

Radiology Workflow Dynamics: How Workflow Patterns Impact Radiologist Perceptions of Workplace Satisfaction

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Rationale and Objectives: The study aimed to assess perceptions of reading room workflow and the impact separating image-interpretive and nonimage-interpretive task workflows can have on radiologist perceptions of workplace disruptions, workload, and overall satisfaction.

Materials and Methods: A 14-question survey instrument was developed to measure radiologist perceptions of workplace interruptions, satisfaction, and workload prior to and following implementation of separate image-interpretive and nonimage-interpretive reading room workflows. The results were collected over 2 weeks preceding the intervention and 2 weeks following the end of the intervention. The results were anonymized and analyzed using univariate analysis.

Results: A total of 18 people responded to the preintervention survey: 6 neuroradiology fellows and 12 attending neuroradiologists. Fifteen people who were then present for the 1-month intervention period responded to the postintervention survey. Perceptions of workplace disruptions, image interpretation, quality of trainee education, ability to perform nonimage-interpretive tasks, and quality of consultations ($P < 0.0001$) all improved following the intervention. Mental effort and workload also improved across all assessment domains, as did satisfaction with quality of image interpretation and consultative work.

Conclusion: Implementation of parallel dedicated image-interpretive and nonimage-interpretive workflows may improve markers of radiologist perceptions of workplace satisfaction.

Key Words: radiology workflow; job satisfaction; workflow dynamics.

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INTRODUCTION

In an increasingly complex and cognitively demanding work environment, the modern radiologist must often balance a myriad of competing responsibilities as an imaging expert and interpreter, physician consultant, educator, and interventionalist (1–3). Although these responsibilities conceptually span a wide range of clinical activities, they can be broadly categorized into image-interpretive (IIT) and nonimage-interpretive tasks (NIT), and as previous work has shown task dichotomiza-

tion leads to decreased reading room disruptions and interruptions and facilitates gains in workflow efficiencies (4–6). These observations at our institution and others have informed a local quality improvement intervention in our practice where discrete image-interpretive and nonimage-interpretive workflows resulted in fewer disruptions and increased time for both image interpretation and trainee education.

The analysis of and subsequent improvements to the radiologist's workflow environment also require a careful analysis of individual workloads and the impact individual workloads have on the overall efficiency of a workflow process. These examinations also afford a more nuanced exploration of the impact workflow design has on individual operators. Whereas workflow represents the sequence of processes through which a piece of work passes from start to finish, workload represents the actual amount of work to be done. Workload, at the individual level, is not an absolute quantity and is variably dependent on numerous intrinsic factors (such as individual experience and skill) and extrinsic factors (such as interruptions and system failures), which all contribute to the overall perception of individual workload (7). The NASA Task Load Index (NASA TLX) is a widely used comprehensive multi-dimensional assessment tool in human factors research that

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captures individual perceptions of individual workload across six domains. Survey instruments such as the NASA TLX allow researchers to capture the interplay among individuals, cognitively demanding tasks, and complex work environments. These assessments can then help researchers understand the relationships between workload and job performance, job satisfaction, and in the healthcare environment potential downstream effects on patient care (8). Using the NASA TLX as a foundation, we developed a tailored survey instrument to assess radiologist and trainee perceptions of (1) workplace disruptors, (2) mental effort required to complete daily workload, and (3) overall workplace satisfaction before and after the implementation of a dichotomized workflow in our reading room. Complementing previous work from our group on workflow design, our results highlight the impact that workflow design has on individual workload and concomitant perceptions on workplace disruptions and radiologist workplace satisfaction.

MATERIALS AND METHODS

This Health Insurance Portability and Accountability Act (HIPAA)-compliant study was granted an institutional review board exemption as a quality improvement initiative.

Study Setting and Population

Survey data were collected from members of our academic neuroradiology practice, which is part of a larger integrated healthcare system comprising 6 hospitals and over 80 outpatient imaging sites. The neuroradiology section was targeted for analysis due to its large clinical volume and centralized reading room structure. The study cohort comprised 12 attending radiologists and 6 neuroradiology clinical fellows. An anonymous preintervention survey was distributed to the neuroradiology faculty and neuroradiology fellows who were intimately familiar with the existing neuroradiology workflow. Surveys were distributed via SurveyMonkey web-

based survey software (Palo Alto, CA), with the preintervention survey distributed 2 weeks prior to the workflow intervention and the postintervention survey distributed 2 weeks after the completion of the reading room intervention.

Survey Development

With the validated NASA TLX survey instrument as a guide, a custom-tailored, 14-question survey instrument was designed (MHL, AJS, DW) to assess current perceptions of the reading room environment. The survey was divided into three sections to address individual perceptions of workplace disruptions, mental effort and workload required to perform one's work, and overall satisfaction in the reading room environment. The questions for each assessment category utilized the following 5-point Likert-type scales: perception of workplace disruption (1 = none, 2 = minimal, 3 = mild, 4 = moderate, 5 = severe); mental effort and workload (1 = very low, 2 = low, 3 = medium, 4 = high, 5 = very high); and satisfaction (1 = completely dissatisfied, 2 = somewhat dissatisfied, 3 = neutral [neither satisfied nor dissatisfied], 4 = somewhat satisfied, 5 = completely satisfied).

The same survey instrument was deployed before and after implementation of a new reading room workflow model that separated reading room tasks into image-interpretive and nonimage-interpretive workflows as previously reported (4). Briefly, dedicated personnel were assigned to the execution of each task workflow, with NITs addressed solely by a first- or second-year neuroradiology fellow and IITs completed by all other physicians present in the reading room (residents, additional fellows, and attending physicians). The postintervention survey was distributed to evaluate changes in individual perceptions of workload following this reading room workflow intervention. The survey assessed individual perception of reading room disruptions, satisfaction, and the ability to interpret imaging studies, quality of image interpretation, ability to perform noninterpretive tasks, quality

TABLE 1. Study Questionnaire Design

Assessment Category	Questions
Interruptions To what degree do interruptions in the neuroradiology reading room adversely affect:	1. Your ability to interpret imaging studies? 2. The quality of your image interpretations? 3. Your ability to address non-imaging interpretation tasks (consultations, protocols, monitoring studies, procedures, etc)? 4. The quality of consultations you are able to provide to referring providers? 5. The quality of trainee education?
Workload Please rate the following as they apply to your work in the current neuroradiology reading room setting:	1. Mental effort required to concentrate on your work 2. Stress experienced while performing your work 3. Effort required to achieve your desired level of performance 4. Effort required to accomplish everything you're asked to do in the reading room
Satisfaction In the current neuroradiology reading room setting, how satisfied are you with:	1. Your ability to interpret imaging studies? 2. The quality of your image interpretation? 3. The workflow for handling non-image interpretation tasks (consultations, protocols, monitoring studies, procedures, etc)? 4. The quality of consultations you are able to provide to referring providers? 5. The quality of trainee education?

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