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Benefits of Integrated RIS/PACS/Reporting Due to Automatic Population of Templated Reports

Mark D. Kovacs, MD[a,*], Maximilian Y. Cho, MD[b], Philip F. Burchett, MS[a], Michael Trambert, MD[c]

[a] Department of Radiology, Medical University of South Carolina, Charleston, SC
[b] Department of Radiology, University of Southern California, Los Angeles, CA
[c] Department of Radiology, Santa Barbara Cottage Hospital, Santa Barbara, CA

A B S T R A C T

With integration of the Radiological Information Systems (RIS), Picture Archiving and Communication systems (PACS), and reporting systems, patient identifiers and examination information can automatically map into examination reports. There are many potential benefits of report automation to radiologists including improvements in efficiency, accuracy, and fatigue. In this article we describe a 2 part study, with the first part being an anonymous survey of radiologists concerning report automation. A total of 13 staff radiologists and 9 radiology residents at a single institution completed an anonymous survey. Respondents were asked if automatic population of examination description, comparison examination data, indications, computed tomography dose, technique, and copy to physician data saved time, decreased fatigue, and increased accuracy. Respondents were asked if a "copy findings" function saved time. The second objective part of the study was a mock examination experiment to assess time savings of report automation and to assess error rates. Of all, 9 radiologists were asked to dictate fields for 8 mock examinations. Subjects were timed and reporting errors monitored. Estimated daily time savings and error rates were calculated assuming a mix of 80 studies. A total of 95% surveyed responded that report automation saved time; 91% that report automation improved accuracy of dictations; 82% that report automation decreased fatigue. Furthermore, 83% of copy finding function users reported time savings. Average time to dictate these prepopulated fields was 51 seconds per study. Average error rate per report was 0.86, with an average of 0.26 errors remaining uncorrected upon report completion. Estimated average time per day saved per radiologist from report automation was 68 minutes. Estimated average corrected errors was 48 per day. Estimated average uncorrected or missed errors was 21 per day. These estimated benefits from report automation result from tight integration of RIS, PACS, and reporting systems.

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Introduction

As radiology departments have become all-digital in the past decade, the increasing integration of Radiological Information Systems-Hospital Information Systems (RIS-HIS) with Picture Archiving and Communication systems (PACS) has generated the potential for marked gains in workflow efficiency. In part driven by the Integrating the Healthcare Enterprise (IHE) initiative sponsored by the Radiological Society of North America (RSNA), there has been an effort toward "increasing connectivity and systems integration" creating avenues for more efficient and predictable communication among imaging modalities, HIS-RIS, and PACS.[1] These changes come at a time in which clinicians are increasingly relying on imaging to aid patient diagnosis and assess treatment outcomes. With meaningful use, referring clinicians and the patients themselves are now also expecting rapid access to their radiology reports.[2,3] Radiologists have accordingly experienced greater pressure for faster radiology report turnaround times and increased productivity.[4]

Voice recognition (VR) is increasingly used by radiologists to create radiology study reports. However, studies have shown that implementation of VR may increase report dictation time, increases errors in reports, and increases costs to the radiology department compared to conventional dictation methods using a transcriptionist.[5,6]

These drawbacks to VR can potentially be mitigated with the use of report automation, now available through the integration of RIS-PACS systems with VR reporting software. History, examination description, technique, comparison examination information, and physician copy to information can now be automatically populated into examination reports. In addition, a separate "copy findings" function is also available at our institution, which may further increase the efficiency of reporting. This feature allows for all the contents of the body of a prior report to be automatically inserted into the current study templated report. Then the radiologist just needs to update size measurements, etc for any fields with changed findings. These various features may result in less errors, increased speed, and less fatigue for the radiologist. This article describes a 2 part study assessing the benefits of report

*Reprint requests: Mark D. Kovacs, MD, Medical University of South Carolina, 96 Jonathan Lucas St, MSC, 323, 210 CSB, Charleston, SC 29425-3230.
E-mail address: kovacsm@musc.edu (M.D. Kovacs).

TABLE 1
Summary findings for category responses

	1	2	3	4	5	Overall positive response
Overall effect of report automation on time savings*	0	0	1 (5%)	6 (27%)	15 (68%)	21 (95%)
Overall effect of report automation on dictation accuracy†	0	0	2 (9%)	11 (50%)	9 (41%)	20 (91%)
Overall effect of report automation on fatigue†	0	0	4 (18%)	7 (32%)	11 (50%)	18 (82%)
Effect of automatic population of examination description on time savings‡	0	0	0	10 (45%)	12 (55%)	22 (100%)
Effect of automatic population of technique on time savings§	0	0	0	11 (50%)	11 (50%)	22 (100%)
Effect of automatic population of comparison examinations on time§	0	0	0	9 (41%)	12 (55%)	21 (95%)
Effect of automatic population of examination indication on time‡	0	0	2	11 (50%)	9 (41%)	20 (91%)
Effect of automatic population of CT dose on time‡	0	0	2	12 (55%)	8 (36%)	20 (91%)
Effect of automatic population of ordering physician data on time‡	0	1	3	8 (36%)	10 (45%)	18 (82%)
Effect of "copy findings" function on time‖,¶	0	0	0	3 (17%)	12 (67%)	3 (17%)

*1—costs 30+ min; 2—costs 0-30 min; 3—does not affect; 4—saves 0-30 min; and 5—saves 30+ min.
†1—significantly decreases; 2—decreases; 3—does not affect; 4—improves; and 5—significantly improves.
‡1—costs 10+ min; 2—costs 0-10 min; 3—does not affect; 4—saves 0-10 min; and 5—saves 10+ min.
§Costs 15+ min; 2—costs 0-15 min; 3—does not affect; 4—saves 0-15 min; and 5—saves 15+ min.
‖Costs 20+ min; 2—costs 0-20 min; 3—does not affect; 4—saves 0-20 min; and 5—saves 20+ min.
¶Copy findings was utilized by 18/22 (82%) of respondents.

automation on workflow at a site with comprehensive RIS/PACS/reporting integration. The 2 parts consisted of an anonymous survey of radiologists and an objective mock study experiment to assess time savings of report automation and to assess error rates.

Methods

Survey

A total of 13 staff radiologists and 9 radiology residents at a single institution with experience in using systems both without and with automatically populated reports were asked to complete an anonymous online 12 question 5-point Likert survey. Respondents were asked if automatic prepopulation of examination description, comparison examination data, indications, computed tomography (CT) dose, technique, and copy to physician data saved time, decreased fatigue, and increased accuracy using a 5-point scale. For time savings questions, responses were 1 = costs *x* minutes per day, 2 = costs 0-*x* minutes per day, 3 = does not save me time, 4 = saves me 0-*x* minutes per day, and 5 = saves me *x* minutes per day. The value of *x* ranged between 10-30 minutes depending on the field queried. For fatigue and accuracy questions, responses were 1 = significant worsening, 2 = worsening, 3 = no improvement, 4 = improvement, and 5 = significant improvement.

Timing Experiment

To obtain a preliminary estimate of time gained by report automation, 6 staff radiologists and 3 radiology residents were asked to dictate, using VR, scripted specific fields listed in the digital requisition into a template report for 8 mock examinations. The dictated report fields included examination description, comparison examination data, indications, CT dose, technique, and copy to physician data fields normally autopopulated at our site. All subjects spoke English as their first language and had more than 2 years of experience using VR. The mock examinations included 2 ultrasound (US), 2 plain radiograph (XR), 2 CT, and 2 MR examinations. In addition to measuring the time taken to dictate the fields, dictation errors and corrections were also monitored and recorded.

These results were then used to extrapolate projected time savings and error rates based on a mix of 80 studies (20 XR, 20 US, 20 CT, 20 MR), an estimate of daily workload for a radiologist. Average times and errors are presented with confidence intervals.

Results

Survey

A total of 15 faculty were invited to participate in the survey and the response rate was 87% (13/15). Response rate for polled residents was 100% (9/9). Of all, 95% of respondents (21) replied that report automation saved time. In addition, 82% (18) of respondents replied that report automation decreased their fatigue. Furthermore, 91% (20) of respondents replied that report automation improved accuracy of dictations. The full breakdown of individual responses to survey questions is depicted in Table 1.

The "copy findings" function was utilized by 82% (18) of respondents. 83% of copy findings users reported time savings from this function.

Timing Experiment

Average time to dictate nonintegrated report fields across modalities was 68 seconds. The breakdown of average times to dictate fields per individual modality is detailed in Table 2.

A total of 56% of reports had errors made during dictation of the report. Of those, 25% of dictations contained an error at the final dictation. Readers had been asked to audit and correct their reports. An average of 0.86 errors were made during each dictation. Furthermore, 0.26 went uncorrected at completion of dictation after reader auditing, seen in Table 3.

Estimated time saved per day using report automation was 68 minutes, assuming an average of 80 studies per day. Estimated number of errors made per day using a nonintegrated system were 69 errors. Estimated number of uncorrected errors per day were 21.

Discussion

The survey results and timing experiment suggest that report automation saves time, decreases fatigue, improves accuracy, and was preferred by the radiologist. The timing study estimates time

TABLE 2
Time savings by modality

Examination type	Mean time savings per study (95% CI)
MRI reports	53 sec (26-81 sec)
CT reports	1 min and 21 sec (1 min-1 min 43 sec)
US reports	39 sec (23-55 sec)
Plain film reports	31 sec (14-49 sec)

TABLE 3
Errors committed per workflow assessment

	Per study	Per day (assuming mix of 80 studies)
Total errors	0.86	69
Errors corrected	0.6	48
Errors uncorrected	0.26	21

savings of 68 minutes per day and avoidance of 69 errors per day, per radiologist.

Regarding time savings, report automation allows the radiologist to spend more time per examination reviewing the images and synthesizing findings into a clinically relevant impression, rather than on dictating automatable noninterpretive but required fields. The use of templates, along with experience in VR, has been shown to increase the efficiency of dictation.[7,8] No studies, however, have demonstrated the effects of a fully automated template system by which all noninterpretive fields are automatically populated. Such workflow is made possible leveraging links between HIS, RIS, and PACS systems, with fully integrated reporting.

Some studies have shown that the use of VR, although decreasing report turnaround times,[9] actually takes more time to complete a report than use of conventional dictation with a transcriptionist.[10] The report automation described mitigates potential VR inefficiencies by obviating the need for dictating initial report fields. Avoidance of this nonclinical data synthesis and reporting improves the radiologist clinical flow and reduces fatigue.

Results from the timing experiment revealed that 25% of nonautomated reports contained errors after final review. This is similar to the 5%-42% error rates reported by others.[11-13] Although most of these errors were trivial, some uncorrected errors could have serious negative consequences. For example, incorrectly dictating a patient's medical history could potentially be propagated into the future, leading to eventual confusion in patient care. Of note however, if the history was incorrectly entered by the referring clinician or technologist, this might well propagate in automated reporting. Errors in dose reporting could result in understatement or overstatement of dose, with associated opportunities for over-radiation of a patient or underutilization of imaging based on these errors. ACR guidelines mandate accurate reports, to minimize such untoward consequences.[14]

The copy findings function was used by 82% of readers, with 83% reporting time savings. This function is actuated with a single click, replacing the default template with the body of the prior selected examination report, then serving as the current report template from which to work forward. Unchanged findings are automatically rereported, as well as previously noted incidental findings, resulting in improvement in efficiency. Ad hoc peer review is also facilitated, in that the reading radiologist that actuates copy findings, sees the structured findings of the prior report as their current template. This makes it easier to identify a discrepancy in the reading of the prior examination, comparing the current examination with the prior, and updating the current report. Randomized peer review is also available.

One significant limitation of this single institution preliminary work is that the mock examination timing experiment represented only a gross estimate of time spent dictating noninterpretive fields at sites without fully integrated reporting, and thus did not represent a true control. Timing of actual study dictations at sites with and without integration of RIS, PACS, and reporting systems would be needed for a full study in the future. Additionally, the qualitative Likert scale questionnaire was limited to radiologists from a single institution. A questionnaire with broader outreach would also help improve on the qualitative assessment in the future.

Extrapolating 8 test examinations out to 80 examinations interpreted and reported each day, could lead to an underestimate, or overestimate of the measured time savings and error rate per day per reader, since examination volumes and mix of examination types at other sites could significantly differ.

In conclusion, report automation using prepopulated fields is estimated to save time, decrease fatigue, and increase accuracy during report dictation. These benefits are made possible through the tight integration of RIS, PACS, and reporting systems.

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