suggested alternative format for hospital summary form for database discharge summary system.

Ottawa Civic Hospital
Division of General Internal Medicine

Dear Doctor Letter and
Database Discharge Summary - Discharge Info

1. Give carbon of completed form to patient as Dear Doctor Letter.
2. ***Make sure*** yellow Hospital Info form is complete and signed.

MOST RESPONSIBLE DIAGNOSIS:		
CONSULTATIONS IN HOSPITAL		
PROCEDURES + SURGERIES	1.	3.
	2.	4.
DISCHARGE MEDICATIONS (WITH DURATION IF NEEDED)	1.	8.
	2.	9.
	3.	10.
	4.	11.
	5.	12.
	6.	13.
ARRANGED MEDICAL FOLLOW-UP:	1.	
	2.	
	3.	
ARRANGED COMMUNITY SERVICES:		
PATIENT'S FUNCTIONAL STATUS AT DISCHARGE		
PENDING INVESTIGATIONS:		
THERAPEUTIC OR DIAGNOSTIC RECOMMENDATIONS		
SEND COPY OF SUMMARY TO: (GIVE NAME + ADDRESS)	1.	
	2.	
NAME (PRINT):	SIGNATURE:	DATE:

Appendix 26: Suggested alternative format for database dear doctor letter.