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Exploring Burnout and the Potential Effects of Health Information Technology Usage among Radiologic Technologists

[1]**Sarah Douglas,** M.S., R.T.(R)(CT)(MR)(QM)(ARRT), [2]**Barbara Tafuto,** (Ph.D., MLIS,)
[3]**Thomas J. Hunt,** (Ph.D., RHIA, CHDA, FAHIMA)
[1]Doctoral Student, [2,3]Assistant Professor
School of Health Professions, Rutgers, The State University of New Jersey, U.S.A.

Corresponding Author: **Sarah Douglas**

Abstract

Purpose: To determine if the use of health information technology contributes to burnout among radiologic technologists. **Methods:** Searches for original research on burnout and the effects of health information technology among radiologic technologists were conducted in the Pub Med and Cochrane databases and the Radiology and Radiologic Technology journals from 2011 – 2024. **Results:** Moderate to high levels of burnout were seen predominantly among radiographers between thirty to forty years of age and with at least ten years of experience. The studies did not assess the effects of health information technology, and a correlation could not be established. **Conclusion:** Radiologic technologists, specifically women in radiography, are affected by burnout. Dissatisfaction with employer incentives and operations and COVID-19 mitigation strategies were contributors. Health information technology usage on burnout among radiologic technologists was not assessed, identifying opportunities to explore this field.

Keywords: Burnout, health information technology, radiologic technologists

Introduction

Research on burnout and the effects of health information technology (HIT) among doctors, nurses, and other healthcare professionals has been widely conducted and published. However, research conducted amongradiologic technologists(R.T.s) has been limited. R.T.s are allied health professionals who utilize radiation-producing machines to examine patients for diagnosis and treatment. They are certified in modalities such as radiography (R), computed tomography (CT), magnetic resonance imaging (MR),sonography, nuclear medicine (NM), radiation therapy (T), and mammography (M).

Medical imaging revolves around technical systems using innovative equipment from various manufacturers. The daily responsibilities of an R.T. include navigating different HIT systems and machines from companies whose software and applications vary significantly. R.T.s increasingly spend more time documenting in electronic health record (EHR) systems, a primary application of HIT. Continuous advancements in HIT, with the demands to remain competent and to provide frequent documentation using these systems, contribute to high stress levels among imaging professionals (Singh et al., 2017).The stress of utilizing numerous HIT systems and its contribution to burnout is a cause for concern among R.T.s, as burnout was observed to be stress-related rather than work-relatedin a study conducted among healthcare workers (Winston, 2015).It isessential to delve into the importance of HIT usage, its contributions and shortcomings, and its influence on burnout to mitigate adverse effects.

Health information technology systems were designed to assist and streamline healthcare workflows and have increased in the last decade, especially in imaging departments with frequent equipment upgrades and acquisitions. However, while EHRs were designed to facilitate clinical documentation, the process left clinicians with an increased workload and frustration at the lack of patient care time (Wu et al., 2021). This is frequently seen in imaging departments, where R.T.s must provide clinical notes and communicate with the healthcare team through messagingusing the EHR system or the technical support team, which can be contacted via the equipment in real time.These added duties utilizing HIT whileperforming imaging examinationscan become quite stressful,leading to burnout.

Radiology was among the first departments to integrate electronic systems into its workflow (Nance et al., 2013). Integration enables the essential exchange of information betweenelectronic systems inradiology through variousconfigurations to assist in managingits operations (Forsberg et al., 2016).However, while integrating EHR systems facilitated efficiency, it also presented challenges and stress to the workforce and workflow, impeding the healthcare workers' abilities to deliver safe patient care services (Zheng et al., 2020).Successful radiology systems' integration supports streamlined workflows, patient scheduling and tracking,billing, metrics, data sharing, and image storage.These functions can all contribute to reducing medical errors and improving the delivery of patient care services, and knowledge of these systems is essential. Several of the most utilized HIT systems in radiology include a hospital information system (HIS), a radiology information system (RIS), and a Picture archiving and communication system (PACS), with many healthcare institutions opting to combine the HIS and RIS (RamSoft, 2022).These systems contribute to a more efficient imaging department. However, utilizationcan also add to HIT-induced stress, leading to burnout, especially when the patient volume is high, accompanied by staff shortage.

The International Classification of Diseases (ICD-11) cataloged burnout as an occupational phenomenon where employees feel exhausted, mentally distanced from their jobs, and have reduced job efficacy (W.H.O., 2019). Burnout was identified as a predictor of Type 2 diabetes and heart disease. Higher levels of burnout are associated with psychological and physical health problems such as anxiety, depression, memory impairment, headaches, and respiratory infections. These health issues contribute to decreased quality patient-care time, increased medical errors, and staff turnover and absenteeism, with adverseconsequences ina healthcare institution (Li et al., 2022).

An assessment of the effects of occupational burnout among R.T.s found that some developed physical symptoms while others used escape mechanisms. Other R.T.s became disappointed, dissatisfied, cynical, and impatient, and some found it challenging to focus and be productive (Shubayret al.,2022).Burnout often stems from workplace factors where employees endure prolonged working hours, additional administrative functions, unanticipated patient workloads, and equipment failures. While dealing with the emotional impact and association of close patient contact and hands-on clinical tasks, these duties contribute to burnout (Martin-Brufau et al., 2020).

Clinicians were seen to be at risk of making medical errors, compromising patients, and resigning from their jobs when suffering from HIT-centered burnout, the consequences of which can place the healthcare system in jeopardy(Wu et al., 2021).Radiologic technologists play a vital role in the healthcare process, and enduring stress-related burnout imposed by HIT systems can also potentially jeopardize patient care and the healthcare system. The weight of HIT and its influence on burnout isa cause for concern among R.T.s. This literature review explores burnout among R.T.s across the various imaging modalities and the potential role of HIT.

Methods

Search Strategy and Screening

To explore burnout and the effects of HIT usage among R.T.s, the medical subject headings (MeSH) for burnout, HIT, and R.T.s were identified. These included:“Burnout, Professional,” “Medical Informatics,” “Allied Health Professionals,” and “Radiology Department, Hospitals.” Acronyms and synonyms for the MeSH included “radiographer,” “healthcare workers,” “health professionals,” “HIT,” “EHR,” “EHRs,” “electronic health record(s),” “and health system.”

Searches to retrieve the relevant literature were conducted in the PubMed and Cochrane databases and the *Radiology* and *Radiologic Technology* journals. Individual MeSH, acronyms, or synonyms, and the Boolean term “AND” combining two or more expressions comprised the equations, which were as follows:

1: “Health information technology” OR “health systems” OR “medical informatics” OR “HIT” OR “EHR” OR “EHRs”

2: “Burnout”

3: Search # 1 AND # 2

4: “Radiologic technologists” OR “radiographer” OR “health professionals” OR “healthcare workers”

5: Search # 3 AND # 4

The pearl-growing method of tracking the references of the articles identified in the searches for evidence and resources for background information was employed (Ramer, 2005).The progression of the number of articles retrieved to the final selection for the review was documented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework (Page et al., 2021).

Inclusion Criteria

Peer-reviewed, original research on burnout using theMaslach Burnout Inventory (MBI) and the impact of HIT among R.T.swas sought. Only articles from 2011 to the presentwere considered when the Medicare and Medicaid Electronic Health Record Incentive Program was established in the United States (U.S.) in 2011 to promote the use of certified EHR technology among healthcare organizations (Centers for Medicare and Medicaid Services, 2024). No language and geographical limitations were placed on the search strategies.

Exclusion Criteria

Non-peer-reviewed articles, editorials, books, documents, and literature other than original research studies were excluded. Original research conducted before 2011 and studies that did not include R.T.s were also excluded from the study.

Data Storage and Extraction

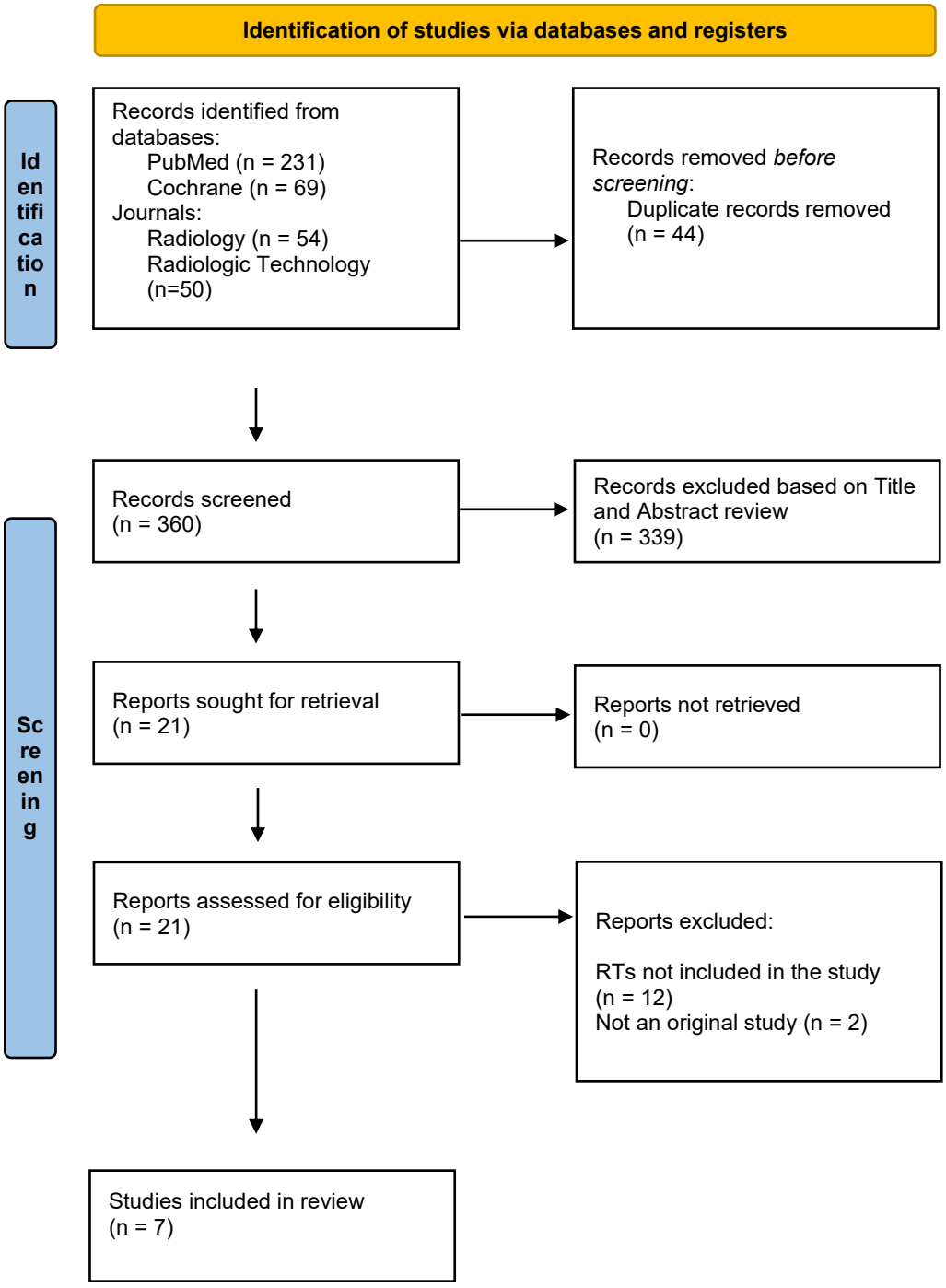
The studies selected for the review and contextual information were exported to the EndNote 21 reference management software. The study, population characteristics, and outcomes tables were created using Microsoft Excel to document the relevant data. The data extracted included authors, year, country, population, gender, age, marital status, children, modality, education level, place of employment, caseload, objective,study type, length of study, number of surveys distributed, number of responses, years of experience, measurement tool(s), outcomes, and responses.

Results

The PRISMA flow diagram (Figure 1) depicts the sequence of the initial literature searches to the final articles selected for the review. The searches retrieved from the PubMed and Cochrane databases generated 300 articles, while the *Radiology* and *Radiologic Technology* journals yielded 104 articles. Forty-four duplicates were removed before screening, 360 were screened for inclusion criteria content based on title and abstract review, 21 articles were assessed for eligibility, and 14 were removed. Seven studies were ultimately identified for the review.There were no studies that evaluated the effects of HIT-induced burnout among R.T.s in any country.Therefore, the assumption that burnout among R.T.s may becaused by HIT usage could not be established. The results provide a global overview of burnout among R.T.s resulting from various factors, many of which were COVID-19 related.

Figure 1

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework. Figure courtesy of the authors.



(Page et al.,2021)

The study summary for the studiesis provided in Table 1. Countries of origin included Jordan, Portugal, the United Kingdom, Australia and New Zealand, Hungary, and Italy. Four studies (Alakhras et al., 2021; Sipos et al., 2023a; Sipos et al., 2023b; Zanardo et al., 2022)were COVID-19-related, with two (Sipos et al., 2023a; Sipos et al., 2023b) conducted by the same principal author in Hungary. Three studies (Singh et al., 2017; Alakhras et al., 2021;Sipos et al., 2023)investigated radiographers, while two (Pereira et al., 2021; Zanardo et al., 2022)focused on radiotherapists. The remaining twostudiesincluded radiographers, sonographers, radiologists, and radiographers, oncologists, and nurses, respectively (Probst et al., 2012; Sipos et al., 2023b). All seven studies (Singh et al., 2017; Alakhras et al., 2021; Pereira et al., 2021; Probst et al., 2012; Sipos et al., 2023a; Sipos et al., 2023b; Zanardo et al., 2022) utilized the MBI tool to measure burnoutin the three dimensions of emotional exhaustion (EE), depersonalization (DP), and personal achievement (PA).The MBI was the first scientifically validated tool to measure burnout and is the most widely used (Mind Garden 2024, Maslach Burnout Inventory). Additional questionnaire(s) were also used to collect key socio-demographic and participant work characteristics.

Table 2 depicts the population characteristics. A total of 2571 responses were analyzed from the studies, of which the majority were women (n=1634). The response from men was less than half of the women (n=804). Most participants were between 30 and less than or equal to 40 (n=471), followed by those greater than 30 years (n=446). Participants between 41 and 50 years (n=302) comprised the third largest group, followed by those greater than 50 years (n=281). The majority of the participants were married or partnered (n=887), followed by those who were single (n=346). Those with children (n=1105) also surpassed those without children (n=315). Radiography was the primary discipline reported (n=839), followed by sonography (n=121). Most participants reported havinga bachelor's degree (n=783) and were employed by a public hospital (n=163) withover 10 years of experience (n=1307), followed by those with less than 10 years (n=738) of experience. Seventy participants had between 7and 15 years of experience. R.T.s (n=189), with a caseload of more than 25 patients per day, experienced burnout.

The results of the three dimensions of burnout using the MBI tool and the additional questionnaires are summarized in Table 3. Emotional exhaustion (EE)was reported as high in five studies (Singh et al., 2017; Alakhras et al., 2021; Pereira et al., 2021; Sipos et al., 2023b; Zanardo et al., 2022),while depersonalization (DP) was highin four studies (Singh et al., 2017;Pereira et al., 2021; Sipos et al., 2023b; Zanardo et al., 2022).Three studies reported high personal achievement (PA) (Probst et al., 2012; Sipos et al., 2023a; Sipos et al., 2023b).

Three studiesprovided open-ended responses to the sources of burnout (Alakhraset al., 2021; Pereira et al., 2021; Sipos et al., 2023).In one study, job-related factors contributed to burnout among radiographers.From highest to lowest scores,they included: fringe benefits, rewards, remuneration, opportunities for growth, operations, and communications (Alakhras et al., 2021). Adapting to change accounted for high EE and DP scores in one study (Pereira et al., 2021), and health concerns, either personal or for a friend, accounted for high EE in another study (Sipos et al., 2023).

The assessment of bias, represented in Table 4, was conducted usingthe Critical Appraisal Skills Programme for Qualitative Research (Critical Appraisal Skills, 2024). All seven studiesexhibitedno bias based on the information provided in the methods sections and conflict of interest disclaimers (Singh et al., 2017; Alakhras et al., 2021; Pereira et al., 2021; Probst et al., 2012; Sipos et al., 2023a; Sipos et al., 2023b; Zanardo et al., 2022).

Table 1

Study Summary

Author(s)	Year	Country	Population	Objective	Outcome	Study Type	Length of Study	Number of Surveys Distributed	Number of Responses	Measurement Tool(s)
Alakhras M., Al-Mousa DS, Lewis S.	2022	Jordan	Radiographers	To measure and determine the correlation and specific factors affecting burnout and job satisfaction among radiographers.	Burnout	Survey	6 months (Oct. 2018 - April 2019)	352	308	A Socio-demographic Questionnaire, the Maslach Burnout Inventory - Human Services Survey for Medical Personnel (MBI-HHS (MP)), and the Job Satisfaction Survey (JSS)
Pereira JM, Silva C, Freitas D, Salgado A.	2021	Portugal	Radiographers	To assess the impact of the COVID-19 pandemic on the incidence of burnout among Portuguese	Burnout	Survey	10 days (April 16-26)	N/A	386	Three-part questionnaire: sociodemographic data, data on the impact of the pandemic on radiographers, and the Portuguese version of the

				radiographers.						Maslach Burnout Inventory - Human Services Survey (MBI-HHS).
Probst H, Griffiths S, Adams R, Hill C.	2012	United Kingdom	Radiotherapists (Therapy radiographers)	To investigate the key concepts identified in a previous qualitative Phase I study using quantitative assessment, and to validate the grounded theory model proposed from the interpretative Phase I, including assessing whether burnout was a key issue that needed further investigation.	Burnout	Survey	Over the summer months	344	97	A questionnaire consisting of Professional plateau, Intrinsic job characteristics, Job satisfaction, Leadership Practices Inventory, Maslach Burnout Inventory, and Task load.
Singh N, Knight K, Wright C,	2017	Australia and New	Sonographers, radiographers, and	To investigate occupational burnout among	Occupational burnout	Survey	N/A	10,788	769	Maslach Burnout Inventory, and a demographic questionnaire.

Baird M, Akroyd D, Adams RD, Schneider ME.		Zealand	radiologists	radiographers, sonographers, and radiologists in Australia and New Zealand.						
Sipos D, Jenei T, Kövesdi O L, et al.	2023a	Hungary	Radiographers	To investigate burnout and occupational stress among radiographers working in emergency (ED) and non-emergency (NED) departments during the COVID-19 pandemic in Hungary.	Burnout and occupational stress	Survey	4 months (February 1, 2021-June 1, 2021)	1546	439	Maslach Burnout Inventory (MBI), the Effort-Reward Imbalance questionnaire (ERI), and a self-designed questionnaire).
Sipos D, Kunstár O, Kovács A, Csima M P.	2023b	Hungary	Oncologists, nurses, and radiographers	To analyze the prevalence of burnout among oncologists, nurses, and radiation therapy	Burnout	Survey	8 months (November 2020-July 2021)	N/A	205	

				radiographers working in oncology patient care, and to determine whether demographic and work-related factors influenceburnout in the above-mentioned professional group.						Maslach Burnout Inventory-Human Services Survey (MBI-HSS), and a self-created questionnaire.
Zanardo M, Cornacchione P, Marconi E, et al.	2022	Italy	Radiation therapy technologists	To assess the prevalence of burnout among RTTs across Italy before and during the pandemic outbreak and whether demographic variables and work-related factors had any	Occupational burnout	Survey	June 2019 and June 2020	~ 2000	367	A Demographic and work-related survey, and the Maslach Burnout Inventory Survey.

				influence on burnout and perceived stress among Italian RTTs.						

Authors		Alakhras M., Al-Mousa DS, Lewis S.	Pereira JM, Silva C, Freitas D, Salgado A.	Probst H, Griffiths S, Adams R, Hill C.	Singh N, Knight K, Wright C, Baird M, Akroyd D, Adams RD, Schneider ME.[1]	Sipos D, Jenei T, Kövesdi O L, et al.	Sipos D, Kunstár O, Kovács A, Csima M P.	Zanardo M, Cornacchi one P, Marconi E, et al.	Tota l

Table 2

Population Characteristics

Population		Radiographers	Radiographers	Radiotherapists (Therapy radiographers	Sonographers, radiographers, radiologists	Radiographers	Oncologists, nurses, and radiographers	Radiation therapy technologists	Total
Gender	Male	149	121	NR	237	NR	47	165	**804**
	Female	159	265	NR	496	354	158	202	**1634**
Age	<30	173	120	NR	NR	82	NR	71	**446**
	>30 ≤ 40	98	153	NR	NR	104	NR	116	**471**
	> 41 < 50	28	78	NR	NR	114	NR	82	**302**
	> 50	9	35	NR	NR	139	NR	98	**281**
Marital Status	Married/partner	NR	215	NR	524	NR	148	NR	**887**
	Single	NR	148	NR	198	NR	NR	NR	**346**
Children	With	NR	174	NR	619	NR	148	164	**1105**
	Without	NR	212	NR	103	NR	NR	NR	**315**

Modality	Radiography	174	NR	NR	613	NR	52	NR	**839**
	Mammography	15	NR	NR	NR	NR	NR	NR	**15**
	Angiography	9	NR	NR	NR	NR	NR	NR	**9**
	Nuclear Medicine	25	NR	NR	NR	NR	NR	NR	**25**
	Computed Tomography	50	NR	NR	NR	NR	NR	NR	**50**
	Magnetic Resonance	35	NR	NR	NR	NR	NR	NR	**35**
	Sonography	NR	NR	NR	121	NR	NR	NR	**121**
Education Level	Graduate	NR	322	NR	NR	NR	NR	NR	**322**
	Diploma	127	NR	NR	NR	NR	NR	NR	**127**
	Bachelor	177	14	NR	592	NR	NR	NR	**783**

	Masters	4	49	NR	NR	NR	NR	NR	**53**
	Doctorate	NR	1	NR	NR	NR	NR	NR	**1**
Employment	Private	101	NR	NR	NR	NR	NR	NR	**101**
	Public	163	NR	NR	NR	NR	NR	NR	**163**
	Military	44	NR	NR	NR	NR	NR	NR	**44**
	County	NR	NR	NR	NR	NR	91	NR	**91**
Caseload	10	43	NR	NR	NR	NR	NR	NR	**43**
Patients per day	15	15	NR	NR	NR	NR	NR	NR	**15**
	20	22	NR	NR	NR	NR	NR	NR	**22**
	25	23	NR	NR	NR	NR	NR	NR	**23**
	>25	189	NR	NR	NR	NR	NR	NR	**189**

[1]Mean age reported= 46.6(SD=12.6, range=22-83).

Table 3

Outcomes

Author(s)	Population	Objective	Burnout Measurement Tool			Questionnaire Outcome(s)
			MBI-HSS / MBI			
			Emotional Exhaustion	Depersonalization	Personal Accomplishment	
Alakhras M., Al-Mousa DS, Lewis S.	Radiographers	To measure and determine the correlation and specific factors affecting burnout and job satisfaction among radiographers.	High	Moderate	Moderate	Dissatisfied with pay (n=221, 71.8%), opportunities for promotion (n=202, 65.6%), fringe benefits (n=239, 77.6%), contingent rewards (n=231, 75.0%), operating procedures (n= 190, 61.7%) and communication (n=162, 52.6%).
Pereira JM, Silva C, Freitas D, Salgado A.	Radiographers	To assess the impact of the COVID-19 pandemic on the incidence of burnout among Portuguese radiographers.	High	High	Moderate	Difficulty adapting to change, which resulted in increased EE and DP. Studies

						showed a clear link between lack of control and burnout.
Probst H, Griffiths S, Adams R, Hill C.	Radiotherapists	To investigate the key concepts identified in a previous qualitative Phase I study using quantitative assessment and to validate the grounded theory model proposed from the interpretative Phase I, including assessing whether or not burnout was a key issue that needed further investigation.	Moderate	Moderate	High	NR
Singh N, Knight K, Wright C, Baird M, Akroyd D, Adams RD, Schneider ME.	Sonographers	To investigate occupational burnout among radiographers, sonographers, and radiologists in Australia and New Zealand. The research aimed to examine the levels of occupational burnout among the participants compared to national MBI norms and the relationship between	High	High	Moderate	NR
	Radiographers		High	High	Low	

		demographic variables and the level of burnout in them.				
Sipos D, Jenei T, Kövesdi O L, et al.	Radiographers	To investigate burnout and occupational stress among radiographers working in emergency (ED) and non-emergency (NED) departments during the COVID-19 pandemic in Hungary.	Moderate	Moderate	Moderate	Concern about personal health impacted DP and EE (p=0.05). Having close friends with a COVID-19 infection impacted EE (p=0.05); not being infected with coronavirus, not being quarantined, and relocating within the workplace had a positive effect on personal accomplishment (PA); radiographers who were 50 years or older with 20-29 years of experience were more affected by depersonalization

						(DP); and those who worried about their health had significantly higher stress scores (p=0.05) in both ED and NED settings.
Sipos D, Kunstár O, Kovács A, Csima M P.	Radiographers	To analyze the prevalence of burnout among oncologists, nurses, and radiation therapy radiographers working in oncology patient care and to determine whether demographic and work-related factors influenced burnout.	Low	Low	High	NR
	Radiation Therapy Technologists (2019)		High	High	High	
Zanardo M, Cornacchione P, Marconi E, et al.	Radiation Therapy Technologists (2020)	To assess the prevalence of burnout among RTTs across Italy before and during the pandemic outbreak and whether demographic	High	High	Moderate	NR

		variables and work-related factors had any influence on burnout and perceived stress.				

Table 4

Risk of Bias for Qualitative Research

Critical Appraisal Skills Programme for Qualitative Research. https://casp-uk.net/checklists/casp-qualitative-studies-checklist.pdf	Alakhras M, Al-Mousa DS, Lewis S.	Pereira JM, Silva C, Freitas D, Salgado A.	Probst H, Griffiths S, Adams R, Hill C.	Singh N, Knight K, Wright C, Baird M, Akroyd D, Adams RD, Schneider ME.	Sipos D, Jenei T, Kövesdi OL, et al.	Sipos D, Kunstár O, Kovács A, Csima MP.	Zanardo M, Cornacchione P, Marconi E, et al.
Was there a clear statement of the aims of the research?	Y	Y	Y	Y	Y	Y	Y
Is a qualitative methodology appropriate?	Y	Y	Y	Y	Y	Y	Y
Was the research design appropriate to address the aims of the research?	Y	Y	Y	Y	Y	Y	Y
Was the recruitment strategy appropriate to the aims of the research?	Y	Y	Y	Y	Y	Y	Y
Was the data collected in a way that addressed the research issue?	Y	Y	Y	Y	Y	Y	Y
Has the relationship between researcher and participants been adequately considered?	Y	Y	Y	Y	Y	Y	Y
Have ethical issues been taken into consideration?	Y	Y	Y	Y	Y	Y	Y
Was the data analysis sufficiently rigorous?	Y	Y	Y	Y	Y	Y	Y
Is there a clear statement of findings?	Y	Y	Y	Y	Y	Y	Y
How valuable is the research? Will the results help locally?	Y	Y	Y	Y	Y	Y	Y

Yes (Y)
Can't Tell (CT)
No (N)

Discussion

While burnout among R.T.s was confirmed, thetheory that the use of HIT attributed to burnout was not proven. The results indicated a gap in the literature where no studies assessed the role of HIT as a variable for burnout among R.T.s. In addition, there was no original research that measured burnout among R.T.sin the United States (U.S.).The discussion,ergo,focuses separately on theeffects of burnout among R.T.s and HIT-induced burnout among other healthcareworkers to providea holistic perspective of how they canimpact R.T.s,necessitatingresearchto understand the importance, effects,and influence of both.

The data from all the studies comprehensively suggested that high and moderate levels of burnout were prevalent among the participants globallyin terms of the emotional exhaustion and depersonalization dimensions of burnout.R.T.s between 30 and 40 years of age, married or partnered with a family, and with 10 or more years of experience were affected by burnout. In addition, public employees with a heavy caseload of more than 25 patients per day reported high levels of burnout. Women radiographers were also established to experience burnout more than their male colleagues.

Research suggests thatalthough burnout is not gender-specific, women physicians experience more burnout symptoms. Gender differences exist between burnout symptoms, specifically exhaustion, depersonalization, and lack of efficacy (De Hert, 2020).Another study that focused on identifying the causes of occupational stress among women healthcare workers reported that safety, staffing and resources, workload, compensation, job roles, and security were triggers of occupational stress (Sriharan et al., 2021).The data from this reviewsuggested that women R.T.s with a heavy caseloadsolidifiedprevious research in which burnout was identified as stress-induced (Winston, 2015).

Burnout also affected R.T.s between 30 and 40 years of age, indicating that this age group is more susceptible to burnout. In a study on the association between age and gender and burnout symptoms, women between 20 and 35 years and over 55 were more disposed to burnout. Burnout levels, however, are reduced in men as they age (Marchand et al., 2018).

Radiologic technologists were moderate to highly emotionally exhausted, followed by a sense of depersonalization. The results shared similarities to a study on burnout among non-physician healthcare workers in the U.S.,where most participants reported burnout in the emotional exhaustion dimension (Dyrbye et al., 2021).The additional surveys distributed in three of the studiesidentified the socio-demographic factors of the participants, and the similarities identified were attributed to burnout (Alakhras et al., 2021; Pereira et al., 2021; Sipos et al., 2023a). Benefits, rewards, salary, job growth,

operations, and communication were referenced; however, the effects of HIT were not reported. Changes in the workplace and health concerns were identified as the reasonsfor burnout in two studies (Pereira et al., 2021; Sipos et al., 2023a).

Although the effects of HIT usage and its potential contribution to burnout were not recognized, parallel research,however, established a correlation between the use of EMRs and burnout in other healthcare providersand concluded that navigating the functionality and usability of the systems, time spent on documentation, and messaging and alert overload were all contributing factors to burnout. The time spent on EMR documentation and the inability to adequately navigate HIT system features were deemed significant indicators of burnout among providers (Li et al., 2022).

A similar qualitative review of the well-being of clinicians reported poor feedback on using digital tools. They reported that communication barriers, inaccurate data, the unavailability of the tools, management challenges, patient safety events, poor quality of care, and organizational and workflow issues were all adverse outcomes of using digital tools (Wosny et al., 2023). Radiologic technologists frequently adapt to new technologies when new machines, applications, and software are acquired. The ability to learn new systems varies with individuals. It can add to workflow stressors,negatively impacting patient safety, such as incorrectly entering data in the wrong patient's chart.This solidifies the need for radiology departments to provide adequate training and staffing when implementing new HIT systems to avoid stress-related burnout arising from new practices in the department. Workflow concerns in radiology that potentially contribute to burnout include multiple instances of EHR documentation during a single study. Streamlining workflow processes or integrating HIT systems with fewer repetitive steps may reduce workload fatigue and alleviate burnout symptoms among R.T.s.

Physical symptoms often manifest because of burnout and HIT use. R.T.s are prone to optical and orthopedic concerns and muscular strain from repetitive use (Hulls et al., 2018; Bernier et al., 2018). Burnout is prevalent among healthcare workers, and signs and symptoms are characteristically similar, as are the causes due to daily repetitive tasks, including HIT use. Further studies on burnout among R.T.s will identify which modalities are more prone to burnout, including predictors and symptoms. Additionally, research on the impact of HIT among R.T.s will assist organizations in managing burnout in this population.

Recommendations to alleviate burnout include promoting healthy workforce management practices, employee engagement aimed at camaraderie and transparency, internal promotions, and additional compensation or acknowledgment (Sipos et al., 2023b). Self-focused interventions such as exercise, wellness, religious activities, hobbies, and

psychological resources were also endorsed.In addition, system-focused interventions, including clear communication, workplace modifications, wellness programs, and resources, were cited as stress and burnout coping-related strategies for women in healthcare (Sriharan et al., 2021).

The demand that medical professionals adapt to new technologies amidst staff crises, adjust to irregular shift patterns and experience a lack of or infrequent career advancement are all determinants of burnout. This also applies to R.T.s, where daily electronic tasks combined with user incompetency can contribute to burnout. Mitigating the factors contributing to burnout will facilitate a more effective, efficient, and safe patient environment. This could also lead to improved employer-staff relationships and building a healthier workforce.

The review of the current literature on exploring burnout among R.T.s and the potential role of HIT was limited. Two studies that explored burnout among R.T.s assessed its correlation with job satisfaction and conducted pre- and post-COVID-19 comparisons (Alakhras et al., 2021; Sipos et al., 2023a). Two studies specifically targeted the oncology and emergency departments (Sipos et al., 2023a; Sipos et al., 2023b). All of the studieswere also conducted outside of the U.S., where the duties and workflows may not mirror those utilized in the U.S.

Future research strategies involvingR.T.s and the effect of HIT may include:

i. Determining the assessment and the effectiveness of HIT systems' user-centered features by quantifyingthe frequency of R.T.s' interactions with the systems.
ii. Assessing the impact of specific HIT systems among R.T.susing standardized surveys, e.g., the Health Information Technology Usability Evaluation Scale (Health-ITUES).
iii. Examining errors and system malfunctions encountered by R.T.s using HIT systems.
iv. Implementing and assessing work-life balance programs and mindfulness interventions among R.T.s to prevent or mitigate burnout.
v. Assessing the time R.T.s spend on direct patient care versus HIT systems bydata analysis or observational studies.

Quantitatively measuring these variables will facilitate the assessment of the effect of HIT on burnout among R.T.s.

Conclusion

Burnout has been recognized as an occupational phenomenon that universally affects healthcare workers. It is validated scientifically by the Maslach Burnout Inventory, the most widelyused assessment tool.Commonly identified occupational indicators were remuneration, pandemic-related fears, and excessive technology utilization among the healthcare workforce. Overwhelming job demands, limited resources and support, and the expectation that staff increase productivity contribute to this phenomenon(Shields et al., 2021).

Loss of interpersonal relationships among colleagues, poor administrative dynamics, and individual propensities contribute to burnout triggers. Similarly, a heavy workload and a lack of or infrequent supervisory support, combined with the emotional impact of navigating a system to care for ill patients daily, contribute to burnout among healthcare providers.

Burnout has been investigated through systematic reviews amongR.T.s, and while it was prevalent, the effects of HIT usage were notestablished. The studies included in this review concluded that burnout was exacerbated due to COVID-related stressors and other occupational shortfalls in the healthcare organization. The possible future research strategies presented in the discussion would assist in providing a holistic view of the effect of HIT systems' usage among R.T.s.

Limitations

Limited original research on R.T.s presented challenges with data collection for this review. Radiologic technologists are principally frontline healthcare workers unless employed in academia or research, which may have contributed to the limited resources. Studies on burnout among R.T.s were easily identified but were limited as most were systematic reviews and did not contain original material. No original research was conducted in the U.S. on burnout or the effects of HIT among R.T.s. Therefore, a significant gap exists in the literature and opportunities to investigate the burnout phenomena among R.T.s and the effects of HIT in this healthcare population.

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