Evaluating the Impact of Workstation Usage on Radiology Report Times in the Initial 6 Months Following Installation

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Picture archiving and communications systems (PACS) workstations are reported to improve workflow by making studies immediately available for review upon their completion. This study tested the hypothesis that a workstation would decrease the time from completion of a study to dictation of results (report time). A four-monitor, 2K × 2K workstation (Imation Cemax-Icon, Fremont, CA), was installed in a body imaging computed tomography (CT) reading room. Use of the workstation by the staff radiologists was voluntary. Images were also printed on film and films continued to be hung at the routine hanging times. To evaluate the workstation's maximum impact, data were collected for report times for studies completed during the routine day shift of the staff radiologist (Monday to Friday, 8 AM to 5 PM). Data were collected before workstation installation (August 1997 to November 1997) and for the subsequent 6 months. Histograms of the number of studies (743 v 103) versus report time (mean, 11.7 v 7.4 hours) showed a bimodal distribution, with peaks at approximately 6 and 24 hours, both before (8/97-11/97) and after (6/98) the workstation's installation. However, the number of studies dictated greater than 60 hours (25.2% v 20.4%) and the percentage of studies in the second peak (16 to 48 hours; 4.4% v 0%) both decreased. In conclusion, the workstation decreased the mean (11.7 v 7.4 hours) and standard deviation (19.8 v 9.1 hours) for report times. This was due to a decrease in both the number of cases dictated the day following their completion and the number of outliers (markedly delayed dictations). The decrease in outliers is probably due to a decrease in the number of "lost" film-based studies.

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PICTURE ARCHIVING and communications systems (PACS) diagnostic radiology workstations have been reported to increase radiologists' efficiency by making studies immediately available for review by radiologists upon study completion. One group reported that a PACS installation resulted in a substantial decrease in turnaround time (time from end of procedure to final report).¹ We

sought to test the hypothesis that use of a workstation would decrease the time from completion of a study to dictation of results.

METHODS AND MATERIALS

A four-monitor, 2K × 2K workstation (Imation Cemax-Icon, Fremont, CA) was installed in a body imaging (abdomen and pelvis) computed tomography (CT) reading room December 1997. Images continued to be printed on film and films for all studies continued to be hung at the routine hanging times. Film served as the long-term archival storage medium. Use of the workstation by the staff radiologists was voluntary. All radiologists were trained on use of the workstation.

To evaluate the workstation's maximum impact, we measured the time from study completion to study dictation (here defined as "report time") for body CT examinations completed during the routine day shift of the staff radiologists (Monday to Friday, 8 AM to 5 PM).

Before workstation installation (August 1997 to November 1997), baseline data were collected. Data collection continued for the first 6 months following installation (December 1997 to June 1998). The baseline data and the data for each month following installation were analyzed. The mean, median, and standard deviation report times were calculated. Histograms of number of studies versus reporting time were also created. Student's *t* test was used to assess significance of the difference of the mean report time for the cumulative baseline data (August 1997 to November 1998) and for the month of June 1998.

RESULTS

Over the 6 months following the installation of the workstation, the mean report time per month showed a gradual decrease while the median was essentially unchanged. The mean for report time for the baseline period was 11.7 hours and for the month of June 1998 was 7.4 hours. The difference was statistically significant: $P(\text{two-tailed}) = .0002$. The standard deviation showed a continuous decrease from 21.4 hours in December 1997 to 9.1 hours in June 1998 (Fig 1 and Table 1).

The histograms for each of the months during the study showed two peaks for reporting times. One peak was between 0 to 12 hours and the second was between 16 to 48 hours. A "tail" was identified of reporting times of greater than 60 hours. Histograms for November 1997 (last month of the baseline period) and June 1998 (6 months following installation) are shown in Fig 2.

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Fig 1. Mean (♦), median (■), and standard deviation (▲) for report times.

DISCUSSION

Our data showed that the workstation significantly decreased mean report time (Fig 1). This finding is consistent with other reports that have shown a decrease in the related variable called “turnaround time.”^{1,2} We did not use “turnaround time,” usually referred to as the time from examination completion to the time a report is signed, because this measurement is affected by a variable not impacted on by the workstation, the time from examination dictation to time of final report sign-off.

The decrease in the mean and standard deviation for report times, without a change in the median, can be attributed to the nonnormal distribution of report times with change in distribution of the report times over the 6 months following workstation installation. The shift in the number of studies dictated from 16 to 48 hours to 0 to 12 hours following examination completion might be attributed to earlier availability of the studies for interpretation.

Table 1. Comparison of Cumulative Baseline Data With the Sixth Month Following Workstation Installation

Measure	Before Workstation Installation (8/97-11/97)	6 Months After Workstation Installation (6/98)
N studies	743	403
Mean report time (hours)	11.7*	7.4*
Standard deviation (hours)	19.8	9.1
Median (hours)	4.3	3.8
% dictations 0-12 hours	70.1%	78.6%
% dictations 16-48 hours	25.2%	20.4%
% dictations >60 hours	4.4%	0%

*The difference in mean report times was statistically significant, *P* (2-tailed) = .0002.

Fig 2. Histograms for November 1997 (last month before workstation installation) and June 1998 (6 months after workstation installation) for time for report times.

tation. Studies routed to the workstation were immediately available for dictation, while those that needed to be filmed required the technologist to have time available to film the study, to collate the films, and to send the films to the file room.

The decrease in the number of studies with report times greater than 60 hours is most likely due to a decrease in studies that were unavailable for dictation. These are studies removed from the radiology department prior to reporting, studies that were not filmed, etc. This conclusion is supported by other reports that showed that installation of a PACS system resulted in a decrease in the number of unread or “lost” studies.^{1,2}

Limitations of our study included the following. Use of the workstation was voluntary. Therefore, a significant number of studies were read from film. It was not possible to determine which studies were read on the workstation and which were read on film. Finally, only a portion of the abdominal CT

studies that a body radiologist would read on a certain day were actually transmitted to the workstation; this required radiologists to review the film board, and may have discouraged use of the workstation.

In conclusion, voluntary usage of a workstation during the first 6 months resulted in a decrease in the mean and the standard deviation for report time. This was primarily due to two factors. One was a decrease in the number of unread studies. The

second was a change in the distribution of when studies were read, with more studies being read the same day that they were performed.

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