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EDITORIAL

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Operational developments at the *Journal of the Medical Library Association*: improved production timelines, new policy introduction, and senior editorial team updates

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See end of article for authors' affiliations.

In our editorial in the January/April 2023 issue of the *Journal of the Medical Library Association* (*JMLA*), we spoke of the challenges we faced when we took on the co-lead editor roles. At the end of that editorial, we stated our intention to get the publishing schedule back on track and to finally tackle other projects. And while it took us some time to report it, we are pleased to share that, in the publication year of 2024, *JMLA* resumed its regular quarterly publishing schedule.

PRODUCTION TIMELINES

In our editorial in the January/April 2023 issue of *JMLA*, we spoke of the challenges we faced when we took on the co-lead editor roles. At the end of that editorial, we stated our intention to get the publishing schedule back on track and to finally tackle other projects. And while it took us some time to report it, we are pleased to share that, in the publication year of 2024, *JMLA* resumed its regular quarterly publishing schedule.

We also improved the time that it takes for a manuscript to work its way through the publication process. The following data from our peer reviewed publication categories of Knowledge Synthesis, Original Investigation, and Case Report demonstrate this shortened timeline. In 2024, 80% of submissions received notification of acceptance in 234 days or notification of decline in 23 days. The 234 days represents the time it has taken for a manuscript to go through one or more rounds of peer review and various rounds of revisions, before being accepted for publication. Unfortunately, we do not have a data point to report the average amount of time it takes for a manuscript authors to hear back from the first round of peer review, but as we reported in our April 2024 editorial, we strive to have this response back within six weeks of submission. This metric of 234 days-to-accept for 80% of our submissions in 2024 represents a significant improvement from 2022, where 80% of our submissions waited 346 days, or nearly a year, for acceptance.

We are also pleased to report that we have had a steady number of manuscript submissions, with 142 in 2022, 152 in 2023, and 165 in 2024. From these submissions, we have accepted 29, 32, and 32 peer-reviewed manuscripts respectively. We look forward to reading your future submissions!

As editors we are always seeking individuals with a diverse set of knowledge and skills in health sciences libraries to serve as peer reviewers. It is important to have a deep pool of reviewers in many subjects and areas of expertise, especially in new and emerging trends, so that authors and readers can fully benefit from the peer review process. *JMLA*'s website has links to several resources on the peer review process and how to provide good peer review. If you are interested in serving as a peer reviewer please contact us at jmla@journals.pitt.edu.

As generative artificial intelligence (GenAI) continues to have an impact on the publishing and research landscape, *JMLA* is proud to be one of the first library journals to have established a policy on the use of GenAI. We continue to monitor the evolution of AI so that we can adjust our policy accordingly. We look forward to publishing articles on GenAI and its impact in libraries and research methodology.

NAME CHANGE POLICY

One of the projects that we were finally able to implement was an official name change policy for JMLA. Thanks to the hard work of the JMLA Equity Group, who drafted the policy with input from the senior editorial team, we now have a clear procedure for any JMLA author who would like to request a name change. Name changes are available to authors upon request with no explanation or legal documentation required. This policy does not apply to author name misspellings due to copy-editing errors or affiliation changes. The lead editor will work with the

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production editor to update all digitally published content, metadata, and associated records under our control to reflect the requested name change, and we will not issue a notice of correction for the name change. For more information about this policy, please see our name change policy webpage.

The *JMLA* editorial board is committed to collaborating with other groups to advocate for systemic changes to ensure author name changes are fully supported in academic publishing. To that end, we strongly encourage all contributors to *JMLA* to utilize open systems like ORCiD which allow authors, researchers, and scholars to create profiles with associated unique, persistent identifiers independent of their legal names and/or institutional affiliations.

SENIOR EDITORIAL TEAM UPDATES

Kathleen Amos has stepped down from her role as Associate Editor, a position she has held for nearly a decade. After completing a two-year term within the National Library of Medicine's Associate Fellow program, Kathleen joined the Public Health Foundation (PHF) as a librarian through the Sewell Learning Partnership program. While in this role, Kathleen published her first article within *JMLA*, exploring plagiarism and duplicate publications within biomedical literature. Although Kathleen's portfolio at PHF quickly grew to includes responsibilities beyond health sciences libraries, her commitment to leading change within the scholarly publishing ecosystem has never wavered. Kathleen leaves *JMLA* as our longest tenured current editorial member; her generosity, humor, and publishing insight will be dearly missed by her colleagues across the journal.

We are delighted to welcome Robin Parker, MLIS, PhD, to the senior editorial team as Assistant Editor, after serving on the *JMLA* Editorial Board from 2021 to 2024 and as a peer reviewer for many years. Robin has significant experience with qualitative research, having completed an interdisciplinary PhD with a digital ethnographic study using sociomaterialism as a framework to examine how health librarians teach knowledge synthesis methods in online environments. Her dissertation described the invisible labour and specialized expertise of librarians supporting learners through the relationships amongst research and communication technologies, online pedagogies, and review methodologies. Robin works as the Evidence Synthesis Librarian and library liaison supporting undergraduate, graduate, and postgraduate Medicine programs at the W.K. Kellogg Health Sciences Library at Dalhousie University in Nova Scotia, Canada. In addition to her interests in using qualitative research methods to understand the role of context in health libraries and health professions education, Robin has extensive experience with review methodologies and systematic searching. She has been involved with the Cochrane Collaboration, including as a Cochrane author for over 15 years. Robin looks forward to supporting authors interested in publishing their qualitative and mixed methods research with JMLA.

Finally, we are pleased to announce our recent re-appointment as the Co-Lead Editors of JMLA. It has been an honor to serve, and we look forward to being able to implement more of our ideas over the next three years.

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ORIGINAL INVESTIGATION
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Acute mental health concerns in emergency settings: development and validation of an Ovid MEDLINE search filter

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Background: The authors sought to develop and validate a search filter to retrieve research about acute mental health concerns during public health emergencies. They did so as a response to a recommendation from a previously published paper on searching for evidence in emergency contexts.

Methods: The definition of acute mental health was adapted from the DSM-5 and the DynaMed entries on acute stress and posttraumatic stress disorder. The definition of public health emergencies was adapted from the Canadian Medical Protective Association. The authors retrieved systematic reviews on mental health concerns pertaining to people in the community and healthcare workers during public health emergencies from MEDLINE. The authors formulated gold standard sets for each population group using articles included in these reviews. The authors then separated the articles into development and validation sets. Keywords and Medical Subject Heading (MeSH) terms from the title and abstracts in the Ovid records in the development sets were used to formulate the filter. The filter was tested via the relative recall method using the validation sets. The authors then tested the filter for precision by conducting MEDLINE (Ovid) searches for the following topics for acute mental health: (i) children/adolescents and earthquakes; (ii) children/adolescents and Ebola outbreaks; (iii) healthcare workers and earthquakes; and (iv) healthcare workers and Ebola outbreaks.

Results: The MEDLINE filter demonstrated 100% recall against the people in the community validation set and 98% recall against the healthcare worker validation set. The filter demonstrated the following percentages for the precision tests: (i) 94% for children/adolescents and earthquakes; (ii) 81% for children/adolescents and Ebola outbreaks; (iii) 81% for healthcare workers and earthquakes; and (iv) 79% for healthcare workers and Ebola outbreaks.

Conclusion: The authors developed a validated search filter that could be used to find evidence related to acute mental health concerns in public health emergencies. The authors recommend that researchers adapt and modify the search filter to reflect the unique mental health issues of their population groups.

Keywords: Search filter validation; search hedge validation; emergencies

See end of article for supplemental content.

INTRODUCTION

Public health emergencies and catastrophes pose significant psychological threats for many population groups and have the potential to do so in the future (1, 2). Exposure to a public health emergency or a catastrophe is common and one-third or more individuals may develop posttraumatic stress disorder and/or other psychological disorders after severe exposure to the event (3). The COVID-19 pandemic was no exception: several systematic reviews detailed a high prevalence of anxiety, depression, and trauma across affected countries and populations (3–5). One study conducted by Zhou et al suggested that posttraumatic stress disorder was a concerning mental health problem in light of several major emergencies over the past two decades, and that it is crucial to further explore the psychological mechanisms and effective strategies for prevention and intervention (2).

To achieve this goal, researchers need to find ways to optimize their retrieval of evidence, which can be hampered by poor search strategies (6). Finding evidence during a public health emergency, especially in the case of a novel pandemic, poses many challenges. During the COVID-19 pandemic, for instance, many librarians, particularly clinical librarians working out of the hospitals, were tasked with finding answers to questions that seemed to outpace the evidence in a rapidly evolving

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information environment (7). These challenges included the volume and heterogeneity of the literature being produced, the rapid production of data, and the proliferation of new resources, all of which prompted the Librarian Reserve Corps to draft a white paper on searching for evidence during public health emergencies (7).

Before constructing the filter presented here, we consulted several resources for validated filters for acute mental health that could be applied to public health emergencies. We were unable to find any existing validated filters for this topic on the ISSG Search Filter Resource (20), the Scottish Intercollegiate Guideline Network (21), the Penn Center for Evidence-Based Practice (22) , or the University of Alberta Health Sciences Search Filters website. (26) The Ovid Expert Searches website published by Wolters Kluwer contains specific searches for COVID-19 and mental health, coping with fires and wildfires, earthquakes and PTSD (10), but the reference lists and validation data are lacking for many of these filters.

In terms of non-validated searches, we found through an Internet search three search strategies that were limited to mental health in the COVID-19 pandemic and used terms that may not be generalizable to other types of disasters (i.e. quarantine, physical distancing, etc.) (9, 23, 24, 25). Finally, we searched CABI's searchRxiv (29) using the terms "acute mental health," "disaster mental health," and "emergency mental health," and we were unable to find any search strategies related to acute mental health in the public health emergencies context.

The one filter we did find was that of Wilcynski et al (31); however, this study did not use the relative recall method, the gold standard for the validation of a search filter, which we used in our study.

We recognized the value of developing validated filters to assist with responses to the evolving information needs of stakeholders during emergencies (7). This manuscript describes the development and validation of a search filter that can be used to retrieve evidence pertaining to acute mental health conditions during public health emergencies. This validated search filter is designed for use in MEDLINE (Ovid) and does not have a specific methodological focus.

This filter is designed to be paired with emergency-specific filters such as those provided by the CADTH (now Canada's Drug Agency) Covid-19 Search Strings website (8), the COVID-19 Repository (9), the filters for emergencies and disasters on the Ovid Expert Searches website (10), and other filters for emergencies and disasters. It is designed to achieve a balance between recall and specificity, and can be used by clinicians, librarians, policymakers, or public health professionals who are finding evidence during public health emergencies.

METHODS

Scope and Definitions

In this project, we designed and validated a search filter to retrieve evidence for acute mental health concerns during public health emergencies. We did not design the filter with the aim of retrieving literature on populations groups with pre-existing mental health conditions. We also did not aim to include studies that focused on the long-term sequelae, prognosis, and treatments for mental health. Our aim was to capture literature that reflected the scope of the United Nations Office for Disaster Risk Reduction (UNDRR) response: actions taken directly before, during or immediately after a disaster to reduce health impacts and "predominantly focused on immediate and short-term needs" (32).

We consulted the following entry for acute stress disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) to inform our definition of acute mental disorders: "The essential feature of acute stress disorder is the development of characteristic symptoms lasting from 3 days to 1 month following exposure to one or more traumatic events" (33). We are cognizant that the timeframe for when acute stress disorder becomes a chronic condition is a matter of debate among professionals in the mental health community. We also consulted the Acute Stress Disorder entry in DynaMed and searched APA PsycINFO, MEDLINE and the grey literature using the terms "acute stress," "acute trauma," "acute mental disorders" and "acute mental health conditions." We were unable to find consistent alternative definitions for acute stress. We noted that the evaluation criteria for posttraumatic stress disorder in DynaMed included the following: "Symptoms must persist for more than 1 month. Some patients may not meet the full diagnostic criteria until at least 6 months after the event (delayed expression)" (34). We used both definitions in the DSM-5 and DynaMed to capture populations with both immediate and delayed expressions of trauma – that is, mental health symptoms lasting from 3 days to 6 months after the event. The mental health concerns included in the filter were the psychological and emotional symptoms related to traumatic events including posttraumatic stress, anxiety, depression, behavioural and emotional problems, burnout, and compassion fatigue.

We consulted the Canadian Medical Protection Association's (CMPA) Public Health Emergencies and Catastrophic Events page to inform our definition of public health emergencies. The CMPA site defines a public health emergency as: "an urgent and critical situation of temporary nature that seriously endangers the lives, health and/or safety of the population. It would require prompt action beyond normal procedures to prevent or limit health consequences to the affected population" (35). These public health emergencies could include pandemics

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and disease outbreaks, natural disasters, mass casualty incidents, wars, and political violence.

We also wanted to include the following two broad population groups when curating the development and validation sets: (i) people in the community and (ii) healthcare workers. By "people in the community" we mean any person in the community living and working in non-healthcare settings. By "healthcare workers" we mean any person working in any healthcare context (i.e. physicians, nurses, therapists, etc.). When developing the filter, we hypothesized that these two population groups would require a different search approach due to different perspectives and the degrees to which each would be mentally impacted by the public health emergency (i.e. burnout, compassion fatigue, etc.).

Creating the Gold Standard Sets

We used the "relative recall" method to validate the search filter. Sampson et al demonstrated the use of the relative recall method in search validation (11). They proposed a collection of 100 relevant studies derived from existing systematic reviews as being an appropriate gold standard for the validation of a search filter. This relative recall method was subsequently adopted by multiple researchers working on filter validation projects (12-14).

For this project, we adapted a published step-by-step guide to creating a validated geographic filter (14) using the relative recall method.

To build our gold standard sets, we began by identifying systematic reviews in MEDLINE on mental health concerns during public health emergencies using a combination of keywords and MeSH to capture the following concepts: (i) mental, psychological, emotional symptoms; (ii) acute symptoms; (iii) pandemics, epidemics, natural disasters, human-made disasters, public health emergencies; (iv) healthcare workers; (v) seniors, adults, adolescents, or children in the community. We aimed to locate a similar number of articles for both healthcare professionals and people in the community. We also aimed to identify reviews addressing a variety of contexts to improve the transferability of the findings. We found that the recent literature focused on the COVID-19 pandemic and infectious diseases in general. Thus, we made a concerted effort to find reviews on natural and human-made disasters ranging from chemical and biological warfare to wildfires. For reviews to be included in the gold standard sets they needed to focus on mental health symptoms lasting from 3 days to 6 months after the event. The reviews also needed to provide a description of a search strategy that at least utilized PubMed or Medline to be considered for inclusion.

We excluded reviews on mental health concerns related to climate change. While climate change is a serious issue and an ongoing emergency it does not present the same acute trauma as other emergencies. Reviews on wildfires, hurricanes, tornadoes, and other weather-related disasters that are connected to climate change were included because they considered the acute mental health concerns in these contexts. We also excluded reviews that focused on individuals with pre-existing mental health conditions, that did not provide details of the search strategy, and that were not indexed in MEDLINE or PubMed.

We gathered 54 reviews on acute mental health concerns during public health emergencies for people in the community and 39 reviews for healthcare workers. The two authors screened these reviews and excluded 32 reviews for people in the community and 17 reviews for healthcare workers because they did not meet the inclusion criteria. The two authors resolved any disputes that arose by consensus. We were left with 22 reviews for people in the community and 22 reviews for healthcare workers. We extracted the included studies from these reviews. This resulted in a total of 525 citations with publication years ranging from 1987 to 2023: 206 articles for people in the community and 319 articles for healthcare professionals. We then divided each collection into two sets: a development set for creation of the filter and assessment of internal validity, and a validation set for assessment of external validity. After randomly ordering the articles, we divided them into the following sets comprising our gold standard: (i) 103 articles for a development set for people in the community; (ii) 103 articles for a validation set for people in the community; (iii) 159 articles for a development set for healthcare workers; and (iv) 160 articles for a validation set for healthcare workers. This process provided us with a sufficient size to allow for a reasonable confidence interval in validation as described by Sampson et al (11). Appendices B and C list the included reviews.

Development of the Filter

We created the initial filter for Ovid MEDLINE based on the results in the community and healthcare worker development sets. The records were reviewed for search terms reflecting the concept of acute mental health issues. The first author reviewed the articles for people in the community and the second author reviewed the articles for healthcare workers. Both authors extracted broad concepts related to mental health problems (affective symptoms, behavioral and emotional symptoms, mental disorders) and acute symptoms (acute disease, early diagnosis, incidence, prevalence, cohort studies and cross-sectional studies), reflective of the predetermined scope of the filter. . The second author extracted the following unique broad concepts related to mental health conditions in the healthcare worker records: occupational stress, psychological resilience, compassion fatigue and burnout. No unique concepts were extracted for people of the community.

Once the broad concepts had been determined, specific search terminology was adopted from the headings and free-text terms present in the reviewed records, using a pragmatic approach to balance recall and specificity. The two authors of this paper each independently developed a search strategy using the extracted headings and free-text terms, combining the search terms with database- and platform-appropriate syntax and Boolean operators, and refining the search iteratively based on reviewing the records retrieved by particular term combinations. We opted to create the filter to search the titles and abstracts only because we found that many of the author-supplied keywords already appeared in the title and abstract. We wanted to increase the precision (reduce the amount of noise) and reduce the yield (the number of articles to screen) during the validation process.

Validation Methods

The targets for the validation of a filter vary among researchers. We adopted a target recall of 90% as proposed by multiple studies (16, 18, 19). We assessed the filter's internal validity by calculating recall against the development sets for each population. We assessed the records for the missed references and included additional terms into the filter to improve recall, after which the calculation was redone. We then assessed the filter's external validity by calculating its recall against the validation set.

Development of Precision Test Set

Finally, we assessed the precision of the filter by testing it in combination with the following topics: (i) children/adolescents and earthquakes; (ii) children/adolescents and Ebola outbreaks; (iii) healthcare workers and earthquakes; and (iv) healthcare workers and Ebola outbreaks. See Table 1 for the precision test search strings.

These strings are derived from one author's search practice and are not themselves validated; they were used simply to assess the precision of the proposed search filter in various contexts. Children and healthcare workers were selected because they represent subpopulations of common interest in discussion of the mental health impact of public health emergencies. Ebola and earthquakes were selected because they represent two different types of emergency (disease and natural disaster) and we wanted to avoid the problem of a filter too specific to the COVID-19 context that we noted in our search for existing filters. We also limited the results for all four scenarios to English-language articles published since 2019 as a convenience limit. All searches were conducted in Ovid MEDLINE.

Table 1 Precision search test strings

Key: 'ti,ab' refers to a search of the title and abstract fields. '/' is indicative of a subject heading. 'exp' indicates explosion of the narrower terms beneath a heading. '*' is used to substitute for zero or more characters. '?' is used to substitute for zero or one character. 'adjN' is used for searching words that appear within N words of each other.

Concept	Children and Adolescents	Healthcare Workers	Earthquakes	Ebola Virus Outbreaks
String	Child/ or Adolescent/ or (adolescen* or boy? or child or children or girl? or highschool* or high school* or juvenile? or kindergarten* or middle school* or preschool* or teen* or toddler? or tween* or youth).ti,ab.	exp Health Personnel/ or exp Nurses/ or exp Patient Care Team/ or (allergist? or anatomist? or anesthetist? or anesthesiologist? or audiologist? or cardiologist? or clinician? or counsellor? or dermatologist? or dietitian? or doctor? or endocrinologist? or gastroenterologist? or geriatrician? or hospitalist? or nephrologist? or neurologist? or nurse? or nutritionist? or oncologist? or ophthalmologist? or pathologist? or pediatrician? or pharmacist? or physiatrist? or physician? or physiotherapist? or practitioner? or psychologist? or psychiatrist? or pulmonologist? or radiologist? or rheumatologist? or social worker? or surgeon? or urologist? or therapist?).ti,ab or ((allied-health or allied health or health or health-care or healthcare or hospital? or medical or nursing) adj2 (employee? or manager? or personnel or staff or team? or work*)).ti,ab.	Earthquakes/ or earthquake?.ti,ab	Ebolavirus/ or Hemorrhagic Fever, Ebola/ or ebola*.ti,ab.

RESULTS

After developing the filter as described in the Methods, we then tested the two filters for acute mental health in people in the community and acute mental health for healthcare workers by assessing its recall against the development sets. The filter developed by the first author had a recall of 99% (102 out of 103 articles) against the development set for people in the community and 86%

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Table 2 Combined final filter.

Key: ‘ti,ab’ refers to a search of the title and abstract fields. ‘/’ is indicative of a subject heading. ‘exp’ indicates explosion of the narrower terms beneath a heading. ‘*’ is used to substitute for zero or more characters. ‘?’ is used to substitute for zero or one character. ‘$N’ is used to substitute for zero to N characters. ‘adjN’ is used for searching words that appear within N words of each other.

Line	String	Notes
1	Affective Symptoms/ OR exp Behavioral Symptoms/ OR exp Emotions/ OR exp Mental Fatigue/ OR Mental Health/ OR Mental Health Services/ OR exp Morale/ OR exp Occupational Stress/ OR Resilience, Psychological/ OR exp Stress, Psychological/	General MeSH terms related to mental health symptoms
2	(exp Mental Disorders/ OR exp Self-Injurious Behavior/) AND (Acute Disease/ OR Cross-Sectional Studies/ OR Crisis Intervention/ OR Early Diagnosis/ OR Incidence/ OR Prevalence/)	Broader mental health MeSH combined with acute terminology; this was done to avoid retrieving material related to pre-existing mental health conditions.
3	((behavior* OR behaviour* OR emotion* OR mental OR psych*) adj3 (burnout OR burn out* OR distress* OR fatigue? OR impact? OR presentation? OR resilien* OR risk? OR symptom? OR wellbeing OR well-being OR wellness)).ti,ab.	General free-text terminology related to current behavioural/emotional distress/presentation
4	(((employment* OR job? OR job-related OR occupation* OR personal OR work OR workplace OR work-related) adj3 (distress* OR stress* OR resilience OR wellbeing OR well-being OR wellness)) OR compassion fatigue).ti,ab.	Terminology related to workplace or personal stress/resilience
5	((anxiet* OR anxious* OR burnout OR burn* out OR compassion fatigue OR demorali* OR depress* OR distress OR emotion* OR externalising OR externalizing OR fear OR grief OR grieving OR internalising OR internalizing OR mental* OR morale OR moral injur* OR overwhelm* OR panic OR peritrauma* OR peri-trauma* OR phobi$2 OR psychiatr* OR psycho* OR posttrauma* OR post-trauma* OR post trauma* OR PTSD OR PTSS OR resilien* OR rumination OR somati* OR stress OR suicid* OR trauma* OR worry OR worrie$1 OR ((emotional* OR level? OR occupational OR perceive? OR perception* OR moral OR perception OR perceived OR psychological* OR work OR work-related) adj3 (distress OR stress*)) OR ((mental* OR emotional OR psychological*) adj3 (disorder* OR distress* OR disfunction* OR dysfunction* OR health OR well*)) OR ((emotional* OR health* OR job OR mental OR occupational OR professional OR psychological*) adj3 (resilien* OR wellness)) OR (emotion* adj2 (experienc* OR mindset OR negative*))) adj3 (acute OR behavio?r? OR burden? OR concomitant? OR concern? OR complain* OR condition? OR consequence? OR crossection* OR cross-section* OR current* OR detect* OR develop* OR difficulties OR during OR effect? OR elevated OR exacerbate? OR frequency OR heightened OR immediate* OR impact? OR incidence OR level? OR morbidity OR new-onset OR onset OR outcome? OR predict* OR present* OR prevalen* OR probable OR problem? OR rate? OR reaction? OR resilience OR responses OR score? OR screen* OR self-assess* OR self-report* OR sequela* OR short-term OR short term OR sign? OR states OR status OR subjective OR surveillance OR symptom* OR trend?)).ti,ab.	Broad free-text emotional and behavioral symptom terminology in combination with broad free-text acute situation terminology
6	1 or 2 or 3 or 4 or 5	Combination of all lines

(137 out of 160 articles) against the development set for healthcare workers. The filter developed by the second author had a recall of 95% (98 out of 103 articles) against the development set for people in the community and 94% (151 out of 160 articles) against the development set for

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healthcare workers. After comparing the filters and assessing the records of the missed articles in each set, we determined that there were sufficient overlaps between the two search strategies to merit combining them into one filter.

Refer to Appendix A to review the initial search strategies developed by the two authors. The combined final filter is presented in Table 2. We then ran this filter against the development and validation sets for each population to assess internal and external validity. The results are summarized in Table 3.

Table 3 Results of internal and external validity testing.

	People in the community	Healthcare workers
Development set	100% (103 of 103 retrieved)	95.6% (152 of 159 retrieved)
Validation set	100% (103 of 103 retrieved)	96.3% (154 of 160 retrieved

In each precision test scenario (summarized in Table 4), the precision was well above the 45% minimum proposed by Avau et al (17).

Table 4 Results of precision tests

Scenario	Result retrieved	Results relevant	Precision
Earthquakes and children/adolescents	292	274	94%
Ebola outbreaks and children/adolescents	33	26	81%
Earthquakes and healthcare workers	116	94	81%
Ebola outbreaks and healthcare workers	78	62	79%

DISCUSSION

Developing searches related to mental health concerns outside of specific disorder is challenging because of the variety of terminology used to describe affective symptoms, which complicates comprehensive retrieval. This is the first validated filter to retrieve literature about acute mental health concerns in public health emergencies using MEDLINE (Ovid) to our knowledge. The filter was developed in accordance with the search filter development methodology using a gold standard suggested by Ayiku et al (14). It can be used and adapted to retrieve emerging scientific literature on acute mental health for any population group for any public health emergency.

The filter demonstrates very strong recall against our gold standard set and good precision in testing across topic areas and population groups, exceeding in all cases the 45% precision recommended by Avau et al (17) and the 90% target for recall proposed by multiple authors (16,18,19). While the internal and external validity of the filter for articles related to people in the community was 100% (see Table 3), both internal and external validity were slightly lower (95.6% and 96.3% respectively) for healthcare workers. We found that some studies in the sets for this population were broader in scope and used language less specific to mental health concerns in the abstract, such as referring to “challenges” encountered. However, all cases remained above the 90% recall standard proposed in the literature.

The combination of the filter with earthquakes and children/adolescents demonstrated the best performance at 94% precision. The other three combinations demonstrated slightly lower precision, each around 80%. There were two main causes of noise in all three scenarios: studies of disaster preparedness (eg. examining worries about a potential future event) and studies of long-term post-emergency impacts, which were outside the scope of acute mental health concerns. An additional cause of noise in the healthcare worker scenarios were studies about healthcare workers treating mental health concerns rather than experiencing mental health concerns themselves.

We recommend readers modify and adapt the terminologies used in this filter to their own particular contexts and informational needs during a specific public health emergency to increase precision. As proposed by Wilczyinski et. al. combining the contents with other search strategies (as we did for our testing) can also increase precision (31). For example, the string could be combined with specific populations, or with a string related to the public health emergency at issue. We anticipate that this filter would be appropriate for the rapid retrieval of evidence in an emergency situation, and that it can be adapted for broader knowledge synthesis efforts. In the former scenario we anticipate precision will be increased compared to our testing because literature on long-term impacts will not yet have emerged, and searchers could further increase precision by excluding disaster-preparedness literature if no secondary evidence is desired.

There were some limitations to our methodology. First, we based our search strategy on a definition of acute mental health based on two resources (DSM-5 and DynaMed), and that definition may not reflect the definition used by all professionals in the field of mental health. As such, the filter may unintentionally exclude studies relevant to alternative definitions. Second, we tested the precision of this search with only two contexts and two population groups. Other contexts and population groups may require additional terminologies that we may have unintendedly overlooked. Other disasters such as

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wildfires, hurricanes, biochemical attacks, political violence, wars, etc. and population groups such as seniors, vulnerable populations, etc. may experience different mental health symptoms that require different search terms. Additionally, searches involving healthcare workers as a population are challenging, not just in the case of this filter but more broadly, as it is difficult to isolate studies of their health concerns from studies of health concerns that they treat in other populations. Another limitation to this project is that the precision tests contained some convenience limitations that may have skewed the results. One final limitation to this project is that this filter is non-specific and could be too broad for researchers interested in specific symptoms such as traumatic stress, anxiety, depression, burnout, prolonged grief, etc. However, there may be instances where there might be a paucity of research in an emerging context and the title and abstract field might be too specific. In those cases, the users may consider applying the keywords in the filter to other indexes such as keyword (.kw) or keyword phase (.kf) to increase the filter's sensitivity.

This filter is designed to be used by clinicians, librarians, policymakers, or public health professionals to rapidly identify the best evidence on a key topic common to emergency situations. It is hoped that this initiative will encourage other professionals sourcing and developing search strategies in the scientific literature to develop more refined searches for various topics during public health emergencies.

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DATA AVAILABILITY STATEMENT

Data associated with this article are available on Open Science Framework at https://osf.io/nd28u/.

AUTHOR CONTRIBUTIONS

Nicole Askin: Conceptualization; Data Curation; Formal Analysis; Investigation; Methodology; Project Administration; Writing - original draft; Writing - review & editing. Mark Mueller: Conceptualization; Data Curation; Formal Analysis; Investigation; Project Administration; Writing - original draft; Writing - review & editing.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest to declare.

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SUPPLEMENTAL FILES

- **Appendix A**
- **Appendix B**
- **Appendix C**

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Enabling discovery of the social determinants of health: using a specialized lens to see beyond the surface

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Background: Investigators encounter challenges in uncovering valuable studies when they are researching health disparities and minority health literature. This evidence scan and qualitative/quantitative crosswalk analysis looked at maternal health literature to gain a better understanding of the nuances in articulating the social determinates of health (SDoH) concepts aligned with the NIMHD Research Framework. SDoH concepts describe the multifaceted causes of health disparities, as opposed to effects that result in health outcomes.

Methods: An evidence scan was conducted to identify literature for a health disparity population using infant low birth weight as a sample population. A qualitative and quantitative analysis of results was performed to examine the medical subject headings (MeSH) terms used to index the literature, along with the terminology used to describe various concepts related to the SDoH within the literature. A crosswalk of MeSH terms to SDoH concepts was used to see if a concentrated focus on SDoH concepts would improve discoverability of the literature.

Results: The 31 articles selected demonstrated that 80% of the MeSH indexed keywords are unique within this collection of full text articles, despite the commonality of the topic. VOSviewer and a Python term counting program were used to visualize the diffusion of terminology. NVivo textual analysis revealed SDoH concepts within meaningful phrases within the literature. Major SDoH themes emerged from the analysis, although were not indexed. Authors used a crosswalk approach with SDoH concepts, to demonstrate that MeSH terms could be used to identify content with a more granular SDoH focus.

Conclusion: Identifying literature that has SDoH concepts within the full text is difficult, due to the diffused nature of the terminology used to describe these concepts. This paper proposes to demonstrate how a crosswalk approach from MeSH terminology to SDoH concepts can provide a methodology for improving the discoverability of the literature. New technologies such as natural language processing, combined with existing technologies to normalize disparate ways of describing similar or related constructs, could be used to help discover and synthesize literature related to SDoH. Investigators, indexers, and librarians can work together to create an improved process for researchers.

Keywords: Health care disparities; Social determinants of health; Controlled Vocabulary; Data Curation; crosswalk methodology; qualitative/quantitative analysis; evidence scan

See end of article for supplemental content.

INTRODUCTION

Social Determinants of Health (SDoH) concepts describe the multifaceted causes of health disparities, as opposed to effects that result in health outcomes. Research related to health disparities and minority health is frequently sought by professionals who work to improve patient wellness, wellbeing, and good clinical outcomes for all. For decades investigators have tried to develop a consensus on how to describe health disparities concepts. Seminal work produced by the Heckler Report in 1984, focused on improving the poor health outcomes for minority populations, as well as the factors that contributed to these outcomes [1]. Experts have continued to call for standard terminology to describe social constructs, such as racism, that lead to health disparities [2-4].

There are many standards available to describe diseases and conditions, however, what is needed are recognized standards to capture SDoH language. In the 2021 publication, "The Science of Health Disparities Research," experts noted a need for constructing consistent and

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standardized language, as well as collaboration among diverse research communities, and an interdisciplinary approach to studying health in minority and low socioeconomic groups [5]. This call to action was described by Duran and Pérez-Stable in 2019 to address the etiology of risk factors and how they impact health outcomes [6]. In their article, “Novel Approaches to Advance Minority Health and Health Disparities research,” the authors outline the causes of health disparities into five broad domains, with 12 to 27 SDoH concepts associated with each domain. The concepts describe the multifaceted causes of health disparities, which lead to health outcomes, such as “*low birth weight*” or “*preterm birth*.” This well-defined structure of health determinant concepts was developed by leading experts in the field. Further work culminated in producing the National Institute on Minority Health and Health Disparities (NIMHD) Research Framework [7].

In recent years, natural language processing (NLP) has been used to explore and identify SDoH terms from medical records. NLP analyzes textual data using computational methods to build a model of the text. It builds both syntactic and semantic models of text to provide structure to unstructured language. Syntactic models resolve ambiguities in the relationships between words. Information extraction looks for sematic associations within text, using an ontology to identify strings of text related to a specific topic [8].

A recent multicenter study noted the importance of uncovering this information to holistically assess clinical decision making needed during diagnosis and therapy planning [9]. The study used NLP techniques to identify a narrow scope of health factors from medical records. The authors of the paper developed a lexicon using manual curation, as there was not an established gold standard terminology fit for use. Keyword matching and classification was a primary method for identifying terminology [9].

In 2013, Bekhuis et al. studied the topic of “comparative effectiveness research design” (CER). Authors of the study worked with experts to develop a local terminology. Bekhuis et al. then aligned medical subject headings (MeSH) terms with their newly developed taxonomy of CER terms by crosswalking the local terminology, to MeSH and Emtree terms [10]. Crosswalking is the mapping of equivalent or near equivalent elements within a database schema. This methodology presented itself as a solution to resolve the frustration experienced by SDoH researchers.

In this study, we adapted the crosswalk approach to bring the SDoH concepts and MeSH terms together to improve discoverability. Previous studies have noted there is potentially more granularity within the Emtree taxonomy [11], however there were compelling reasons to focus on MeSH for this study. Improvements have been made in indexing medical terminology, as the National Library of Medicine (NLM) added SDoH terms to the MeSH taxonomy in 2020 [12]. In a recent November 2024 study, Suda-King et al. [12] described the improved precision and recall for high priority SDoH terms and definitions. The importance of their findings conveys one of several ways emerging studies are being indexed.

Authors of this paper began this research after a bibliometric portfolio analysis on SDoH topics was performed. The analysis returned limited SDoH terms. A broader investigation showed why societal factors that influence health may have been omitted and how the creation of relevant MeSH terms proved to be a larger undertaking. Authors posit the crosswalk of MeSH terms to the SDoH concepts will provide a tool for librarians and investigators. It will also demonstrate the need for further methods of discoverability, using emerging technologies to facilitate rapid and precise retrieval of SDoH concepts throughout the literature.

We conducted an evidence scan of maternal and child health studies and qualitative/quantitative analysis of the literature and performed a crosswalk of the results. To ensure the quality and intention of this evidence scan and crosswalk of terminology, leading experts, and practitioners in the field from the National Institutes of Health agreed to participate as committee members for the protocol. These committee members offered meaningful insights, which enabled a narrower scope and focus. Their recommendation to focus on a well-defined outcome, “*low birth weight*,” provided the precise scope, to enable ample SDoH terms to emerge from the literature. They also contributed and advised throughout the process. The aim of this evidence scan and quantitative and qualitative analysis is to explore how SDoH terminology is being used, and how it aligns with the NIMHD Research Framework [7], and how SDoH concepts could be better aligned with MeSH terminology.

METHODS

To examine the SDoH terminology, we used three distinct methodologies: an evidence scan, quantitative and qualitative textual analysis, and a crosswalk to MeSH terms to SDoH concepts.

Evidence Scan

We performed a review of the literature to answer the question “what the relationship is between health disparities and low birth weight?”, focusing on low birth weight within the broader category of maternal and child health literature.

The evidence scan methods which were adapted from the National Academies of Sciences, Engineering, and Medicine 2020 review process, uses an analytical framework to develop the associations between maternal/low birth weight and SDoH factors [13, 14].

Similar to a systematic review methodology, an evidence scan uses a rigorous approach to searching the literature, screening records to promote transparency and reproducibility, but it does not include an evaluation of the results or risk of bias. The analytical framework provides the inclusion and exclusion criteria and limits to the review. A protocol was developed and registered in Open Science Framework, https://osf.io/zw7a3.

The inclusion and exclusion framework was developed in consultation with content expert committee members. The topic of health disparities and low birth weight is well researched within the literature, and preliminary searches discovered existing quality systematic reviews. Therefore the authors decided to take an umbrella review approach to this evidence scan by limiting the search to systematic reviews, scoping reviews, umbrella reviews and meta-analysis. The search date was limited to 2019-2014 to capture current use of SDoH terminology and to include literature prior to the Covid pandemic. The authors wanted to see if there were any trends that could be noted pre-Covid pandemic versus post-pandemic. We also wanted to see if any of the SDoH MeSH terms added in 2020 were used or if more frequent indexing of SDoH terms appeared. The inclusion and exclusion framework shows the *a priori* criteria used to examine and determine the selected articles.

Inclusion criteria:

- *Population:* pregnancy (prenatal care, labor and delivery, difficult pregnancy care, eclampsia, ectopic, high-risk). premature. Birth—newborn (4 weeks, 28 days) (birth, newborn)
- *Intervention:* health inequity, structural racism, access to healthcare, social determinates of health
- *Comparison*: None
- *Outcome:* low birth weight. Preterm, low gestational weight/small fetus size
- *Study Design:* systematic reviews, meta-analysis, scoping, rapid, umbrella reviews. published peer-reviewed articles
- *Limits***:** Human. English, United States
- *Date***:** 2019–2024

Exclusion criteria:

- *Population:* children older than 28 days, paternal/father health outcomes, maternal studies not including pregnancy and newborn
- *Intervention:* studies not focused on health disparities or marginalized groups or studies not focused on access to healthcare
- Studies not focused on delivery of healthcare
- *Comparison*: None
- *Outcome:* assessment/measurement of scale, survey, or instrument, or focused on government policy without addressing health disparities
- *Study Design:* literature or narrative reviews, or non-review articles, non-peer-reviewed articles, (e.g., preprints, conference abstracts, proceedings, dissertations, reports, editorials, and retractions) or no abstract available
- *Limits***:** animal studies, non-English, and studies that do not include US data
- *Date***:** studies published before January 2019

The search strategy was developed by medical librarians (GB, DT, and CS) in collaboration with the committee members (VB, DD, CG, and KM). The comprehensive search strategy included keywords, MeSH and Emtree terms using Boolean operators and the strategy was peer reviewed. The search was conducted on February 22, 2024, in two electronic biomedical databases: PubMed/MEDLINE and Embase (Elsevier). (See Appendix A: Search Strategies). The search strategy is in searchRxiv: https://www.cabidigitallibrary.org/doi/10.1079/searchRxiv.2025.00935.

Database results were exported into EndNote X21 (Clarivate) reference manager and after the removal of duplicates, records were imported into Covidence screening software (Covidence, Veritas Health Innovation, Melbourne, Australia; available at www.covidence.org). An initial pilot using sample records was performed by two reviewers (CS and GB) in Covidence to help refine the eligibility criteria and data extraction, and to ensure consistency applying the inclusion and exclusion criteria. The full screening of records was completed by two reviewers (CS and GB) who independently screened title/abstract and the full text of records, applying the inclusion criteria. Conflicts were resolved by a third reviewer (DT).

Quantitative and Qualitative Analysis

Three methods of analysis were used to examine the relationship between terminology used to describe the SDoH and the SDoH as concepts. First, a keyword co-occurrence analysis of the literature results was conducted using VOSviewer (version 1.6.18, bibliometric network analysis software), to visualize the relationships between terms. VOSviewer is an open-source co-occurrence analysis tool that produces reliable and clear visualizations of bibliometric networks. In this process, the citations of included articles were identified within Clarivate Web of Science Core Collection, using PubMed ID numbers. The citations were then exported using the

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"full record and cited references" format and moved to VOSviewer, where a keyword co-occurrence algorithm was run. Keyword co-occurrence is the number of publications where keywords, extracted from the title, abstract, or author keyword list, appear in two or more publications [15]. Visualized maps were generated from this analysis, to show the frequency and relationships between terms.

The second method applied a "bag-of-words" approach, which is a technique used within NLP. The "bag-of-words" approach counts how often a particular term is used in a collection of documents; by figuratively tossing the terms into a "bag" and pulling each term out to count how frequently the term appears within the collection of documents. The process provided a representation of terminology used within the result set. MeSH terms were uploaded to a Python script to count the number of occurrences for each MeSH term across the data set. The code and associated data are available in Open Science Framework, https://osf.io/nge2s.

In the third method, a qualitative analysis was used to identify text describing the SDoH within the full text of included articles. NVivo 14 (Lumivero) allows researchers to structure code to identify and qualitatively assess themes within unstructured text, and was used for the analysis because the software was available to the authors. The full text of the 31 articles were imported into NVivo and two reviewers (CS, GB) independently performed qualitative analysis by mapping phrases that contain health determinants as contributing factors in adverse health disparity outcomes.[6] In this study these health determinants are referred to as SDoH concepts, and the domains for these health determinants or concepts align with the NIMHD Minority Health and Health Disparities Framework.[7] To help ensure coding consistency between reviewers, an initial pilot was performed using 20 sample articles, with a subset of SDoH concepts. The full set of SDoH concepts in each of the five domains within the NIHMD Framework were used to code the final included full-text articles. After the coding process was completed in NVivo, results were reviewed by both screeners (CS, GB) with a third reviewer (DT) present to settle disputed coding items. A coding comparison was performed.

Crosswalk of MeSH Terms to SDoH Concepts

Authors of this paper wanted to know how many SDoH concepts aligned directly with one or more medical taxonomies. A crosswalk model used by Bekhuis, et. al [10] was adapted to map MeSH terms to the SDoH concepts as described by Duran and Pérez-Stable in 2019 [6]. Their description of domains and associated concepts provided the ideal structure for mapping MeSH to the NIMHD Research Framework since both knowledge structures were developed and maintained by NIH. The decision to focus on MeSH was based on the opportunity to explore the use of newly established SDoH MeSH terms within the literature[12], and NLM's easy to use *Mesh on Demand* tool. The NLM, *MeSH on Demand[16]* and *the MeSH Browser[16]* were used to confirm the definitions of terminology as they were applied to concepts. If a series of terms branched up into a higher-level term within the MeSH tree structure, then the higher-level term was listed.

A comparison of crosswalked SDoH terms and MeSH terms indexed to articles was conducted on a subset set of articles to see if there was a variance. The subset of articles were chosen based on their ability to represent the major themes extracted from the NVivo thematic analysis. SDoH concepts for each article were listed. The "crosswalked MeSH terms" were matched with SDoH concepts identified in the subset of articles. The crosswalked MeSH terms were then compared with MeSH terms indexed within PubMed to see if there was a variance in the two lists of terms.

RESULTS

Evidence Scan

The database search results generated 1,585 records and after the removal of duplicates, 1,039 abstracts were screened, with a total of 236 articles were included for full-text review, and a final 31 articles [17-47] meeting the inclusion criteria (Figure 1). Of the 31 studies identified four were scoping reviews, 14 were systematic reviews and 13 were systematic reviews and meta-analyses. The full list of included articles is in Appendix B: Table 1 - Study Characteristics.

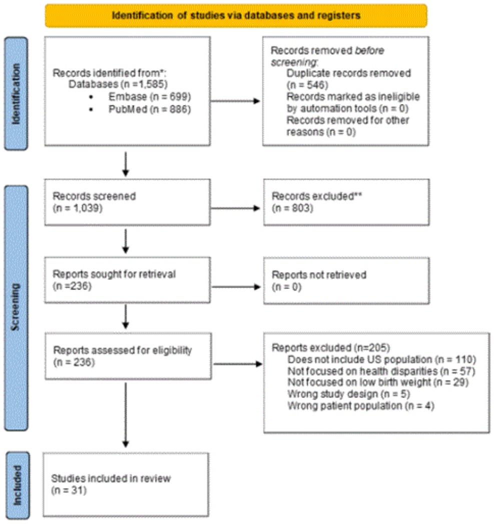

Figure 1 PRISMA flow diagram to show studies included in the review

Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. (This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/)

Table 1 Number of times each MeSH term was used to index an article in the result set of 31 studies

27	Humans
23	Females
23	Pregnancy
21	Infant, Newborn
20	Premature Birth
11	Infant, Low Birth Weight
10	Pregnancy Complications
8	Infant
6	Stillbirth
5	Risk Factors Pregnancy Complications
4	Developed Countries Socioeconomic Factors
3	Prenatal Care Adult Cross-Sectional Studies Racism Birth Weight
2	Social Determinants of Health Observational Studies as Topic Outcome Assessment Health Care Hot Temperature Maternal Health Services Child Cesarean Section Mothers Parturition Infant, Small for Gestational Age Air Pollution
1	Pre-Eclampsia Pregnancy, Unplanned Poverty Areas Poverty Physical Exertion Perinatal Death Patient Protection and Affordable Care Act Pregnancy in Adolescence Particulate Matter Overweight Abortion, Spontaneous Prenatal Exposure Delayed Effects Systematic Reviews as Topic White People Walking Violence Veterans Temperature Stress Disorders, Post-Traumatic Prospective Studies Standing Position Sociodemographic Factors Social Work Social Support Social Environment Retrospective Studies Racial Groups Microaggression Occupational Exposure Developing Countries Health Services Accessibility Food Insecurity Follow-Up Studies Fetal Growth Retardation Extreme Heat Ethnic and Racial Minorities Employment Diabetes, Gestational Depression, Postpartum Hearing Tests Demography Cohort Studies Child, Preschool Child Nutritional Physiological Phenomena Black or African American Anxiety Disorders Air Pollution Hearing Hispanic or Latino Obesity Maternal Exposure Nutrition Assessment Neonatal Screening Military Personnel Military Deployment Adolescent Medically Uninsured Medicaid Maternal Health Maternal Age Housing Lifting/adverse effects Life Change Events Insurance, Health Insurance Coverage Infant, Premature Infant Nutritional Physiological Phenomena Infant Health Indigenous Peoples Women, Working

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Qualitative Assessment of Keywords Used in the Literature

VOSviewer Keyword Co-occurrence Networks provide knowledge maps of how topics relate to each other in a particular field. Nodes are the keywords, and lines show the number of keyword co-occurrence connections within a collection of publications. The size of a node indicates the number of publications affiliated with that keyword, and the thickness of the lines shows the number of co-occurrences. The algorithm clusters keywords that are used frequently together with the same color and in proximity to how frequently the terms appear together.

The VOSviewer keyword co-occurrence analysis was performed using 29 of the 31 citations identified during the evidence scan. The algorithm for "All Keywords" was used, which contains both, "Author Keywords" and "Keywords Plus." "Keywords Plus" includes words or phrases that appear in the titles of an article's references, but do not appear in the title of the article itself. Since these keywords are based on titles of articles in the reference list, articles without references will not contain Keywords Plus.[48] Two citations (Bellerose, 2022, DiTosta, 2021) did not produce "Keywords Plus" from the Web of Science, Core Collection, thus these citations were not included in the analysis.

A 2-keyword term analysis, where a keyword needs to occur at least twice in a set of publications, provides a good landscape map on a given topic. Appendix C, Figure 1, shows "*preterm birth*" is the most frequently used keyword, as expected, since it is central to the topic. A few SDoH concepts can be viewed on the perimeter of the various clusters within the landscape map. Climate related terms appear in the yellow cluster. The red cluster shows relationships between SDoH concepts such as "*racial/ethnic disparities*," "*psychosocial factors*." The green cluster lists "*ambient air-pollution*," and "*intimate partner violence*." From the collection of articles, 30 Keyword Plus terms appear within the landscape map. Nine of those terms are associated with risk factors that align with SDoH concepts.

If we readjust the algorithm to examine the landscape for more granularity at 3 Keyword Plus terms, where a Keyword Plus term has to occur in a set of publications a minimum of three times, we find the image generated (shown in Appendix C, Figure 2) produces a map with 15 or half of the Keyword Plus terms. The keyword term, "*preterm birth*" continues to appear central as expected, but the SDoH concept terms have almost disappeared. The only two terms that align with SDoH concepts are "*racial/ethnic disparities*" and "*high ambient-temperature*."

Quantitative Analysis of the Usage of MeSH Terms

MeSH terms from the 31 studies were also examined using a "bag-of-words" approach to measure the frequency of use for each term. The results from the "bag-of-words" analysis demonstrated how SDoH terminology is diffused, as over 80% of the terms were used only once or twice, within the 31 articles .The list of terms below in Table 1 shows the terms and how often each term appears within the 31 studies. There were 100 unique MeSH terms from the 31 included articles. Most MeSH terms were used fewer than 10 times. Most terms were used once (70 terms) or twice (11 terms).

The authors were curious to know if any differences in indexing could be determined for those publications that emerged just prior and during the pandemic, versus those articles published as we were recovering from the pandemic. The 31 results were divided by years of publication into 2 sets to explore those differences: articles published from 2019–2021 and those published between 2022–2024. Authors conjectured that research published prior to 2021 was likely conducted prior to or early on in the Covid pandemic. Publications published during or after January 2022, had the opportunity to use the updated NLM SDoH terms.[12] Twelve articles from the result set were published between 2019–2021. Nineteen articles were published between 2022–2024. Two articles [28, 33] did not have MeSH terms applied within PubMed. A basic comparison of the number of SDoH Terms indexed was used as a rudimentary barometer to compare indexed MeSH terms: One to 2 terms; versus 3 or more terms. Of the 12 articles published between 2019 and 2021, 9 (75%) had 1 or 2 SDoH related MeSH terms. Three articles (25% of reviewed articles) contained between 5 and 7 terms. Of the 19 articles published between 2022–2024, 15 (79%) only had 1 to 2 SDoH related MeSH terms. The 4 other articles (21% of reviewed articles) had 3 to 7 terms listed. Based on this simple analysis no significant trends were noted in the use of MeSH terms.

Qualitative and Quantitative Assessment of SDoH Terms

The NVivo analysis reveals that SDoH themes within the full text of the 31 selected articles retrieved by the evidence scan matched the 5 domains of influence from the NIMHD Framework (*Biological, Behavioral, Physical/Build Environment, Sociocultural Environment, Health System Care*). This coding structure allowed us to see the volume of meaningful phrases in the selected articles that match the concepts within each domain. (See Appendix D, Figures 1 – 5)

Four dominate themes emerged from the studies: "*In utero exposure*," "*Social and economic adversity*," "*Discrimination, racism, and stigma*," and "*Access to preventive service and quality health care*." Examples of these four themes are in Appendix E, Table 1- Primary Coded Concepts. Additional phrases that relate to the various SDoH concepts can be viewed in the Appendix E, Table 2 – SDoH Coded Concepts, where they are organized by SDoH domains.

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Table 2a – Behavioral, Crosswalk of MeSH Terms to SDoH Concepts

Behavioral	MeSH
Diet and nutrition	Physiological Phenomena Diet, Food, and Nutrition Beverages Fermented Foods Food Nutritional Physiological Phenomena
Preventive health behaviors	Health Behavior Health Risk Behaviors Self-Examination Breast Self-Examination Preventive Health Services Sleep Hygiene Smoking Cessation Smoking Reduction Tobacco Use Cessation Treatment Adherence and Compliance
Unprotected sexual intercourse	Unsafe Sex
Domestic/family violence	Domestic Violence Violence Exposure to Violence
Physical activity	Exercise
Substance use, abuse, misuse, and addiction	Substance-Related Disorders
Compliance and adherence with prescribed therapy	Treatment Adherence and Compliance
Delays in seeking care after symptom awareness	Refusal to Participate Attitude to Health Treatment Adherence and Compliance Patient Participation Treatment Refusal
Living responsibly with infectious disease	**No direct alignment with MeSH**
Hygiene/oral hygiene	Oral Hygiene Oral Health Dental Care Hygiene
Cultural beliefs	Culture Ethnic and Racial Minorities Family Hierarchy, Social Medicalization Minority Groups Secularism Social Capital Social Change Social Conditions Social Environment Social Class Social Factors
Religious beliefs/schemas	Religious Philosophies

Table 2b – Biological, Crosswalk of MeSH Terms to SDoH Concepts

Biological	MeSH
Biochemical	Biochemistry Biochemical Phenomena Biological factors Molecular Biology
Genome and epigenome	Genome
Proteome	Proteome
Microbiome	Microbiota
In utero exposure	Embryonic and Fetal Development
Metabolic factors	Metabolism
Pathogens	Disease Transmission, Infectious
Physiologic responses to stress/allostatic load	Allostasis
Organ systems	Cardiovascular System Lymphatic System Respiratory System Endocrine System Gastrointestinal Tract Urogenital System Musculoskeletal System Nervous System Immune System
Nervous system	Nervous System
Telomere/cellular aging/senescence	Telomere Cellular Senescence
Cellular functions and communication	Cell Physiological Phenomena
Enzymes	Enzyme Activation Enzymes
Inflammation	Inflammation
Demographics	Demography Quality of Life, Ethnicity
Endocrine system/hormones	Endocrine System Hormones

Table 2c – Clinical Events & Health Care System, Crosswalk of MeSH Terms to SDoH Concepts

Clinical Events & Health Care System	MeSH
Patient-clinical communication	Health Communication
Health insurance coverage/policies	Insurance, Health
Access to prevent services and quality health care	Health Services Accessibility

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Disease management and functioning status	*Disease Management
Symptom and pain management	Palliative Care Pain Management
Drug interactions and synergies	Drug Interactions
Use of alternative therapies	Complementary Therapies
Appropriate diagnostics	*Diagnosis
Access to emerging techniques	Biomedical Technology
Access to public health education, information, and health alerts	Health Education
Precision medicine	Precision Medicine
Generalizability of research findings	Outcome Assessment, Heath Care
Translation of research	Culturally Appropriate Technology Disruptive Technology Technology Transfer
Dissemination and diffusion of research results	Diffusion of Innovation
Macro-structural stressors (e.g. Policies and procedures)	Social Control Policies
Incorporation of spiritual and traditional healers	Traditional Medicine Practitioners
Institutional discrimination in health care	Systemic racism Health inequities Minority Health Social Determinants of Health
Health care system mistrust	Betrayal Delivery of Health Care
Culturally competent care	Cultural Competency
Workforce diversity	Workforce diversity
Electronic medical records	Electronic Health Records
Palliative and end-of-life care	Palliative Care Terminal Care Hospice and Palliative Care Nursing
Living with chronic illness and comorbid conditions	Chronic Disease
Long-term care	Long-Term Care
Access to health information/ consent in primary language	Consumer Health Information Patient Education as Topic
Policies and political practices	Health Policy
Diversity of biomedical/health delivery workforce	Health Workforce Workforce Diversity Diversity, Equity, Inclusion

Table 2d – Sociocultural Environment, Crosswalk of MeSH Terms to SDoH Concepts

Sociocultural Environment	**MeSH**
Employment status and security	Employment
Income	Income
Housing and food security	Housing Instability Food Supply Access to Healthy Foods Foods, Specialized
Health insurance status (affordability/quality)	Insurance, Health Medically Uninsured
Social and economic adversity and inequality	Socioeconomic Factors Economic Factors
Immigration and legal status	Transients and Migrants Human Migration
Geographic location	Geography Geography, Medical Topography, Medical
Residential segregation	Residential Segregation
Education attainment	Educational Status
Access to quality education	**No direct alignment with MeSH**
Transportation options	**No direct alignment with MeSH**
Limited English proficiency	Communication Barriers
Health literacy/numeracy	Health Literacy
Discrimination, racism, and stigma	Social Discrimination
Health socialization and education	Health education
Psychosocial stressors	Stress, Psychological
Historical trauma	Historical trauma
Social safety net	Safety-net Providers
Community reentry (e.g. prison, military service)	**No direct alignment with MeSH**

Table 2e – Physical Environment, Crosswalk of MeSH Terms to SDoH Concepts

Physical Environment	**MeSH**
Housing status	Housing
Neighborhood violence	No direct alignment with MeSH
Unhealthy housing units	Housing Residence Characteristics Home Environment
Residence crowding	Housing Housing Quality

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Exposure to toxic substances (e.g., pollution, radiation, lead, mold, dust mites)	Environmental Pollutants Pesticides Radiation injuries Heavy Metal Poisoning Fungi Pyroglyphidae
Aesthetic elements (e.g. trees)	Environment Design Ecosystem
Access to safe recreational facilities	Sports and Recreational Facilities
Quality of air and water	Air Pollution Water Pollution
Concentration of fast-food outlets and access to full-service grocery stores	Fast Foods Food Supply Supermarkets
Public safety (e.g., fire dept., police)	Emergency Responders
Occupational conditions and hazards	Occupational Exposure Environmental Monitoring Radiation Exposure
Affordability of resources	Resource Allocation Economics

Table 3 - SDoH Concepts that do not have corresponding MeSH terms

SDoH Domain	Concept
Behavioral	Living responsibly with infectious disease
Physical Environment	Neighborhood violence
Sociocultural Environment	Access to quality education
Sociocultural Environment	Community reentry (e.g. prison, military service)
Sociocultural Environment	Transportation options

Comparing Crosswalked MeSH Terms to SDoH Concepts

The crosswalk of MeSH Terms to SDoH concepts includes the five domains of Biological, Behavioral, Physical/Build Environment, Sociocultural Environment, Health System Care (See Table 2a-2e) and it demonstrates that most SDoH concepts have one or more MeSH terms that align with each concept. There are five SDoH concepts that did not map directly to MeSH terms. (See Table 3).

Comparing Crosswalked MeSH Terms to Actual MeSH Terms

A subset of six papers of the 31 studies was used for additional analysis. The subset articles were chosen based on their ability to represent the prominent themes that emerged from the textual analysis. The "crosswalked MeSH terms" were matched with the SDoH concepts identified in the textual analysis. The crosswalked MeSH terms were then compared with MeSH terms indexed in PubMed. The SDoH concepts, the crosswalked MeSH, and the actual MeSH are presented for these six articles in Table 4. These concepts are shown in groups representative of the five SDoH domains: Behavioral, Sociocultural Environment, Biological, Physical Environment, Clinical Events and Health Care System.

DISCUSSION

The aim of this study was to explore how SDoH terminology is being used, how it aligns with the NIMHD Research Framework [7], and how SDoH concepts could be better aligned with MeSH terminology. Our data shows that, while the terminology used by authors aligns with the NIMHD Research Framework, authors are not using consistent terminology when writing about SDoH. We also learned that there are MeSH terms that align with SDoH terminology, but that they are not being applied to articles containing SDoH concepts. When we compared the Crosswalked MeSH to the actual MeSH (Table 4), we discovered a significantly more granular and specific level of SDoH that exist within MeSH.

The comparison of crosswalked MeSH to actual MeSH (see Table 4) demonstrates the differences between what SDoH concepts can be uncovered within the literature versus what concepts are being indexed. When using a SDoH focused approach several more MeSH terms can be applied to each citation. For instance the Bellerose [22] article has one of the highest rates of SDoH terms indexed within PubMed among the 31 articles included in this study. However, even with focused SDoH indexing in place, we identified several additional relevant MeSH terms such as: "*Economic Factors*," "*Resource Allocation*," "*Long Term Care*," and "*Systemic Racism, Health Inequities*."

This has significant implications for librarians and researchers who need to search the literature for SDoH concepts. The VOSviewer images in Appendix C showing the co-occurrence of 2 keyword terms (Appendix C, Figure 1) versus 3 keyword terms (Appendix C, Figure 2), begin to highlight the challenges librarians face as they develop search strategies that include SDoH concepts. The task is to cast a wide net, that includes a myriad of phases to capture a SDoH concept, while simultaneously maintain the specificity and precision to reduce the false hits within results, thus uncovering critical literature that contributes to health policy research.

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Table 4 Comparing Crosswalked MeSH Terms to Actual MeSH

Study	SDoH domains	SDoH Concepts Extracted from Qualitative Analysis	Crosswalked MeSH to SDoH Concepts	MeSH Terms Indexed in PubMed	Mesh Terms indexed in PubMed (non-SDoH)
Bellerose, 2022 [22]	Sociocultural Environment	Health insurance status (affordability quality) Social and economic adversity and inequality Health socialization and education Health literacy numeracy	**Insurance, Health** **Socioeconomic Factors** **Economic Factors** **Health Education** **Health Literacy**	**Insurance, Health** **Medicaid*** **Patient Protection and Affordable Care Act***	Adult Female Humans Infant, Newborn Pregnancy United States
	Physical Environment	Affordability of resources	**Resource Allocation**	**Health Services Accessibility**	
	Clinical Events and Health Care System	Health insurance coverage policies Long-term care Policies and political practices Health care system mistrust Institutional discrimination Access to preventive services and quality health care	**Long-term Care** **Health Policy** **Delivery of Health Care** **Betrayal** **Systemic Racism** **Health Services Accessibility**	**Medically Uninsured** **Health Services Accessibility** **Insurance** **Coverage**	
Crawford, 2021[22]	Behavioral	Cultural beliefs/schemas	**Culture** **Ethnic and Racial Minorities** **Family**		Anxiety Disorders Female Humans Infant, Newborn Outcome Assessment, Health Care Pregnancy Premature Birth* United States
	Sociocultural Environment	Discrimination, racism, and stigma Historical trauma Health insurance status (affordability/quality) Income Social safety net Immigration and legal status Housing and food security	**Social Discrimination** **Racism** **Historical trauma** **Insurance, Health** **Income** **Safety-net Providers** **Transients and Migrants** **Human Migration** **Housing Instability** **Access to Healthy Foods**	**Microaggression** **Racism**	
	Biological	Physiologic responses to stress/allostatic load Metabolic Factors Telomere/cellular aging/senescence	**Allostasis** **Metabolism** **Telomere**		

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	Clinical Events and Health Care System	Access to preventive services and quality health care Institutional discrimination in health care Policies and political practices Health care system mistrust Culturally competent care Diversity of biomedical/health delivery workforce	**Health Service Accessibility** **Systemic Racism** **Health Inequities** **Minority Health** **Social Determinants of Health** **Medically Uninsured** **Delivery of Health Care** **Cultural Competency** **Workforce Diversity**		
DiTosto, 2021[30]	Sociocultural Environment	Housing and food insecurity Health insurance status Social and economic adversity and inequity	**Housing Instability** **Food Supply** **Insurance, Health** **Socioeconomic Factors** **Economic Factors**	**Housing**	Cross-Sectional Studies Female Humans Infant, Newborn Pregnancy Premature Birth Prospective Studies Retrospective Studies United States
	Physical Environment	Housing status Affordability of resources Residence crowding Unhealthy housing units	**Housing** **Resource Allocation** **Economics** **Residence Characteristics**		
	Clinical Events and Health Care System	Access to preventive services and quality health care	**Health Services Accessibility**	**Outcome Assessment, Health Care**	
Dzekem, 2024[31]	Behavioral	Tobacco use	**Tobacco Use** **Tobacco Smoking**		Female Humans Infant, Low Birth Weight Infant, Newborn Pregnancy Pregnancy Outcome Premature Birth Stillbirth United States
	Sociocultural Environment	Education attainment Geographic location Social and economic adversity and inequality Discrimination, racism, and stigma Housing and food security Health insurance Social and economic adversity and inequality	**Education Status** **Geography** **Socioeconomic Factors** **Social Discrimination** **Residential Segregation** **Housing Instability** **Food Supply** **Insurance, Health** **Socioeconomic Factors**		

		Income Social safety net Access to quality education	**Income** **Safety-net Providers** **Education**		
	Biological	Demographics Metabolic factors Biochemical Pathogens Cellular functions and communication	**Demography** **Ethnicity** **Metabolism** **Biochemistry** **Disease Transmission, Infectious** **Cell Physiological Phenomena**		
	Physical Environment	Quality of air and water Exposure to toxic substances Residential segregation	**Air pollution** **Water pollution** **Environmental Pollutants** **Quality of Life**	**Air pollution**	
	Clinical Events and Health Care System	Policies and political practices Generalizability of research findings Access to preventive health services and quality health care	**Health Policy** **Outcome Assessment, Health care** **Health Services Accessibility**		
Manzo, 2024[36]	Behavioral	Living responsibly with infectious disease	**Communicable Diseases** **Sexually Transmitted Diseases**		Female Humans Military Deployment Military Personnel Pregnancy Pregnancy Complications Pregnancy Outcome Premature Birth United States Veterans
	Sociocultural Environment	Psychosocial stressors Social and economic adversity and inequity Social safety net Community reentry Discrimination, racism, and stigma Health socialization and education Historical trauma	**Stress, Psychological** **Socioeconomic Factors** **Safety-net Providers** **Reentry (non-MeSH)** **Returning Citizen (non-MeSH** **Social Discrimination** **Health Education** **Historical Trauma** **Systemic Racism** **Health Inequities**		

	Biological	Physiologic responses to stress, allostatic load	**Allostasis**		
	Physical Environment	Occupational conditions and hazards Neighborhood violence	**Occupational Exposure**	**Stress Disorders, Post-Traumatic**	
	Clinical Events and Health Care System	Long-term care Living with chronic illness and comorbid conditions Symptom and pain management Patient-clinical communication Access to preventative services and quality care Disease management and functioning status Institutional discrimination in health care Culturally competent care	**Long-Term Care** **Chronic Disease** **Pain Management** **Health Communication** **Health Services Accessibility** **Disease Management** **Health Inequities** **Cultural Competency**		
van Daalen, 2022[47]	Behavioral	Diet and nutrition Delays in seeking care after symptom awareness Tobacco use	**Diet, Food, and Nutrition** **Attitude to Health** **Treatment Adherence and Compliance** **Tobacco Use**		Cohort Studies Cross-Sectional Studies Female Humans Infant, Newborn Pregnancy Pregnancy Outcome Premature Birth
	Sociocultural Environment	Discrimination, racism, and stigma Social and economic adversity and inequality Income Educational attainment Housing and food security Historical trauma Geographic location Psychosocial stressors Health socialization and education	**Social Discrimination** **Socioeconomic Factors** **Health Inequities** **Income** **Education Status** **Housing Instability** **Food Supply** **Historical Trauma** **Geography** **Stress, Psychological** **Health Education** **Insurance, Health**	**Racism**	
	Biological	Demographics	**Demography**		

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	Physical Environment	Affordability of resources Public safety	**Resource Allocation** **Economics** **Emergency Responders**		
	Clinical Events and Health Care System	Institutional discrimination in health care Institutional discrimination in health care Access to preventive services and quality of care Policies and political practices Institutional discrimination in health care Health insurance coverage policies Patient-clinician communication Macro-structural stressors(policies, procedures) Culturally competent care Workforce diversity Diversity of biomedical health delivery workforce Long-term care	**Health Services Accessibility** **Health Policy** **Systemic Racism** **Health Communication** **Social Control Policies** **Cultural Competency** **Workforce Diversity** **Diversity, Equity, Inclusion** **Long-Term Care**		

The areas of SDoH terminology that are not covered by MeSH terms have a significant social science component to each concept, so it is understandable that they may not be found within the MeSH taxonomy. Although there are existing MeSH terms similar to these concepts, the terms are not directly correlated. For instance, "*neighborhood violence"* requires the combined use of MeSH terms: "*Residence characteristics*" and "*Violence*." Whereas "*neighborhood violence"* refers to the level of distress within a community due to historic and current threat of violence.

Findings of this paper are consistent with similar studies that discuss the challenges of identifying SDoH terminology within the literature. Suda-King et al. noted the need for improved behavioral science research terminology to build a knowledge base[12]. We also observed that there are behavioral science terms that do not align well with MeSH terms and agree that there is a need for more clarity and definition around this terminology (See Table 3.).

Our results also confirm as Eldredge and Wallerstein did [49] that a deeper level of indexing for SDoH concepts can be applied to studies if researchers, librarians and indexers allow the SDoH concepts to emerge and be recognized within the paper, where they align with SDoH concepts, instead of assigning specific terms to a study.

This study shows why it is difficult to design a search strategy that will successfully uncover literature that describes SDoH concepts. . The crosswalking exercise demonstrates that there are many existing MeSH terms available that align with SDoH concepts, yet, more importantly, how many SDoH concepts are being missed not just from indexing, but from discovery within the literature. A better process is needed to align existing MeSH terms with SDoH concepts or librarians and researchers will continue to miss relevant articles on SDoH.

The results from the VOSviewer analysis confirm that investigators are not describing SDoH concepts consistently. However, our qualitative analysis of the full text provides evidence these concepts are within the literature and that they can be mapped to the NIMHD Framework. Using the SDoH concepts as presented by Duran and Perez-Stable[6] can serve as a starting point to identify specific concepts for consideration, as part of an improved process. Librarians could use the SDoH concepts as a guide to generate "search hedges" for each concept, and associate the search hedges with the MeSH terms that were crosswalked to each SDoH concept. The SDoH concepts and corresponding MeSH terms could also be used by researchers to identify author keywords when publishing their work.

Many SDoH concepts are nuanced and the proper key terms could vary depending on the cultural or regional environment. A key term chosen to describe something in one environment, might be different than a term used within a similar but slightly different environment. For example, the circumstances to choose: "social discrimination," "racism," "microaggression," or perhaps "historical trauma" may be similar but nuanced. We see the challenge not as defining and assigning the right terminology to the literature; rather the challenge is identifying SDoH concepts in their natural form within text and phrases, and then mapping them to identified MeSH key terms or other similar taxonomies. This process was completed in our study through a time-consuming and careful effort looking specifically for SDoH concepts. If health equity research is to continue to mature, this process needs to occur in a more automated fashion, where researchers can recognize SDoH concepts and associated terms in a less time intensive manner. There are decades of health science literature that contain a multitude of SDoH concepts, which provide evidence of health determinate risk factors. The research community cannot go back and reindex all of the literature, but we can create tools to enable the discovery of SDoH concepts within the literature, and link those concepts to existing taxonomies such as MeSH. This process will help researchers to identify health risk factors, all across the public health spectrum. Awareness that this alignment needs to occur is a step toward progress.

FUTURE DIRECTIONS

In addition to librarians and researchers using the results of our research to identify concepts within the literature, indexers can now use our results to assign associated MeSH terms to specific studies, to improve the network of concepts across studies. Since this process is labor intensive and tedious, informaticians can work together with librarians, indexers, and investigators to explore how to leverage technology to improve discoverability of SDoH concepts. Recent improvements in MeSH indexing were reported by the Suda-King et al. study. They demonstrated significant improvements in precision within the quantitative and qualitative results. This precision is due to the result of adding 35 new SDoH terms to MeSH [12]. This is a good start, but our rudimentary analysis showed the newly added terms are not significantly effective on every topic. This finding reinforces the need for new tools, using techniques such as NLP to identify and tag SDoH concepts as they emerge from the literature, to then map those concepts to corresponding crosswalked terminology.

NLP used to uncover SDoH within medical records now[9] can be combined with other technologies at NLM to create such a tool. The terms, concepts, and sample phrases used to describe SDoH concepts identified in our analysis, can be used to create programmatic algorithms to identify concepts within text. To maximize the functionality of such a tool, a push and pull approach can

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be used to programmatically assess text. Search strings developed by librarians and researchers to identify SDoH concepts can be employed to push the search. The NLP syntactic and semantic models used to provide structure to unstructured language[8], can enable SDoH concepts to emerge, or pull, from the text. Such a dual action methodology could enhance technologies already used in other NLM tools.

The NLM provides a tool called PubTator 3.0 that was created to synthesize terminologies with similar content or context. It uses artificial intelligence to highlight semantic terms and their relationships within papers, allowing reviewers to filter and highlight entities such as diseases, chemicals, genes, or variants within these documents. PubTator 3.0 also uses autocomplete technology to normalize the nomenclature for a specific entity by pooling the various forms of chemical names or genes into a single format [50]. This study demonstrates that a similar tool, programmed to identify NLP text focused on each SDoH concept identified within the NIMHD Research Framework, would operationalize SDoH concepts [6]. It would be a valued resource used by researchers, librarians, and indexers to help normalize and solidify the terminology related to the SDoH.

This study has several limitations. We only examined MeSH terms in our analysis. Future research could include investigation of this crosswalk approach with Emtree terminology to examine the discovery of SDoH literature within Embase. We only applied the NIMHD Research Framework to analyze the SDoH literature and concepts. Exploration of SDoH concepts from other frameworks, such as the Center for Disease Control's Healthy People 2030 could be valuable. Our analysis has a narrow focus on maternal child health, in vulnerable populations, and only looks at "*low birth weight*", "*small for gestational age*" or "*preterm birth*" as an outcome of pregnancy. Other topics may generate other SDoH concepts and varying numbers of results. Studies included populations either inside the United States, or international studies that included US populations which may limit generalizability. We did not include primary studies within the evidence scan, due to the overabundance of results of existing quality reviews. We limited the scan to systematic reviews, scoping reviews, umbrella reviews, rapid reviews, and meta-analysis. Primary studies may provide additional insight into how SDoH concepts are used within the literature. The synthesized reviews may characterize the SDoH concepts somewhat differently than reported in primary studies.

The results of our study showed MeSH terminology aligned with SDoH concepts provide a more granular lens for finding literature with a SDoH focus, but that current indexing does not reach its full potential. There is potential for this process to be automated and turned into an investigative tool to reveal embedded SDoH concepts across the health sciences literature by applying technology with leading experts in the field as well as bioinformatics experts at the NLM. This new tool would highlight SDoH concepts in the context of an article, and link them to associated MeSH terms. This would enable librarians and researchers to more readily identify, analyze and document SDoH health factors in context. It would also help indexers apply descriptive MeSH terms. This specialized lens could help health science investigators and informaticians demonstrate outcomes from the risks associated with health inequities, leading to effective preventive measures.

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CONFLICTS OF INTEREST/COMPETING INTERESTS

There are no conflicts of interest or competing interests.

ETHICS APPROVAL

No ethics approval was required for this study.

CONSENT TO PARTICIPATE

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CONSENT FOR PUBLICATION

All authors agreed with the content and that all gave explicit consent to submit and that they obtained consent from the responsible authorities at the institute/organization where the work has been carried out before the work is submitted.

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DATA AVAILABILITY STATEMENT

Data and materials are available within the Supplementary information. The protocol will be made available at the Open Science Framework, https://osf.io/zw7a3.

CODE AVAILABILITY

Code available at the Open Science Framework, https://osf.io/nge2s.

AUTHOR CONTRIBUTIONS

All authors contributed to the study conception, methodology, and design. Material and software selection, data collection and analysis were performed by Cynthia Sheffield, Gisela Butera and Dera Tompkins. The first draft of the manuscript was written by Cynthia Sheffield, Gisela Butera and Dera Tompkins and all authors participated in reviewing, editing, and approval of the final manuscript.

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SUPPLEMENTAL FILES

- **Appendix A**: Search Strategies
- **Appendix B**: Study Characteristics
- **Appendix C**: Qualitative Assessment of Keywords Used
- **Appendix D**: Qualitative Code SDoH Concepts
- **Appendix E**: Tables 6a – 6b SDoH Concepts Emerged from Coding

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Physicians' information-seeking, appraising, and clinical decision-making practices for drug prescriptions: an exploratory study

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Objective: The purpose of this study is to understand the process of physicians' evidence-based clinical decision-making for new drug prescriptions.

Methods: Eleven semi-structured interviews were conducted, and thematic coding was used for data analysis.

Results: Several findings emerged. First, point-of-care information seeking focuses more on accessible and easy-to-use sources, such as medical websites, while out-of-practice searches encompass broader sources such as printed sources and extended networks. Medical websites are becoming preferred sources of information. Second, critical appraisal of information is performed passively by using pre-appraised information sources and referring to professional networks. Third, professional networks (i.e., specialists and senior colleagues) remain essential throughout the process and are pivotal for the decision to change prescription practices.

Conclusions: Medical information systems that facilitate immediate access to summarized reliable evidence and feature real-time connectivity to the communities of practice can be an effective strategy for improving physicians' evidence-based practice for new drug prescriptions.

Keywords: Evidence Based Practice, Information-Seeking, Clinical decision-making

INTRODUCTION

Evidence-based practice (EBP) requires physicians to be current with the best scientific knowledge produced by research. The National Academy of Medicine (NAM) identifies EBP as one of five core competencies for clinicians of all disciplines to ensure safe, patient-centered, timely, efficient, and equitable care [1]. However, the growing body of medical literature makes it difficult for physicians to stay current, contributing to outdated patient care. The ever-increasing accumulation of evidence and practitioners' inability to keep up to date is not new, especially in the medical field, where biomedical research information doubles every 20 years. For example, citation records in MEDLINE have risen to 981,270 in 2022 compared to just 579,041 in 2004 [2]. The exponential growth of information, coupled with rapid technological advancements and the increasing demand for interdisciplinary collaboration, is rapidly transforming the healthcare landscape, making it increasingly difficult for physicians to manage the overwhelming influx of information [3]. Despite physicians' positive attitudes toward evidence-based medicine (EBM), actual practice remains poor due to barriers such as lack of access to readily available applicable knowledge, lack of time to search for evidence, and lack of skills to identify, appraise, and clinically apply that knowledge [4-6].

The research-to-practice gap has been an ongoing issue, and despite continuous awareness and a push for evidence-based practice, it still exists [7]. Failure to use research evidence to inform decision-making is one of the reasons for the gap between best practices and physicians' actual prescribing practices [8], which manifests as overprescription [9] or underprescription of drugs [10-11]. Moreover, the gap between research evidence and practice not only deprives patients of receiving the best possible care but also leads to the waste of billions of dollars spent each year in healthcare research [5].

Translating evidence into practice requires the creation and dissemination of research information, as well as the active participation and effort of physicians in acquiring and applying the evidence both prior to and during decision-making [6]. In an environment like healthcare, where research evidence constantly accumulates from numerous sources, it remains unclear how physicians navigate these sources in the context of evolving technologies to inform their decision-making processes [12]. It is still not well understood how physicians choose

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information sources and seek information to find answers to their clinical questions, especially at the point-of-care (POC) [13].

To improve the uptake of research evidence by physicians at the point-of-care, it is essential first to understand how physicians, from their perspective, use information sources and other information technologies to inform their decisions. The purpose of this study is to provide deeper insights into the current practices of physicians in selecting, appraising, and applying information to inform drug treatment decisions, as well as the role of information technologies in these practices. We focus on drug-related information-seeking and application practices as drug therapy, or treatment-related clinical questions are more frequent for physicians in practice settings [3, 13].

For this purpose, the following research questions will be investigated:

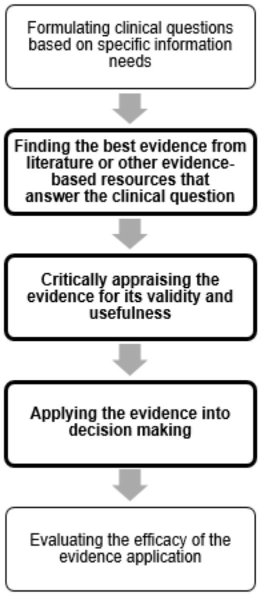
- How do physicians choose information sources for their drug information needs?
- How do they determine the reliability and validity of the new information they find on drug prescriptions?
- How do they make the decision to apply the information in their practice?

METHODOLOGY

Theoretical Framework

The concept of EBM was first introduced in 1992 in a research article by Guyatt et al [14]. EBM focuses on informing clinical decision-making based on the best available research evidence [15]. EBM has been defined as "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients" [16]. As our study focuses on evidence-based practices of individual practitioners, to investigate the physicians' process of acquiring and applying evidence-based information in practice, we have adapted the EBM model [15, 17]. The model consists of five essential steps, of which three steps of finding the best evidence (objective I), appraising the evidence (objective II), and applying the appraised evidence in clinical decision-making (objective III) will be explored in this study (figure 1).

Figure 1 The Evidence-Based Medicine Model [15].



Study Design

A qualitative research design using semi-structured, open-ended interviews was employed to explore the context of drug prescription decisions. This approach is well-suited for health services research, allowing for an in-depth exploration of the research questions through physicians' narratives [18].

Participant Recruitment

Participants were recruited using convenience sampling, targeting physicians with clinical practice experience prescribing drugs. To gather diverse perspectives, participants varied in age, gender, experience, practice areas, and qualifications. After obtaining Research Ethics Board approval from Toronto Metropolitan University (REB 2020-115), recruitment was conducted through social media (LinkedIn and Facebook), publicly available emails of physicians' practices, in-person visits to physicians' offices, and snowball sampling. Informed consent was obtained, and participants received a $20 Amazon gift card as compensation for their participation. The initial target was 20-30 participants, a number considered acceptable and recommended by experts in the qualitative research field [19-20]. Due to low response and limited resources, 11 were ultimately recruited, including family physicians, specialists, residents, and medical officers ("doctors who worked in hospitals and do not have a postgraduate qualification") [21].

Data Collection

An interview guide was developed based on the EBM model and previous similar studies [21] to include inquiries into the three particular themes: (i) how participants search for drug information, (ii) how they appraise and assess the information, and (iii) how it informs their decision-making and prescriptions. The interview questions were validated with expert reviews (e.g., trained qualitative researchers and a healthcare professional with knowledge of drug prescription practices). As the interviews progressed, the guide was updated with additional prompts, and a few questions were rephrased for clarity, keeping the main theme consistent, to ask respondents about their information-seeking behaviors in specific situations that emerged (see Appendix A).

Eleven participants were recruited, leading to eleven in-depth interviews between August 2021 and January 2023. One interview was conducted in person at the participant's workplace, and the other ones were conducted virtually through Zoom. Interviews lasted from 25 minutes to 1 hour, averaging 45 minutes. The interviews were recorded, leading to 447 minutes of audio recordings that were transcribed verbatim into 132 pages of transcripts using Microsoft Word Transcribe. Transcripts were reviewed for accuracy and anonymized by AN.

Data Analysis

Data were analyzed using a thematic analysis approach. Researchers read the transcripts and notes taken during the interviews thoroughly to familiarize themselves with the data. Two researchers (AN and JM) independently coded the first 2 interviews in NVivo-12 and then discussed together to develop an initial list of codes. Subsequent interviews were coded using this list. If new themes emerged, those were added to the list after consulting with the research team. Then, the similar codes were collated into various emerging sub-themes, which were then placed under the three major themes established from the three major steps of the EBM model. Throughout the data analysis, codes, sub-themes, and themes were iteratively reviewed and discussed with the second researcher to resolve any discrepancies and disagreements.

RESULTS

Sample Description

Among the eleven respondents, seven were female, and four were male. Four of them were Family Physicians (FPs) (three independent practitioners and one resident), five were from specialized practice domains (one practicing geriatrician, two ophthalmologists, one otolaryngologist, and one psychiatry resident) and two were medical officers (internal medicine). Seven of the respondents are licensed to practice in Canada, and four are internationally trained physicians from Bangladesh. The practice years of the independent practitioners varied from 1 year to 18 years (table 1).

Table 1 Respondent Characteristics (n = 11)

Participant	Gender	Practice Domain and Country	Years of Experience	Practice Setting
FP-1	Male	Family Physician [Canada]	18 years	Group Practice Settings
SP-1	Male	Psychiatry [Canada]	First Year Residency	Academic Health Science Centre
FP-2	Female	Family Physician [Canada]	17 years	Group Practice Settings
SP-2	Female	Geriatrics [Canada]	3 years	Academic Health Science Centre
FP-3	Female	Family Physician [Canada]	Unspecified	University Community Medical Clinic
FP-4	Female	Family Physician [Canada]	Final Year Residency	Academic Family Health Team
SP-3	Female	Ophthalmologist [Canada]	1 year	Group Practice Settings
IMG-1	Female	Internal Medicine Medical Officer [Bangladesh]	4 years	University-affiliated Medical College and Hospital
IMG-2	Female	Internal Medicine Medical Officer [Bangladesh]	2 years	University-affiliated Medical College and Hospital
IMG-3	Male	Otolaryngologist [Bangladesh]	18 years	Solo Practice in a Private Clinic
IMG-4	Male	Ophthalmologist [Bangladesh]	6 years	Non-profitable Specialized Hospital

*FP, SP, and IMG refer to Family Physicians, Specialists, and International Medical Graduates respectively, and were used to identify the participants in the study.

The main themes are discussed below with some supportive quotes.

Encountering a New Medication and Seeking Information

In our sample, participants mentioned that they were often introduced to new medications by visiting pharmaceutical sales representatives, at conferences, or, in a few instances, by patients.

Most of the time, participants did not actively seek information on it until they felt that this medication might satisfy their prescription needs. For instance, a patient might experience side effects with other medications and the physician was running out of alternatives. At that point, the physician would seek additional information about the drug, such as confirmation of its efficacy, side effects, dose, drug interactions, any available studies, legal approval, or insurance coverage.

To find answers to these clinical questions, physicians referred to different sources of drug information including paper-based and electronic resources such as medical websites, journals, MEDLINE/PubMed, product monographs, pharmaceutical handouts by pharmaceutical sales representatives as well as their professional networks such as colleagues, specialists, pharmacists. However, the selection of specific sources was highly contingent on the presence or absence of the patients in the room.

i) Information Seeking at Point-of-Care

At the point-of-care, during a patient encounter, when most clinical questions arise, physicians usually have limited time to look for information. They would then opt for fast and readily accessible sources such as peer-reviewed point-of-care subscription resources (eg., UpToDate, Dynamed), medical websites/apps (Medscape, Epocrates, Rx Files), product monographs, and pharmaceutical handouts.

> If it's something I can quickly look up, I would just have the patient wait, check it, go back into my office, and then double-check the literature... certain websites are reliable, so we would just often quickly Google and go on those websites and then double-check that drug. SP3

Some respondents even mentioned reaching out to interpersonal sources from their professional networks, such as colleagues, pharmacists, and specialists, given that they were immediately accessible at the point-of-care and perceived as reliable (table 2).

> If I'm in the clinic and through our EMR system, I can actually send instant messages to him (Pharmacist) if he is working that day. So sometimes, you know, if I don't have time to go through the entire UpToDate or entire RX files, I often instant message him. FP4

ii) Information Seeking Outside the Practice Time

Point-of-care searches remain time-constrained, and physicians often conduct extended searches for information outside of their practice settings. This would include literature reviews on research databases or at their institutional libraries.

> We generally refer to newer medications like articles that have been published, like randomized clinical trials, etc. So the primary literature, but again, that's really on our off time, we wouldn't really be doing this with the patient in the room, and if this is something that we're thinking, I would schedule a follow-up appointment. Then, I can do my own research before prescribing them. SP1

Table 2 Information Sources Used by The Participants

Categories	Information Sources	Used by	Physicians' Perceptions of the Sources	Used at
Electronic Resources	Web-based Medical Resources such as Prescription subscriptions (UpToDate, DynaMed), Medical Websites/ Apps (Medscape, Rx Files)	FP1, SP1, SP2, FP3, FP4, SP3	Information availability, Time-consuming	Point-of-care
	MEDLINE/PubMed/ University library websites	SP1, SP2, FP4	Accessibility	
Paper Resources	Product monographs, Pharmaceutical handouts	FP3, IMG3		
	Textbooks		Time-consuming, lack of applicability	
Interpersonal /Expert Knowledge Sources	Supervisors (for residents)	SP1	Reliable, Accessibility	Out of practice
	Specialists	SP1,FP4	Reliable, information availability	Point-of-care
	Practice-Based Small Groups/Opinion leaders	FP1, FP3, FP4	Reliable, accessibility	
	Colleagues	FP2	Accessibility	Out of practice
	Pharmacists	SP1, FP2, FP3	Accessibility, reliability	Point-of-care
Continuing Professional Development (CPD)	CME sessions	FP2, SP2, FP4	Reliable, information availability	Point-of-care, Out of practice
	Journals/professional associations newsletters	FP1, FP2	Reliability	Not specified
	Conferences	SP1, SP2, FP2, IMG4	Reliability, information availability	Point-of-care, Out of practice

During out-of-practice searches, they might also inquire into their professional networks such as colleagues, specialists, and pharmacists. For less pressing questions, they might get information by attending Continuing Medical Education sessions (CME), virtual lectures, presentations, pharma-sponsored dinners, seminars, academic and teaching sessions, scientific meetings, and conferences.

I would probably not prescribe that drug at all to the patient until I've done my thorough research or learned about it. It's really reading the articles...or reaching out to the drug reps... Or I could consult, like, maybe a senior colleague who used the drug before. Or I could do both these seminars that we have from time to time about educating us about different devices in ophthalmology, and different drugs in ophthalmology, and I would learn through that. SP3

Critically Appraising the Information

Participants emphasized ensuring the reliability and validity of any information related to a new drug. Only a few would appraise new evidence, while most respondents relied on sources that were already validated by other sources or experts, such as UpToDate, Medscape, and Dynamed.

Medscape is something that's easily accessible to us as physicians and that's something where we have evidence-based information about like side effects, dosing, frequency of drugs. So that's something we've used. SP3

The perceived trustworthiness of the sources was more crucial in determining the reliability and validity of the information rather than the quality of the information itself. For instance, while respondents welcomed information from pharmaceutical sales representatives (PSR), it was not sufficient to alter their prescription practices. Before prescribing it, physicians will confirm the information with either colleagues or supervisors.

The drug reps no, I don't 100% believe everything basically. Their job is to sell the drug, right? So they're already biased. So I don't trust every drug rep. I take the information down, and I have to consult with another colleague or another clinician to really believe if a drug is actually effective because drug reps will; their job is to sell you the drug, so they will say everything positive about it. So I think my trust for drug reps isn't that great, but I think they are a good resource to bring new information on the table. SP3

Engaging within their communities of practice provides an opportunity to discuss and validate any new drug or information. This could mean attending journal club sessions, conferences, or even dinners with colleagues.

One part of conferences or big meetings is abstract submission and research publications. Everyone will submit papers nationally and internationally, and you have a session whereby you will have a poster presentation or articles that are interested will be chosen for oral presentation. So there, people will present their newer research, and then you have the opportunity to ask questions or critically appraise your research. SP2

Applying the Information in Clinical Practice

Expert knowledge and opinions from professional networks (e.g., specialists, colleagues, supervisors, and pharmacists) highly influence prescription practices for new drugs.

The drug Rep would have dropped it off. I think I kind of looked at the box and then put it down, and I still, at that time, just did my regular. I kind of had my go-to sleep medications that I continued to use, and then I attended a virtual lecture...He was a psychiatrist, and he was sharing the details about this new medication and comparing it to the traditional ones. So actually after that discussion is when it started to become in my algorithm in my brain I guess of what I might use for sleep disorders. FP3

Respondents, above all, valued the practical experience shared by their respected senior colleagues and specialists, which may sometimes even lead to certain biases about a particular drug:

One of the retina specialists was giving a talk through a seminar. He actually experimented with that drug in the States and, during that seminar, told us that the outcome of that drug is that it has many side effects, such that the benefits don't outweigh the risks. There were a few other ophthalmologists there at the dinner, and we all talked about that drug, and we kind of all agreed that. We all asked each other like, do you use it, do you use it? And all of us said nope, we haven't experimented with it. We've read about it. So after hearing this now, we're not going to use it until it's like last resort...so it is, I think, through the discussions, seminars, conferences, like a collaboration with our colleagues, that we learn. To some extent, we probably become biased toward using certain drugs over the other. SP3

Sometimes, simple reassurance from experts can influence drug prescriptions by FPs or junior physicians:

I wasn't very sure about it, but when I recently prescribed it in psychiatry, a psychiatrist who was working with me last week. He has some experience, so he shared that he reassured me that this is a good medication I can actually prescribe. FP4

Specialists were considered to have more clinical experience using a new drug in their domain and to have already evaluated all new evidence related to the new drug. It builds trust towards that new drug among other physicians, which influences the future use of that drug in practice:

Glaucoma specialists only see glaucoma patients. If there is a new glaucoma drug in the market, if I wanted to try that, I would first maybe read about the drug myself, and if I had questions, I would first seek advice from a glaucoma specialist to see how they tried it. If the glaucoma specialist says no, I don't trust this

> drug because of this and this reason then as a comprehensive ophthalmologist who sees some glaucoma patients...I would think, well, maybe the glaucoma specialist definitely has more experience than me. They are obviously more knowledgeable about this disease and the outcome, and they have reasons to believe why this drug is not effective. So then I would rely on their opinion, too, and if they don't use it, then I'd be very hesitant to use it without any kind of confirmation that it actually works. SP3

DISCUSSION

The results section detailed how physicians seek and evaluate information for drug prescriptions, both during practice and at POC, and provided insights on how physicians effectively find, appraise, and apply evidence to inform their drug prescribing decisions. Specifically, the following three key findings emerged:

Our first finding shows that at the point-of-care, physicians prefer immediately accessible sources such as medical websites or apps or proximal colleagues. In out-of-practice, they refer to primary literature, journal articles, or extended professional networks for detailed information. While reliability, easy accessibility, and convenience of use have been mentioned as some of the essential qualities of information sources by the participants, similar to other past studies [22-24], our finding suggests that easy accessibility is particularly critical at POC. Time constraints at point-of-care lead to an emphasis on accessible information sources, notably the immediate professional network and medical websites. These results reinforced how the timeliness of response is critical in determining which source to consult [25], depending on the practice setting.

Prior literature suggested conflicted findings as to physicians' preferences. Some argued that textbooks, journals, and colleagues' opinions were preferred [4, 22-23], while others suggested that web-based information sources were preferred over textbooks or journals [26-27]. Our results indicate that this may depend on the search timing, with medical websites/apps being preferred at point-of-care and journals and textbooks during out-of-practice searches because of time constraints. This seems likely considering that physicians spend only 2.2 mins searching for information during patient consultations instead of 32 minutes after consultation [28]. When an average patient consultation lasts less than 10 minutes, spending less time searching for information is reasonable [29]. Future research could confirm the hypothesis that at POC, easy accessibility to information is more highly correlated to satisfaction than during out-of-practice searches.

Our second finding is that physicians mostly rely on pre-appraised information sources or their professional networks to obtain reliable and valid information rather than appraising the evidence themselves. Most respondents relied on POC tools such as Dyna Med or UpToDate for evidence-based information. These websites are considered "pre-appraised" sources with already sorted higher-quality and up-to-date information [30]. Our study suggests a growing awareness and importance of such electronic sources compared to prior studies that reported low awareness and underutilization of such sources [4]. As these sources are effective at providing answers [31] and time-efficient for reliable information [32], this evolution is likely to continue.

Despite the pervasiveness of digital tools providing information on medications, when it comes to critically appraising medical information, our study suggests that physicians' professional network plays the most crucial role as they prefer to evaluate any new evidence through discussion within their communities of practice. This could mean consulting specialists, attending conferences, Continuing Medical Education events, journal club sessions, or other social events with their peers. This finding is in line with past research where specialists have been posited as a "shortcut" for general practitioners who lack the skills or time to assess all the evidence about drugs [33]. It also confirms a past study that found that physicians rely more on the authoritativeness of an information source to determine validity than on the content itself [34]. However, the literature provides limited support for physicians' critical appraisal practices, leaving an opportunity for future research in this area.

Our third finding is that the professional networks of physicians (i.e., specialists, senior colleagues, pharmacists) keep playing a decisive role in the final decision to prescribe a new medication. Physicians remain heavily influenced by the opinions of their professional networks, especially specialists or senior practitioners who were perceived to have more experience than them. The study suggests that the emergence of reliable and accessible online tools has not supplanted specialists yet. Validating their decisions with specialists could help physicians minimize their risks of applying new evidence (or a new drug) [35]. Physicians often require support, guidance, affirmation, and feedback beyond simply finding information that helps them make critical clinical decisions [22,36] and this behavior persists among technologically savvy physicians too. This raises the question of how reliable of a source senior practitioners are, especially when it comes to new medications. While this behavior protects patients from untrustworthy and unethical online information, it might also introduce cognitive and affective biases in their decision-making [37-38] and resistance to new drug adoption. As social norms evolve, future research could investigate the role of "shared decision-making" with patients, considering their opinions and preferences for any new drug.

Overall, our findings show that professional networks and, more generally, the reliance on peers for

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consequential decisions, such as new drug prescriptions, remain critical to enabling the translation of medical evidence into prescription practices.

As AI-driven decision tools emerge, that instantaneously synthesize large volumes of clinical evidence to provide physicians with relevant and up-to-date information based on individual patient characteristics [39], it remains to be seen whether and how these technologies will modify the current balance between fast POC practices and more time-consuming but more reliable out-of-practice information seeking practices.

Our study has implications for practice. The distinction between POC and out-of-practice information-seeking behaviors suggests a need for software providers to consider the dual needs of physicians: one modality of information searches focused on accessibility and simplicity and the other on comprehensiveness and reliability. This may involve integrating the two or considering bridges in the physicians' journey toward information seeking. Integrated options to consult experts in real time could also significantly encourage physicians to prescribe more state-of-the-art medications.

LIMITATIONS

The study also has its limitations. First, the study had a small number of participants in specific locations and specialties and remains explorative. Future research should attempt to confirm its findings with a larger sample and possibly quantitative approaches. Such studies would investigate the role of other factors. For instance, residents, younger practitioners, and family physicians seemed more dependent on the opinions of their professional networks than specialists for new drug prescriptions. Second, interviewees' responses may have recall or response bias, reflecting socially desired practices rather than actual ones. To minimize bias, participants were asked to describe their most recent experiences. Observation of actual drug-prescription practices in future studies would alleviate that limitation. Finally, the data were collected during the pandemic over the course of 18 months, which may have altered respondents' practices and views towards more virtual information-seeking behaviors.

CONCLUSION

This study has provided preliminary but valuable insights into physicians' drug-related information-seeking and clinical decision-making practices. By taking the physicians' perspective, we captured and documented a range of POC and out-of-practice evidence-seeking, appraisal, and use practices. As electronic and web-based resources continue to evolve and become more pervasive at the POC, it may be tempting to assume they will significantly influence physicians' decision-making for drug prescriptions at POC. Studies like this remind us that context and processes are critical in determining what information sources will be selected and whether they will be acted upon or dismissed. This will become even more important as the promises of these resources, coupled with the emerging disruption by artificial intelligence-based tools, expand if we want to ensure that the gap between evidence-based medicine and actual practice does not widen.

DATA AVAILABILITY STATEMENT

Data associated with this article are available to researchers at https://borealisdata.ca/dataset.xhtml?persistentId=doi:10.5683/SP3/GG45SJ&version=DRAFT. Access to the data can be requested from the corresponding authors.

AUTHOR CONTRIBUTIONS

Akhi Nath: Conceptualization, methodology, investigation, data curation, formal analysis, writing - original draft. Julien Meyer: Conceptualization; methodology; investigation, funding acquisition; formal analysis; project administration, supervision, writing - review & editing. Mathieu Templier: Conceptualization, writing - review and editing.

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ORIGINAL INVESTIGATION

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Graphic medicine in academic health science library collections

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See end of article for authors' affiliations.

Objective: Academic health science library catalogs were analyzed to determine the presence and frequency of graphic medicine titles in print format in the collections. The secondary objectives were to gauge if students could access graphic medicine titles, through other libraries within the same system or as eBooks, and to examine if libraries highlighted graphic medicine collections and their uses on their websites.

Methods: A convenience sample of health science libraries was created from the Association of Academic Health Science Libraries member list. A title list was developed from collection resources and award lists for graphic medicine and graphic novels. Data was collected from public-facing library catalogs.

Results: Fifty-six percent of the libraries analyzed had at least one title from the list in their collections available as print. An additional thirty percent had at least one title available as an eBook, leaving only fourteen percent with no graphic medicine titles.

Conclusions: This study provides a starting point in describing the prevalence and breadth of graphic medicine collections in academic health science libraries. Although their presence may be small, our findings suggest that graphic medicine is being collected by academic health science libraries. Academic librarians can support the growing interest in the comic art format by incorporating graphic medicine into their collections and educating their patrons on this important genre.

Keywords: Graphic medicine; collection development; health science libraries

See end of article for supplemental content.

INTRODUCTION

Biology, physiology, and biochemistry may be the foundation of medical education, but people are more than just a disease state and medical decision-making is not always straight forward. To bridge this gap, medical school curricula began incorporating medical humanities in the 1960s as a way to integrate ethical considerations and understanding of the patient's experience into the harder edges of medical practice [1]. By 2018, ninety-four percent of medical schools participating in the Liaison Committee on Medical Education (LCME) medical school questionnaire reported medical humanities as a part of required or elective courses [2]. The integration of humanities into medical curriculum has also been determined as foundational content for physician development by the Association of American Medical Colleges [3].

The expansion of the humanities within medical school curricula has been accompanied by an increase in the subject areas that comprise medical humanities to include narrative medicine, visual arts, theater, film, music, and comics [4]. Comics specifically have evolved from their early use as medical caricatures [5] into the unique field of study known as graphic medicine [6]. The term "graphic medicine" was first coined by comic artist and physician, Ian Williams, in 2007 as "the intersection between the medium of comics and the discourse of healthcare" [6,7]. This definition illustrates the breadth of graphic medicine across health disciplines with an active presence in fields such as nursing, public health, and bioethics [8].

Although comics may not intuitively seem appropriate for the serious nature of health care professions, the addition of visual elements in comics can help impart understanding and convey experiences more effectively than text alone [9]. For example, in the public health arena, Meredith Li-Vollmer [10] uses comics to communicate

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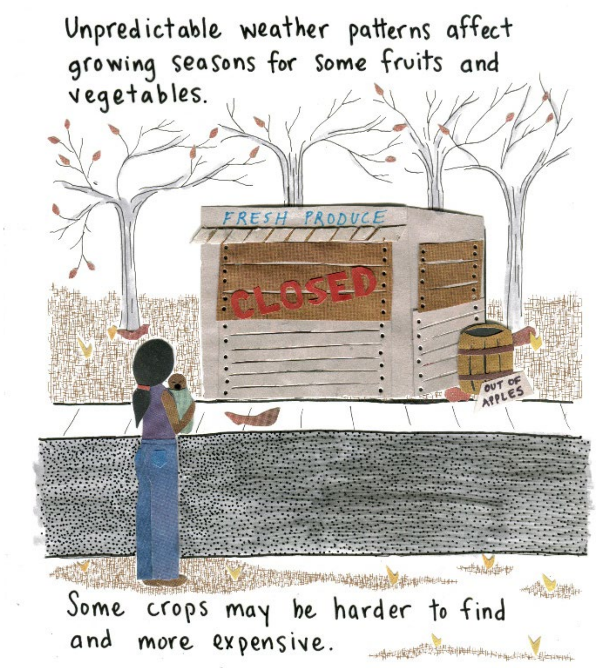
how global issues such as climate change impact local communities.

Figure 1 Climate Changes Panel 1. Courtesy of Public Health – Seattle & King County. Written by Meredith Li-Vollmer, artwork by Mita Mahato.



In Figure 1, the text explains that the produce supply is changing due to altered weather patterns. The illustration shows a woman and child at a closed food stand with an empty apple basket drawing attention to how global change translates on a local level. Comic art connects these global issues and their local impacts, fostering a deeper understanding of how these issues may affect communities on a personal level. This unique quality is also what makes comics appropriate for promoting understanding of difficult subjects in health science education. Graphic medicine can also be an effective tool in clinical care by providing a connection between hard to grasp concepts about the body and how they affect specific individuals.

In medical education, graphic medicine's versatility is evident – from illustrating specific concepts in a single assignment to forming the foundation for an entire course. For example, Masel et al [11] assigned medical students to read one of three comic art panels illustrating difficult situations experienced by either patients or doctors and then write a reflection on the situation depicted in the comics. This application demonstrated how a single comic art panel can promote reflection on a complex situation. Similarly, studies conducted by Green [12] and by Ronan and Czerwiec [13] describe implementing a four-week course of reading and creating comics to promote empathy and understanding among medical students of the patient experience across a variety of disease states.

While promoting empathy and understanding of the patient's experience remains a significant contribution of graphic medicine, its evolution extends beyond this aspect. Since its initial description in 2010 [9], the use of comics has expanded to include facilitating students in exploring their professional identity, grappling with medical ethics, and comprehending complex health information [10, 11, 12]. Importantly, this evolution has not been confined solely to medical education; recent literature describes the use of comics in nursing education and in the education of other health professionals [14, 15, 16].

Graphic medicine can help promote essential learning and clinical skills. Studies found that students reported better understanding and appreciation of patient's experiences after reading certain comics [12, 13]. Additionally, students reported that creating comics helped improve their communication and clinical skills [12]. In an undergraduate nursing course, the addition of cartooning to a case study presentation resulted in higher post-test scores [16]. A study of residents reported that graphic medicine content added to their knowledge about clinical conditions [13]. Although more research is needed to determine the effect of comics on specific educational domains, there is evidence to conclude that comics are seen as novel and engaging information sources [13, 15, 17].

The approachable nature of graphic medicine also makes it effective for patient care. In the clinical realm, comics have been used for patient education, health literacy, and health promotion. Comic book interventions for preoperative education have been found to reduce anxiety in children and adolescents [18]. Comic books can also facilitate health literacy of complex [19] or stigmatized topics [20]. A study of patients at high risk for metabolic syndrome demonstrated that the addition of educational materials in comic format resulted in increases in healthy eating and physical activity behaviors [21]. Aligning with the findings from educational research, patients have also identified comics as an enjoyable format for learning [19].

As institutions that support health science education, health science libraries adapt and respond to the curricular changes of the programs they support. Health science librarians are poised to identify curricular needs and actualize collection resources. The National Library of Medicine (NLM) has recognized the significant contribution that graphic medicine can have in healthcare, amassing a collection of forty titles by 2018 [22]. Furthermore, NLM curated the exhibit titled *Graphic Medicine: Ill Conceived and Well Drawn* to explore the graphic medicine genre and showcase valuable

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programming ideas for libraries supporting health science education [22].

Despite this national recognition, a 2020 survey of graphic novels in academic libraries revealed that graphic novels make up less than one percent of academic library collections [23]. Given the increased reporting of graphic medicine usage in medical education, we wanted to see if these statistics also held true for health science library collections. In this study, we performed an analysis of academic health science library catalogs with two primary objectives: to determine which, if any, recommended graphic medicine titles in print format are contained within the collection, and to see which graphic medicine titles could be found most often in these collections. Our secondary objectives were to gauge if library users could access graphic medicine titles, either through other libraries within the same system or as an eBook, and to examine if libraries with graphic medicine titles highlighted these collections on their websites.

METHODS

We adapted the methodology used by Kevin Mulcahy [24] in "Science Fiction Collections in ARL Academic Libraries" and Cassie Wagner [25] in "Graphic Novel Collections in Academic ARL Libraries" to develop a list of health science libraries and graphic medicine titles. Instead of the Association of Research Libraries member list, we used the Association of Academic Health Science Libraries (AAHSL) member list. This allowed us to focus on libraries that support the information and knowledge needs in the health care environment [26].

We excluded the following to reflect the focus of our study:

1. Libraries that are not solely a health science library
2. Non-academic organizations/libraries
3. Health science libraries (HSL) with catalogs that require an organizational login to search
4. Libraries whose online catalogs do not differentiate holding locations within a library system
5. Libraries without print collections
6. Virtual libraries.

Health science libraries with multiple locations using the same catalog were counted as one entity. The final academic HSL list used for this study was developed between December 2022 and January 2023. It consisted of 125 libraries and is included in Appendix A.

Recommended title and award lists are a staple of library collection development; however, while there are existing lists for graphic novel titles, few are devoted to the subset of graphic medicine. We reviewed graphic novel award lists for titles that were graphic medicine in nature. Additionally, we examined the following graphic medicine award lists and collection development resources for graphic medicine titles:

1. *Essential Graphic Medicine: An Annotated Bibliography,* a list of thirty graphic medicine titles curated in 2018 by health science librarians Alice Jaggers and Matthew Noe [27]. This list was designed as a collection development tool for librarians interested in starting graphic medicine collections.
2. The Graphic Medicine International Collective (GMIC) shortlist for the inaugural 2022 GMIC Award for outstanding health-related comic projects completed and or published in 2021 [28]. The GMIC was founded as a not-for-profit organization in 2019 to support the use of comics in health.
3. The American Library Association's (ALA) Graphic Novels and Comics Round Table's (GNCRT) best graphic novel lists for the years 2020 through 2022. [29]. ALA published the first list in 2020, and all available years were consulted for titles.
4. Award lists from the Eisner Award, Kirkus Prize, Hugo Award, Benjamin Franklin Award, and the Doug Wright Award. No titles from these lists were chosen either because they were not graphic medicine in nature or were duplicated in another list.

The final title list used for this study encompassed all thirty books from Essential Graphic Medicine and twenty that address health-related topics from the ALA's Best Graphic Novels for Adults Reading List and Best Graphic Novels for Children Reading List. Since this project focuses on university-affiliated health sciences libraries, selections from the children's reading list were limited to those that are indicated for older readers. Seven titles from the GMIC Award shortlist were also incorporated. Books that are not readily available for purchase in the U.S., not available in English, or only available in electronic format were excluded. The final list consisted of fifty-seven graphic medicine titles and can be found in Appendix B.

We decided to focus on identifying titles available in print format at the health science library in an attempt to ascertain the collection development priorities of health science libraries. Since electronic resources lack specific holding locations, we felt that eBooks might reflect priorities from other groups within the library system. Furthermore, the availability of individual titles can fluctuate due to purchasing or licensing agreements and may not be connected to a targeted plan. We adopted the following approach to identify print graphic medicine

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works held within health science library collections. We performed title searches directly in each institution's online catalog to provide the most accurate information about an individual library's holdings. We did not search using either the genre/form terms "Graphic medicine (comics)" or "Graphic Novel(s)" due to inconsistencies in local cataloging practices and the application of genre/form terms.

We developed and tested a standardized data collection worksheet using Microsoft Forms. We collected the following information based on holding information found during the title search:

1. If the title was available in print format at the health science library location. This included books that were noted as lost, on order, or on reserve.
2. If the print book was available from another (non-health specific) library in the system
3. If the title was available as an eBook
4. If the library website featured a graphic medicine collection
5. If the library website had a library guide on graphic medicine.

Data was collected from April to August 2023. Additional content information was collected from the identified library guides in February 2024.

RESULTS

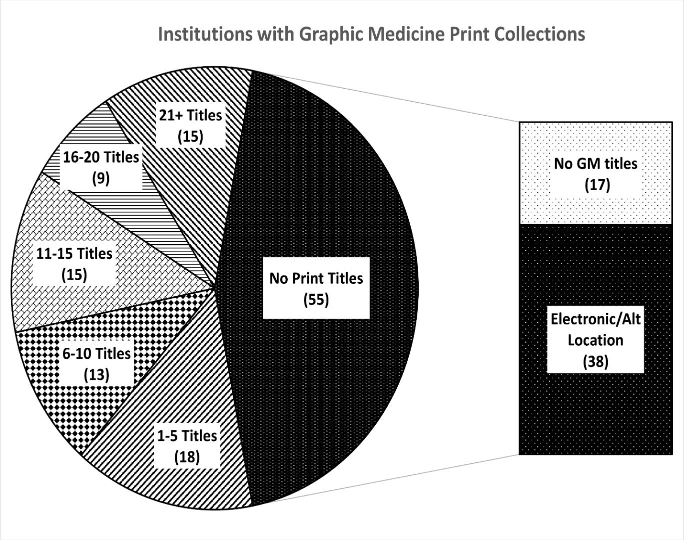
Q1: Are graphic medicine titles available in health science libraries?

Of the 125 library catalogs examined, seventy had at least one graphic medicine title from the list in their print collection. This represents fifty-six percent of the total libraries analyzed (Figure 2). Twelve percent of libraries had larger collections of twenty-one titles or more.

Q2. Are graphic medicine titles available as eBooks or through other libraries within the university's library system?

Figure 2 also shows the prevalence of graphic medicine titles available as eBooks or from other libraries at the university among those with no print graphic medicine titles. Of the fifty-five libraries that did not have any print titles in their collections, thirty-eight had access to the titles as an eBook. Seventy percent of all library catalogs examined had access to at least one graphic medicine title on the list as an eBook. Additionally, sixty-two percent had access to print titles through other libraries at their university. Of all the libraries examined only seventeen (14%) had no access to any of the graphic medicine titles on the list through either a print collection, eBooks, or other libraries at their university.

Figure 2 Health Science Libraries with Graphic Medicine Titles



Q3: What graphic medicine titles are most often found in health science library collections?

Titles from the Essential Graphic Medicine list featured more prominently in library collections compared to titles from other resources we consulted. The Essential Graphic Medicine list represented a little over fifty percent of the complete list developed for this project and included the earliest titles dating from 2006 to 2019. The other sources used to develop the graphic medicine title list only included titles published from 2020 to 2022. A complete list of titles and their presence in library collections is in Appendix C.

Q4: Do libraries feature graphic medicine library guides or collection information on their websites?

Figure 3 shows the number of library guides and featured collections in relation to the size of the print collections. Of the academic health science library websites examined, twenty-five had graphic medicine collection information on their website and/or on a library guide related to graphic medicine. This information was in the form of individual books with catalog information or permalinks to the collection in the catalog. Approximately a third of the institutions with print titles from our list had a library guide (21) and/or featured collection (25). Two libraries with no print titles had a library guide.

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Figure 3 Total library guides and feature collections by print collection size.

Print Titles	Library Guide	Featured Collection
none	2	0
1-10	3	5
11-20	9	10
21-30	4	4
31-40	4	4
41-50	1	2
Total	**23**	**25**

DISCUSSION

Among the health science libraries analyzed, over half included graphic medicine titles from our list in their print collections. However, roughly a quarter of these had fewer than ten titles. This is not a surprising finding given the trend in academic libraries to reduce print collections in favor of electronic resources [30]. Our data confirmed this trend: 70% of libraries offer at least one graphic medicine title in eBook format compared to only 56% with print copies. Most of the libraries without print editions had access to the titles in electronic format (69%).

Although a detailed discussion of acquisition decisions and the reasons why a library may acquire a title in a specific format is outside the scope of this study, based upon our data it seems likely that health science libraries may not be collecting graphic medicine titles in print if other libraries within their university offer them, or if they are available as eBooks. Academic libraries are generally on tight budgets and may be putting their funds toward resources that are more readily accessible (eBooks) or may have collaborative collection development practices in place that discourage duplicating materials that are present within their overall system. Additionally, health science libraries may face collection development constraints, such as requirements to purchase from specific vendors, prioritize curriculum-related materials, or acquire electronic formats due to space limitations. Although the eBook format was found to be more prevalent in the academic libraries examined, a study of undergraduate and graduate students found that the preferred format for comics is print [31]. Librarians investing in graphic medicine materials may consider this preference when adding to or developing their collections.

Titles from the Essential Graphic Medicine list were most frequently found in library collections. Essential Graphic Medicine is one of the few collection development resources available for this genre and may be influencing acquisition choices. This is evident in the title list developed for this study as slightly over fifty percent of our entire list came from this source and may have skewed the results in favor of finding these titles. Additionally, the Essential Graphic Medicine list includes older titles dating back to 2006 allowing libraries more time to add them to their collection. Considering that graphic medicine is a relatively young genre, it’s unsurprising that some libraries lack titles in this category.

We hypothesized that the existence of a graphic medicine library guide would be associated with the size of a health science library’s graphic medicine collections. Among the twenty-three library guides observed, eighteen originated from libraries with twelve or more graphic medicine titles. Conversely, only five library guides were associated with libraries possessing fewer than ten titles. Further examination revealed these libraries instead had electronic collections of graphic medicine titles. Most libraries with graphic medicine library guides (twenty-two of twenty-three) provided information specifically about the graphic medicine collection within the library. This aligns with the common practice of featuring collection resources in library guides [32]. Although many library guides featured collection information, we can draw no direct correlation between the size of the collection and the existence of a library guide. The presence of a library guide may be driven by other factors like a librarian’s interest in graphic medicine or course offerings on or using graphic medicine.

Librarians with graphic medicine collections are actively promoting graphic medicine as a topic, both as a teaching tool and for research purposes on their library guides. Eighteen of the libraries with library guides included topical information and links to relevant resources. Research-oriented content, such as scholarly articles and database search strings, were featured in eleven guides. Additionally, nine of the library guides emphasized teaching with graphic medicine, offering examples, assignments, syllabi, and tools for creating comics. Notably, one guide was dedicated entirely to a graphic medicine course. Given its value in traditional medical education [9], graphic medicine occupies a unique position. Librarians play a pivotal role in advocating for its use both as a research resource and as an educational aid. By showcasing resources that demonstrate graphic medicine’s application in research and teaching, libraries can drive utilization of existing collections and contribute to the advancement of this genre.

LIMITATIONS/FUTURE DIRECTIONS

Our decision to use a selected title list and to focus on print titles limited the scope of our findings. Institutions may hold additional titles not included in our list. We discovered at least two libraries with other graphic medicine titles available in their collections. Some libraries

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do not have print collections or are no longer investing in print materials. While we documented cases where electronic editions were present in the catalog, we did not include these in our primary study for reasons described in our methodology.

Focusing solely on academic health science libraries does not take into consideration general academic libraries that support health professional programs or collaborative collection development practices that may exist amongst university library systems. A survey of graphic novel collections in Association of Research Libraries (ARL) institutions found that although they tend to be small, graphic novel collections are often present in ARL libraries [25]. General libraries may be collecting graphic medicine titles that support multiple programs offered at their universities.

Future studies could address these limitations by exploring the resources that librarians consult for collection development, investigating specific titles available through the eBook format, and titles recommended for younger age ranges since all the titles on our list are indicated for fifth grade and above. Additionally, the ALA's Graphic Novels and Comics Round Table's "Best Practices for Cataloging Comics and Graphic Novels Using RDA and MARC21" published in 2022 [33] may help to standardize and align cataloging practices, allowing for more targeted and efficient search methods to be employed in future studies.

Examining the collections of all academic libraries that support health professional programs could provide further insight into the prevalence of graphic medicine collections along with factors that may be driving collection development such as librarian interest, budget, and program needs. Additionally, circulation statistics may add information about the preference between print and electronic titles and how these materials are used in educational programs outside of health.

CONCLUSIONS

Graphic medicine is a relatively young genre with applications across health science professional programs. This study provides a starting point for describing the prevalence and breadth of graphic medicine collections in academic health science libraries. Only fourteen percent of libraries in this study did not have any graphic medicine titles available in either print or electronic editions. This suggests that, although their presence may be small, academic health science libraries are collecting graphic medicine titles. Additionally, the use of graphic medicine in both research and education is an emerging field [6]. Academic librarians can support the growing interest in the comic art format by incorporating graphic medicine titles into their collections and educating their patrons on this important genre.

DATA AVAILABILITY STATEMENT

Data associated with this article are available in the Open Science Framework at

https://doi.org/10.17605/OSF.IO/NBMWX

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; methodology; investigation; Writing- original draft. Author 2: Conceptualization; methodology; investigation; Writing- original draft. Author 3: Methodology; Data curation; visualization; writing-review and editing. Author 4: Conceptualization; investigation; writing-review and editing.

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SUPPLEMENTAL FILES

- **Appendix A**
- **Appendix B**
- **Appendix C**

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CASE REPORT

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Systematic librarian-led zip code analysis to target underserved communities

Rachel Roberts; Kelsey L. Grabeel

See end of article for authors' affiliations.

Background: To compare the library's health information service usage area and customer topics with the hospital's reasons for hospitalizations to examine commonalities and explore potential growth opportunities within the community.

Case Presentation: Researchers partnered with the hospital for this project. IRB approval was received. Researchers gathered the health information service's 2022 data, which was de-identified. Data analyzed included zip code and customer topics, which were coded according to the hospital's business line, which was defined as why a patient was hospitalized or used the ED. The health information service's business lines were compared with the hospital's business lines. Lastly, researchers also reviewed the hospital's targeted zip codes to see if those overlapped with the top zip codes that utilize the health information service. The top zip codes that used the library's health information service were 37920, 37918, 37917, 37919, and 37876. Usage of the health information service varied across zip codes and topics. The most requested topics for the health information service and reasons for hospitalizations/ED visits were General Medicine in three of the five zip codes. Based on the data's results, librarians performed outreach to organizations in the targeted zip codes to increase visibility of the library's services.

Conclusion: The reasons people requested health information from the library aligned with hospitalizations and ED visits in most of the zip codes. Providing further outreach to the hospital's targeted zip codes will benefit both the hospital and the library by increasing usage of the health information service.

Keywords: Health literacy; outreach; consumer library; hospital librarianship; Social determinants of health; Hospital

BACKGROUND

Throughout the years, hospitals have provided the community with medical and surgical care. According to the American Hospital Association, in 2022, there were over 6,000 hospitals in the United States (U.S.) and over 33 million admissions [1]. In 2021, there were over 139 million Emergency Room (ER) visits [3]. With so many hospitalizations in the U.S., there is no wonder why 72% of adult internet users have searched online for health information [4]. Although many people may turn to Google to find health information, this can lead to misinformation. Additionally, many studies have found that online patient education is written at a grade level higher than the average reading grade level [5]. By having a hospital library, physicians have a place to send their patients to find reliable and accurate health information instead of telling them to find the information online [6]. Many studies have found that the library and its resources have a positive impact on patient care [7]. Having a dedicated patient and family library has been shown to improve the patient and family experience [8].

While all libraries that provide health information services are essential to promoting access to healthcare and health information, this is especially true in rural communities that lack resources like Internet access and access to reliable health information [11]. Hospital libraries are also valuable for communities that lack resources like Internet access. These populations are more likely to call or come in person for health information, so the librarians can provide grade level appropriate information following a reference interview in which they evaluate a patient's health literacy level, which refers to a person's ability to understand health information and use that information to make health-related decisions [9, 10]. Hospital libraries positively contribute to a person's health literacy, which is a defining aspect of overall community health [12].

Libraries often partner with community organizations to raise awareness of library services and target specific needs [11]. While public libraries receive questions about health topics on a regular basis, not all public librarians feel comfortable answering health related questions [13]. This makes hospital libraries a crucial and unique service for communities. However, a service is only beneficial if people know about it. Raising awareness for an unknown service requires an intentional marketing plan. Direct marketing, such as sending brochures to various organizations in the community, is a proven way to increase patron awareness of a service [14].

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The University of Tennessee Medical Center (UTMC), a teaching hospital located in the middle of Knox County, TN, has over 33,000 discharges annually [15]. Knox County, a county of 470, 313 people, is ranked 9th out of 95 counties in Tennessee for overall health [16]. Knox County has a higher than national average percentage of people with incomes below the poverty level [16]. In addition to Knoxville, UTMC also serves surrounding counties with lower health scores, lower income, and lower health literacy [17]. All of these factors contribute to lower health literacy, with low socioeconomic status being one of the main determinants of health literacy [18].

Although Preston Medical Library has offered a free health information service for over 25 years, there was a drastic increase in requests in 2014 due to the opening of the patient and family library inside of the hospital [19]. While there have been studies analyzing the health information service requests and the zip codes, there has not been a study comparing the library's top usage area in Knox County request topics with the hospital's reasons for hospitalizations and ED visits [20]. To examine the relationship between patron use of the library and a patient's use of the hospital, researchers partnered with the hospital's Performance Improvement Coordinator.

The first goal of this case study was to collaborate with the hospital to define the library's top usage area by zip code in Knox County. For this study, usage is defined as any use of the library, in person or otherwise, that resulted in health information being obtained by the patient. The second goal was to see why people were being hospitalized and if the reason for hospitalization aligned with the topics people were requesting health information on from the library. Lastly, the third goal was to evaluate the hospital's targeted zip codes for outreach to see if there was any overlap with the information service's top zip codes. The targeted zip codes for outreach were selected by the hospital as those with the greatest need based on their Community Needs Index Score [17]. Based on these results, outreach to community organizations was planned to reach the targeted zip codes with the lowest usage of the health information service.

CASE PRESENTATION

IRB approval from the Graduate School of Medicine (IRB # 5169) was received. Researchers at the library requested data from the hospital by completing a Health Equity/Disparities Data Request Form to compare the health information service requests topics and zip codes from 2022 with the hospital's data from 2022. After completing the form, the health information service data was downloaded from the library's in-house database. Researchers de-identified the information, leaving only the date, zip code, city, method of contact, and customer text. Customer text was the health topic on which the person requested information. Researchers then coded the customer text to match the hospital's reasons for hospitalizations or Emergency Department (ED) visits, known as a "business line." The hospital has defined 21 business line topics, or broad categorizations of reasons for hospitalizations or ED visits: Cardiac Surgery, Cardiology, ENT, General Medicine, General Surgery, Gynecology, Hematology/Oncology, Medical Oncology, Neonatology, Neurology, Neurosurgery, Obstetrics, Ophthalmology, Organ Transplant and Vent Assist Devices, Orthopedics, Psychiatry, Surgical Oncology, Thoracic Surgery, Trauma, Urology/Nephrology, and Vascular Surgery. Each customer text topic was given one business line topic that most closely matched. For example, if a person requested information on "allergies" or "diabetes," that was given the General Medicine business line.

Data was sent to the hospital's Performance Improvement Coordinator to find the top five usage zip codes of the health information service. Furthermore, for each zip code in the top five, the coordinator found the business line and number of inquiries in each zip code for the health information service. Once that was completed, the coordinator pulled the hospital business line data for the top health information service zip codes. The information was then analyzed based on the business line topic to determine if the requests for information matched the reasons for hospitalization, called Inpatient, or reasons for ED usage.

The top zip codes that utilized the health information service in order of highest use to lowest were 37901, 37920, 37917, 37876, and 37725. The results were broken down and analyzed for each zip code. For zip code 37901, there was very low usage of the hospital, whether Inpatient or ED use. The most common use for Inpatient or ED was General Medicine; however, the library received more requests for information on Urology/Nephrology in that zip code. See Table 1 for the business lines and their usage related to Inpatient hospitalizations, ED visits, and library health information requests in 37901.

Zip code 37920 used the hospital the most for Inpatient and ED but was the second highest zip code that used the health information service. General Medicine was the most common use for Inpatient and ED and the most requested health information topic. For zip code 37917, the library's requests were mostly Neurology whereas the ED and Inpatient usage was largely General Medicine. See Table 2. Neurology had 69 Inpatients and the ED had 67 in zip code 37917, which is 5% and 2% versus 33% for the library's health information requests.

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Table 1 Inpatient hospitalizations, ED visits, and Library Requests for patients associated with Zip code 37901.

Zip Code 37901			
Business line	Inpatient Hospitalizations	ED Visits	Library Requests
Cardiac Surgery	1	1	0
Cardiology	1	0	4
ENT	0	5	0
General Medicine	5	13	40
General Surgery	1	10	2
Gynecology	0	1	0
Medical Oncology	0	0	19
Neonatology	1	0	0
Neurology	1	0	3
Obstetrics	1	1	0
Ophthalmology	0	0	5
Psychiatry	0	1	0
Surgical Oncology	0	0	3
Urology/Nephrology	1	0	41

Table 2 Inpatient hospitalizations, ED visits, and Library Requests for patients associated with zip code 37917.

Zip Code 37917			
Business line	Inpatient Hospitalizations	ED Visits	Library Requests
Cardiac Surgery	45	325	0
Cardiology	72	16	1
ENT	8	262	0
General Medicine	431	1096	12
General Surgery	98	646	0
Gynecology	4	19	0
Hematology/Oncology	13	7	3
Medical Oncology	6	0	0
Neonatology	146	0	0
Neurology	69	64	15
Neurosurgery	17	0	0
Obstetrics	150	109	0
Ophthalmology	5	36	1
Organ Transplant and Vent Assist Devices	3	3	0
Orthopedics	98	44	4
Psychiatry	25	314	0
Surgical Oncology	7	0	0
Thoracic Surgery	8	0	0
Trauma	39	33	0
Urology/Nephrology	39	77	9
Vascular Surgery	9	0	0

The last two zip codes, 37876 and 37725, mainly requested health information on General Medicine, which matched the reasons for Inpatients and ED visits. In all zip codes, only 1% of health information requests were on Obstetrics / Gynecology, whereas Obstetrics / Gynecology comprised 14% of Inpatients and the ED in those five zip codes. Overall, in 2022, the topic people requested the most information on from the library was General Medicine, which aligned with the top reasons for hospitalizations and ED usage.

Researchers then compared the most used zip codes for the health information service with the hospital's targeted zip codes to determine if there was any overlap. The only zip code from the targeted zip codes in the library's top five was 37901. Therefore, researchers planned outreach for the other four zip codes: 37912, 37914, 37915, and 37921.

In researching possible organizations to contact to initiate outreach, it was decided that public libraries and local health departments would be the best places to contact [11]. Librarians contacted the public libraries in those zip codes and explained how the health information service could help them. They also offered to send brochures to the libraries to be displayed for their patrons. Two of the four libraries responded (zip codes 37912 and 37914) and were sent brochures.

In addition, researchers contacted health departments and health specific organizations in the four zip codes. Representatives from the health departments responded enthusiastically, and while no brochures were sent, a relationship was established between the library and the health departments. The administrative coordinator of one health department electronically forwarded information about the library's health information service to their colleagues and other areas in the organization. As a result, the library received communication from two separate individuals who had specific questions about the library's resources. The library sent information about mental health resources that will benefit the employees of the

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health department and their patients. These departments serve the public in all four zip codes, and each voiced their excitement over sharing the health information service with their populations.

Discussion

The library's location in the middle of the hospital results in a symbiotic relationship that mutually benefits both, as health information is a valuable part of a hospital patient's care. The more information the library is able to provide for the hospital's patients, the more likely the care they receive in the hospital will result in positive outcomes [21]. Additionally, the more patients that come into the hospital results in a larger, more easily accessible population for the library to have contact with. By partnering with the hospital to identify zip codes, hospital usage, and information request topics, researchers were able to gather detailed information to determine if there was any overlap of zip codes and topics, which gave them a broader understanding of their population base. The overall takeaway from this project was that the most requested information from the library aligned with the top reasons for hospitalizations and ED usage.

Zip codes are one of the only consistent quantifiable pieces of data that the library records about the patrons who use the health information service, with many studies being published on the zip codes that use this service [22, 23]. By evaluating the area from which health requests come from, librarians can glean important information about their customers. Similarly, the hospital values the zip code data it records from its patients to evaluate its customer base and identify if they are reaching patients with the greatest need, as zip code impacts a patient's health and wellness [24]. The other big piece of information that both areas of service records is the health information need itself. By comparing these pieces of information, librarians determined that some patrons in these zip codes requested information that overlapped with why patrons from this same zip code are being hospitalized or going to the ED. Furthermore, the library and hospital's needs overlapped in that they both wanted to help patients in need and improve the patient experience.

When comparing the results, researchers found that three out of the five zip codes' top requests and hospitalizations or ED visits were for General Medicine. This is a potential weakness, as General Medicine is a broad topic and could reflect many different, non-related health conditions. It is also important to note that the library did not receive many information requests related to Obstetrics / Gynecology, whereas the hospital had many Inpatients and ED visits in this area. This might be because those patients with that business line are having a baby. However, there might be a need for the library to reach those patients in case they do need health information and are unaware of the service. In addition, it might be beneficial for the library to do outreach to the Obstetrics / Gynecology department at the hospital to make them aware of the resources the library provides [25].

Based on the results, the library targeted specific zip codes that the hospital determined were areas with the greatest need based on their Community Needs Index Score. While the original plan was to send brochures to community-based organizations in these zip codes, it became clear that electronic communication was also effective [26]. This information can be shared with the public, so while the library will receive no data when these transactions occur, these interactions may result in more community awareness about the library's resources.

Librarians will continue tracking where health information requests come from by recording patron's zip codes. This project will be considered successful if there is an increase of patrons from the targeted zip codes. In addition, the library has already received a health information request from a member of one of the health organizations that was contacted. Any measurable increase in presence in the targeted zip codes will be considered a valuable outcome from the marketing done in these areas. One challenge to this evaluation is that it depends on library staff recording the zip code for every patron who requests health information. While this is protocol, staff do not always remember to ask for the zip code. The second major issue is that awareness of the health information service may not result in people actually requesting health information. There is only so much that librarians can do to encourage people to use their services [27].

Hospital libraries may benefit from partnering with their hospital to show their impact on patient care. In addition, through the collection of hospital data, libraries can find which hospital service areas may need outreach to learn more about library services. Lastly, hospital libraries can evaluate if their consumers are asking health questions related to the top reasons for hospitalizations or ED visits.

Overall, this project strengthened the relationship between the hospital and the library through their work in analyzing zip code data and topic requests together. Furthermore, it led to librarian awareness of the hospital's targeted zip codes and provided a new goal to outreach to these areas. It has already led to new relationships between the library and local health departments, resulting in the library providing health information to organizations that have direct contact with the public.

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DATA AVAILABILITY STATEMENT

Data associated with this article cannot be made publicly available because they contain personally identifiable information. Access to the data can be requested from the corresponding author and may be subject to IRB restrictions.

AUTHOR CONTRIBUTIONS

Rachel Roberts: Conceptualization, Data Curation, Formal Analysis, Methodology, Writing – Original Draft, Writing – Review & Editing. Kelsey L. Grabeel: Conceptualization, Data Curation, Formal Analysis, Methodology, Writing – Original Draft, Writing – Review & Editing

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CASE REPORT

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Breathing life into learning about air quality: developing and implementing environmental health outreach with high school students

Katie Hoskins; Nguyen Dang; Fahad Molla

See end of article for authors' affiliations.

Background: The San Joaquin Valley (SJV) is comprised of diverse populations that cumulatively are medically underserved and experience significant air pollution. The SJV regularly has poor air quality and does not meet the state and federal attainment standards for particulate matter (PM) 2.5, ozone (eight hours), and PM 10. Air pollutants contribute to a high incidence of emergency room visits and hospitalizations for conditions like asthma. Because air pollutants correlate with built environments, these outcomes are concentrated geographically, which is a major driver of social determinants of health. Librarians from an osteopathic medical school in the SJV developed an educational outreach session to inform high school students about the causes and health impacts of air pollution and how they can find resources to educate themselves and others in their communities.

Case Presentation: Two-hour interactive outreach sessions were provided at three local high schools in the SJV to students in health careers pathways. Librarians and student doctors guided high school students in health professions pathways through activities to understand the causes of poor air quality in the SJV; describe the different parts of the respiratory system and how air pollutants impact it; identify strategies for monitoring air quality and protecting their respiratory health; explore correlations between zip code and health outcomes; and access National Library of Medicine resources for reliable health information.

Conclusion: Librarians can lead effective health outreach programming. High school students who participated in the outreach sessions increased their understanding of AQI, the causes of poor air quality, and the health effects of air pollution

Keywords: Community Outreach; Instruction; High Schoolers; Environmental Health

BACKGROUND

Over the years, the National Library of Medicine (NLM) has expanded its outreach efforts in support of its goal to facilitate access to high-quality health information [1]. Some of this work is done under the aegis of the National Network of Libraries of Medicine (NNLM), which provides funding for "projects that improve access to health information, increase engagement with research and data, expand professional knowledge, and support outreach that promotes awareness and use of NLM resources in local communities" [2].

In August 2021, NNLM Region 5, which includes California, announced a call for proposals for a $5,000 Environmental Health Outreach Award. Successful projects would focus on reaching underserved populations to increase awareness of environmental impacts on health or address a specific environmental health issue within underserved communities [3]. The lead author developed an educational outreach series funded by the NNLM to teach high school students in the San Joaquin Valley about the impact of poor air quality on the respiratory system, which is further described in the case presentation.

California's San Joaquin Valley (SJV) is home to an estimated 4.3 million people as of July 2021. Of these 4.3 million residents, 56% identify as Hispanic or Latino; however, some research suggests that the area's total population may be underestimated, especially among communities of color [4]. The average median household income in the SJV is approximately $63,708 compared to the state median household income of $84,097 [4]. The SJV is also a medically underserved area, with the second lowest ratio of primary care physicians (47 per 100,000 population in California) and the lowest ratio of specialists (81 per 100,000 population in California) [5].

The SJV regularly has poor air quality and does not meet the state and federal attainment standards for particulate matter (PM) 2.5 and ozone (eight hours), nor does it meet the state attainment standards for PM 10 [6]. Air pollutants contribute to a high incidence of emergency

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room visits and hospitalizations for conditions like asthma [7, 8]. Because air pollutants correlate with built environments that themselves reflect systemic inequities like historical redlining practices, these negative health outcomes are concentrated geographically, which is a major driver of social determinants of health [9, 10].

CASE PRESENTATION

Goals and Learning Activities

The project leaders decided to provide in-person sessions for high schools from rural and underserved areas in the Fresno and Madera regions. The goals were for high school students in health professions pathways to: understand the causes of poor air quality in the SJV; describe the different parts of the respiratory system and how air pollutants impact it; identify steps they can take to monitor the air quality and adjust their activities to protect their health; and access NLM resources for health information. Based on these goals and the class duration of two hours, activities were organized into five stations, which students rotated through approximately every 20 minutes.

Station 1: Respiratory System. Medical students used an anatomical model to demonstrate the air pathways as well as the functions of other parts of the respiratory system like alveoli, before offering one or more of the following interactive activities. High school students were asked to take a deep breath and hold it, counting how long they were able to hold their breath. Then they were asked to hyperventilate (breathe very quickly) for 5 seconds and hold their breath, counting how long they were able to hold it. This demonstrated that the amount of time they could hold their breath increased after hyperventilation due to how the respiratory system works. Another activity had students do jumping jacks while breathing through a straw to simulate breathing with asthma.

Station 2: Air Pollution and the Respiratory System. Medical students played clips from three videos and discussed the concepts with high school students. The first video was "The Air We Breathe-Inside Your Lungs," which discussed the type of air pollutants (PM 2.5 and PM 10) and how they affect the lungs. The California Health Sciences University Simulation Center produced a second video, which showed a patient in respiratory distress. The medical student periodically paused the video to ask students questions and provide background information. A 1.5-minute clip of a third video, "What is Asthma? - Pathophysiology of Asthma," explained how short and long-term inhalers relieve asthma symptoms.

Station 3: Types of Pollutants, AQI, and Outdoor Activities. Faculty librarians took high school students on a walk outside the building to measure Air Quality Index (AQI) using AirBeams and mobile phones that were distributed to small groups of students [11]. After making an initial measurement, the librarians explained the definition of AQI and different particle sizes (PM 2.5 and PM 10). Students were asked questions like "What do you think gives off the most pollution around or inside the school?" “Around or inside your home?," and “Why is it important to identify these causes?" The students were then instructed to measure AQI at different heights and distances apart to compare the differences in values. After the walk, the librarians compiled a graph of measured values and discussed with the students the change in values throughout the walk. In the end, students were shown a video on how AQI value changes when devices are close to car exhaust.

Station 4: National Library of Medicine (NLM) and Community Resources. A faculty librarian demonstrated how to find reliable health information on the websites for MedlinePlus and TeensHealth through a combination of print handouts and online quiz questions [12, 13]. The librarian also shared local online resources to help high school students discover the current AQI and implications for outdoor physical activity, which included Healthy Air Living Schools Program, Real-Time Air Advisory Network (RAAN), San Joaquin Valley Air District, and AirNow [14-17].

Station 5: Causes of Air Pollution and Health Impact Disparities. A faculty librarian provided an overview of the causes of poor air quality in the SJV, the various bodily systems impacted by poor air quality, and why zip code is a fairly accurate predictor of health. Students were asked what they thought were the three most common causes of poor air quality before being given the opportunity to compare their responses with the known causes. Another activity involved the use of the California Office of Environmental Health Hazard Assessment (OEHHA)'s CalEnviroScreen 4.0, which can be used to help identify California communities that disproportionately experience pollution [9]. Students were able to see that the SJV has a higher pollution burden and population sensitivities than other regions in California [9], as well as variations within the SJV itself. The last activity involved the students entering their zip codes onto the Healthy Fresno County Community Dashboard to see the rates of health conditions like asthma for that zip code and how it compared to county and state levels [18]

RESULTS

Pre- and post-surveys were implemented to assess student learning. There were a total of 93 responses for the pre-survey. Of the 57 students who completed the post-survey, the last four digits of their phone numbers were matched to the pre-survey, leaving a total of 50 post-survey responses to compare with the pre-survey.

In the pre-survey, high school students were asked 11 questions about AQI and its health impacts (see supplement/appendix). In Question 4 (Q4), students were asked to describe their understanding of AQI and how to modify their daily activities accordingly. A rubric was used to evaluate responses. Students got 2 points for knowing the full definition of AQI and then 2 points for mentioning changes to outdoor activity, with partial points given. Table 1 summarizes the results, which showed that after the educational outreach activities, the students had a statistically significant increase in understanding of AQI definition and overall understanding of AQI. There was no statistically significant difference regarding modification of daily activities.

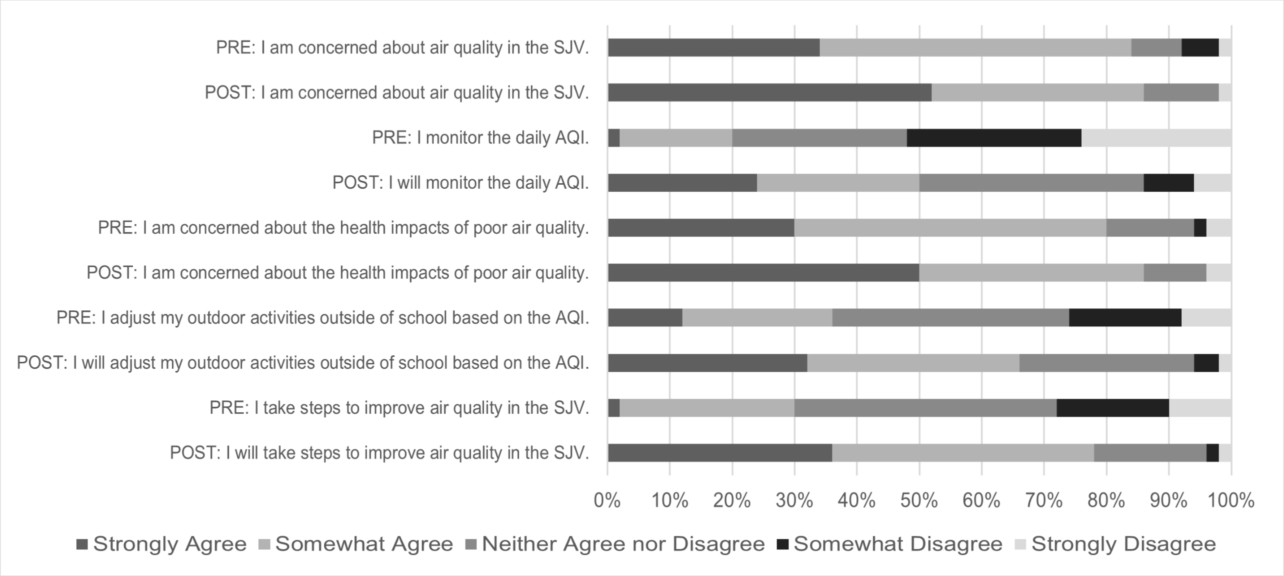
Question 6 asked students to identify which body systems were impacted by air pollutants: respiratory system only; respiratory and circulatory systems; respiratory, circulatory, and neurological systems; or respiratory, circulatory, and neurological systems and premature death. In pre-survey Q6, most students thought that the air quality only impacted the respiratory system (38%) or both the respiratory and circulatory systems (30%), which is incorrect. Only 20% of students correctly identified that air quality impacts the respiratory, circulatory, and neurological systems as well as premature death. Post-survey, 76% of students selected the correct answer, which is a statistically significant increase, $t(49) = -9.92$, $p < 0.001$

Question 7 consisted of a five-point Likert scale assessing students' concern about air quality in the SJV, their concern about the health impacts of air pollution, whether they did/will monitor the daily AQI, whether they did/will adjust their outdoor activities based on AQI, and whether they did/will take steps to improve air quality. Student responses to this question are visualized in Figure 1.

Table 1 AQI Knowledge as measured by Q4, in which students were asked the definition of AQI and what daily activities should be changed to accommodate for poor air quality.

		AQI Definition	**Daily Activities**
Mean (Pre)		0.48	0.52
Mean (Post)		0.98	0.66
Mean Difference		-0.50	-0.14
Standard Deviation		1.02	0.89
Standard Error of Mean		0.14	0.13
95% CI	**Lower**	-0.78	-0.39
	Upper	-0.22	0.11
t-value (paired t-test)		-3.49	-1.10
Degree of Freedom		49	49
p-value		0.00064	0.14

Figure 1 Comparison of Pre and Post Survey Responses for Q7



DISCUSSION

From the responses collected, the high school students who participated in the outreach sessions increased their understanding of AQI, the causes of poor air quality, and the health effects of air pollution. Prior to the intervention, students' knowledge of AQI (Q4) was poor overall with an average pre-survey score of 0.48 out of 2.0. Students also did not understand how the AQI value impacts recommendations for engaging in daily activities outdoors (Q4) as seen with the pre-survey score of 0.52 out of 2.0. Following the intervention, students' performance on the post-test demonstrated statistically significant improvement in their understanding of AQI. On the other hand, the data do not show a significant difference in students' understanding of the impacts of AQI on daily activities after the intervention. It is unclear whether these differences in the impact of the intervention on student learning reflect the content covered (e.g., perhaps there was insufficient discussion of how to modify outdoors activities based on AQI), or if this reflects that it is harder to change people's behaviors than to increase their knowledge.

In pre-survey Q6, most students thought that the air quality only impacted the respiratory system (38%) or both the respiratory and circulatory systems (30%), which is incorrect. Only 20% of students correctly identified that air quality impacts the respiratory, circulatory, and neurological systems as well as premature death. Post-survey, 76% of students selected the correct answer. This suggests that the health outreach session accomplished its goal of improving students' understanding of the wide-ranging health impacts of poor air quality.

One interesting tension in our findings is that while most students (84%) in the pre-survey indicated their concern about air quality in the SJV and understood some of the health impacts of poor air quality (Q7), their prior knowledge of AQI was limited (Q4) and that few students reported adjusting their outdoor activities to reflect air quality (Q7). This may indicate a disconnect between students' perception of the air quality of their communities and their understanding of how air quality is empirically measured. Reviewing the pre and post survey responses for Q7 about monitoring the daily AQI, the biggest difference occurred in those who disagreed about monitoring AQI, declining from 52% to 14%. It appears that the activity in which students took a walk and measured the AQI using AirBeams may have influenced their understanding of the value of monitoring AQI. This finding aligns with prior work in the area, which has found that hands-on health outreach programming can lead to meaningful community-based learning opportunities [19-22].

Limitations of these outreach sessions include that there was only a single two-hour session and no long-term follow-up. Similar future outreach efforts could consider multiple sessions, which would enable additional interactive activities and more in-depth discussion. Following up with students several months after the learning activities could examine long-term learning retention, as well as if students were still making changes to reduce air pollution and/or mitigate the health impacts of poor air quality. Such a follow-up would have been a valuable comparison with the results of Dorevitch et al.'s study, which had participants complete a follow-up questionnaire a year after the instructional intervention and found that many participants demonstrated limited recall of the knowledge gained twelve months prior [20].

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DATA AVAILABILITY STATEMENT

Data associated with this article are available in the Open Science Framework at https://osf.io/btwqa/.

AUTHOR CONTRIBUTIONS

Katie Hoskins: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, visualization, writing – original draft, writing – review & editing. Ngyuen Dang: data curation, formal analysis, investigation, visualization, writing – original draft, writing – review & editing. Fahad Molla: data curation, formal analysis, investigation, visualization, writing – original draft, writing – review & editing.

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CASE REPORT

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Stepping up to the moment: collaborating on a data management and sharing workshop series

Sara M. Samuel; Yulia V. Sevryugina; Mark MacEachern; Kate Saylor; Rachel Woodbrook

See end of article for authors' affiliations.

Background: Many researchers benefit from training and assistance with their data management practices. The release of the Office of Science and Technology Policy's Nelson Memo and the National Institutes of Health's new Data Management and Sharing Policy created opportunities for librarians to engage with researchers regarding their data workflows. Within this environment, we—an interdisciplinary team of librarians and informationists at the University of Michigan (U-M)—recognized an opportunity to develop a series of data workshops that we then taught during the summer of 2023.

Case Presentation: The series was primarily aimed at graduate students and early career researchers, with a focus on the disciplines served by the authors in the Health Sciences - Science, Technology, Engineering, and Mathematics (HS-STEM) unit of the U-M Library. We identified three topics to focus on: data management plans, organizing and managing data, and sharing data. Workshops on these topics were offered in June, July, and August 2023.

Conclusion: The number of registrants and attendees exceeded our expectations with 497 registrations across the three workshops (174/169/154, respectively), and 178 attendees (79/49/50, respectively). Registrants included faculty, staff, students, and more, and were primarily from the health sciences clinical and academic units. We received a total of 45 evaluations from the three workshops which were very positive. The slides and evaluation forms from each workshop are available through U-M's institutional repository. We developed these workshops at an opportune time on campus and successfully reached many researchers.

Keywords: Data education; Data Management; Data management and sharing plans; data sharing; data services; library workshops; Workshops

See end of article for supplemental content.

BACKGROUND

Scientific and biomedical researchers need opportunities to improve their understanding of and skills in data management and sharing. In a recent survey of scientists, Tenopir et al. found a "need for organizations to offer more formal training and assistance in data management to scientists, or to better publicize the support they do offer" [1]. In another survey of biomedical researchers, it was found that most had no formal training on the topic of writing data management plans [2]. Moreover, interviews with National Institutes of Health (NIH) intramural researchers conducted by Syn and Kim found that "it is clear that institutions will benefit from increased awareness and training, ensuring researchers know their options for managing their data with an eye towards long term data preservation" [3].

Librarians and information professionals have provided and assessed instruction on research data management and sharing topics at many institutions. Xu et al. found 124 articles published between 2011 and 2021 that discuss research data management instruction in academic libraries [4]. In a case report detailing how they conducted a long-term evaluation of workshops, LaPolla, Contaxis, and Serkis reported offering workshops on data topics including data management at their institution [5]. In another case study, Read provides an overview of developing research data management education for those working in a clinical setting [6]. Rod, Hervieux, and Lee investigated an active learning intervention within the setting of introductory research data management workshops at their institution [7]. Our case study builds on this literature by illustrating how it can be important to harness current events (both on campus and in the broader research landscape) when conducting outreach or developing new educational offerings.

The University of Michigan (U-M) is one of the largest research institutions in the United States, with total research expenditures of $1.86 billion USD in fiscal year

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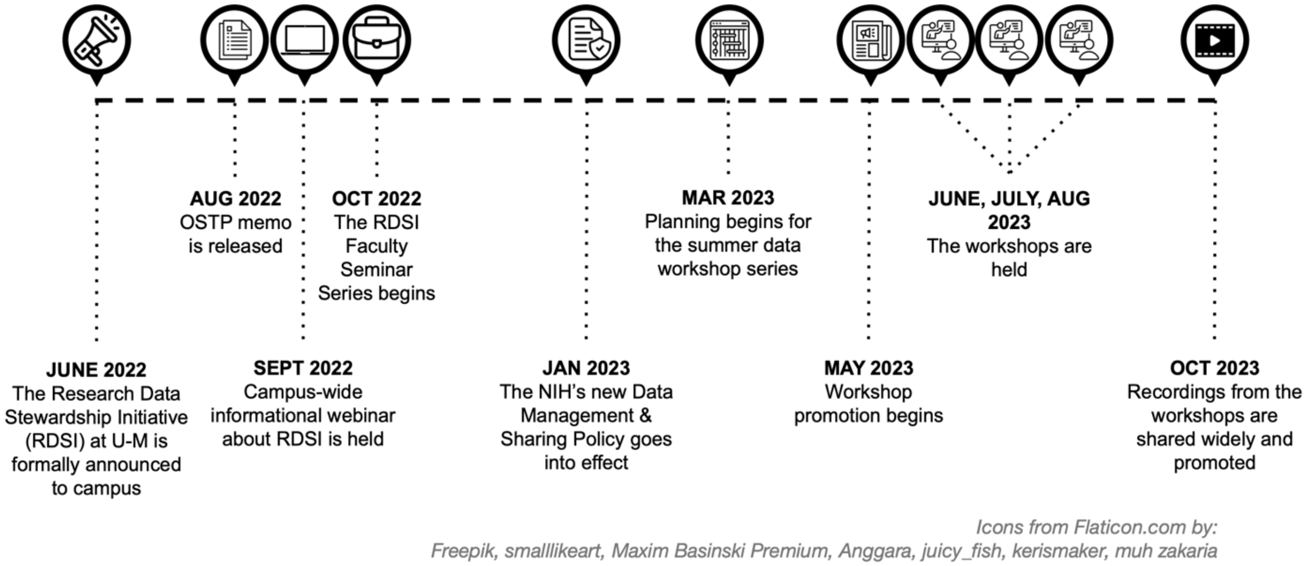
2023, with more than $1 billion USD (56%) of this from federal funders [8]. Correspondingly, U-M has an extensive population of researchers who create, manage, and share data as a necessary part of their work. Research data services have been available at the U-M Library in some form for over a decade, including workshops to help researchers better plan for, access, manage, and share data. However, the summer of 2023 was a uniquely advantageous time at U-M for librarians and informationists to do outreach on campus about data management and data sharing as it was preceded by the introduction of the new Research Data Stewardship Initiative (RDSI) on campus, the release of a data-related memo from the Office of Science and Technology Policy (OSTP), and the new NIH Data Management and Sharing Policy going into effect.

RDSI is a campus-wide initiative focused on research data management and sharing. The initiative's goal is "[t]o ensure researchers across the University of Michigan are better positioned to equitably and securely maximize the impact of their research data" [9]. The initiative is led by the Office of the Vice President for Research and consists of a working group that includes representatives from various campus units that are involved in data management or sharing in some way, including information technology, the sponsored projects office, the research integrity office, the U-M Medical School's data office, the U-M Medical School's regulatory affairs office, and the library. RDSI was formally announced to the campus via email and newsletter in June 2022 [10], and an informational webinar was held in September 2022. RDSI then engaged the campus with a series of online seminars in which faculty from different departments presented about their involvement with—or research on—good data management and sharing practices. In June 2023, concurrently with our workshop series, RDSI announced a new institutional Research Data Stewardship Policy, which includes guidance for sharing and long-term preservation of research data [11].

Likewise, initiatives from federal scientific agencies further highlighted the importance of research data management. The Nelson Memo from OSTP, released in August 2022, sought to "make publications and their supporting data resulting from federally funded research publicly accessible," accomplished by directing federal agencies to update their policies of how they will achieve this and resulting in researchers needing to plan for and share more of their data [12]. Both RDSI and the library harnessed the release of the Nelson Memo to increase campus awareness about growing data sharing requirements from the federal government. Moreover, the NIH's new Data Management and Sharing Policy went into effect in January 2023 [13]. In preparation, there were efforts on campus during the fall of 2022 to communicate the new requirements including information sessions, faculty meeting presentations, and the creation of online resources and videos [14]. RDSI and the library led much of this outreach.

Given the increasing campus discussions about data management and sharing resulting from RDSI, the Nelson Memo, and the new NIH policy, there was a heightened level of interest in data management and sharing topics from researchers across campus. Within this environment, we—an interdisciplinary team of librarians and informationists—recognized an opportunity to merge our expertise and develop a series of data workshops which we taught during the summer of 2023 to a receptive audience.

Figure 1 Timeline of context and key points in our work to develop and teach a summer data workshop series.



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CASE PRESENTATION

Our team consisted of a chemistry librarian, three health sciences informationists, and a data curation specialist from the institutional repositories and research data services unit in the library. The team formed in March 2023 to begin planning for the workshop series. See Figure 1 for a timeline of the context and key points in our work.

The series was primarily aimed at graduate students and early career researchers, with a focus on the disciplines served by the authors in the Health Sciences - Science, Technology, Engineering, and Mathematics (HS-STEM) unit of the U-M Library. We identified three topics to focus on: writing a data management plan, organizing and managing data, and sharing data. Workshops on these topics were scheduled in June, July, and August 2023. Each team member volunteered to plan and co-teach at least one workshop that aligned with their interests and expertise, with two instructors leading each workshop.

We began promoting the workshop series in May, sharing widely across campus in a variety of formats and utilizing existing department- and school-level communication channels. Liaison librarian colleagues were informed about the series so they could share it with their departments. We proactively reached out to relevant communities through email lists and created a graphic for digital displays in the library and other university spaces. We submitted write-ups about the series to various channels including the Medical School's newsletter submission form, which reaches thousands of researchers through different departmental newsletters. A few colleagues shared about the workshop on social media channels. See Appendix A for the graphic created to help advertise the workshops. We also referenced the entire series in each individual workshop description, as well as at the beginning and end of each workshop. We wanted it to be clear that the workshops were connected to one another and encourage attendees to register for future sessions in the series, when applicable.

The order of the workshops was a deliberate choice, since we hypothesized that many researchers would be most attracted to the workshop about writing a data management plan if they had a new need to write one due to a funder requirement or had been hearing about the new NIH policy. Then, during the first workshop we could spark their interest in the additional workshop topics and encourage them to register for those. We also developed witty yet descriptive workshop names to both grab attention and convey exactly what the workshop was about.

The workshops were taught live online via Zoom and recorded. The sessions were primarily lecture-based, but participants were engaged throughout each workshop using polls, prompts to share comments in the chat, and time for questions at the end. Clear learning objectives were identified for each workshop, and we aimed to share practical steps so that attendees could immediately begin using what they learned. An evaluation survey based on the learning objectives was shared at the end of each workshop. Table 1 provides the workshop titles and learning outcomes, with more robust descriptions of each workshop available in Appendix B.

Table 1 List of workshop titles, dates offered, and learning outcomes.

Workshop (Date)	**Learning Outcomes**
Be prepared! Writing a data management or data sharing plan *(June 14, 2023)*	Understand the purpose and importance of a data management plan (DMP) for research projects. Learn to create a comprehensive DMP by incorporating its typical elements effectively. Know the data management and sharing policies and requirements set by the National Science Foundation (NSF) and the NIH. Apply best practices and utilize available resources to effectively draft a DMP.
Data, data everywhere! Managing & organizing data *(July 13, 2023)*	Recognize the importance of data organization in facilitating high-quality research. Learn recommended practices to ensure data remains well-organized and easily retrievable throughout the research process. Understand how to effectively describe data for clarity and usability. Implement practical strategies to start organizing data more effectively.
Help! I have to share my data: Preparation for sharing and choosing a repository for long-term data storage *(August 10, 2023)*	Understand requirements and reasons for sharing your data. Recognize what is needed for successful data sharing. Understand how to evaluate and choose a data repository. Know when to consider using U-M's repositories, and where to get local help.

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DISCUSSION

Previous data-related workshops offered by the library (since 2013) had an average of 24 attendees and a median of 18 attendees; these numbers were fairly steady even when looking at only online sessions, only sessions from the previous two years, or only DMP-specific workshops. In contrast, our 2023 workshops series average was more than double that of previous data sessions, at 59 attendees per session (79/49/50, respectively), meaning up to 178 individuals may have attended one of our workshops if there were no repeat attendees. Registration numbers provide another data point, as registrants either intended to attend or were interested in the session content; these numbers were even higher, at 174/169/154, respectively, for a total of 497 registrations, and an average of 166 registrations per workshop. Although we do not have comparable numbers of registrations from previous data-related workshops, this was higher than what we are accustomed to seeing. We believe this increase was due to the catalysts noted above, an increased number of researchers recognizing a need for support in data management and sharing, as well as our strategic utilization of existing communication channels. Attendance for the first workshop, which focused on crafting DMPs specifically, was highest, which was likely due to more people now having to write a data management and sharing plan for their NIH grant applications.

The registration system we used for our workshops captures some basic information about registrants, although it is self-reported and may be outdated if a person shifted status or positions at the university. Interest in research data management and sharing cuts across all statuses at the university since we had registrants who were students, staff, faculty, and more. A good portion of registrants for each workshop are staff, which could be due to so many staff members supporting researchers and faculty in their data activities. Also, the workshop about DMPs drew the most faculty attention, while the data management workshop was most appealing for students. See Appendix C to see the breakdown of the university status of registrants for each workshop.

In addition to university status, the registration system also includes self-reported unit affiliations. Registrants were from across the university, although primarily from the health sciences and medical units, as expected due to the new NIH requirement, and the College of Literature, Science & Arts, where most of the science units live on campus. Appendix D shows the breakdown of unit affiliations of the workshop registrants.

An evaluation survey was shared at the end of each session and via the follow-up email with the workshop slides and recording. For each workshop, the learning objectives were the main components of the evaluation, and respondents indicated their increase in understanding: no increase, minimal, moderate, or major. The U-M Institutional Review Board reviewed the evaluation survey and determined that it is not regulated (HUM00260990).

We received a total of 45 evaluations, with 23 responses for Workshop 1, five responses for Workshop 2, and 14 responses for Workshop 3, which were very positive. Overall, 46% of the responses indicated a major increase in understanding of the learning objectives, and 87% indicated at least a moderate increase. Table 2 shows the breakdown of the learning objectives and increase in understanding for each objective, and Appendix E shows a visual display of the mean increase in understanding for each.

Table 2 Increase in understanding for each workshop, using evaluation questions based on the learning objectives, % responses (N responses). Total responses is 45, with 23 responses for Workshop 1, five responses for Workshop 2, and 14 responses for Workshop 3.

Workshop	How much has your understanding changed as a result of this workshop?	1 - No Increase	2 - Minimal Increase	3 - Moderate Increase	4 - Major Increase	Mean level of increase (1-4) (SD)
1	What a data management plan (DMP) is and why researchers write one	0	9% (2)	44% (10)	48% (11)	3.4 (0.7)
1	Typical elements of a DMP	0	4% (1)	35% (8)	61% (14)	3.6 (0.6)
1	DMP policies from NSF and NIH	0	13% (3)	44% (10)	44% (10)	3.3 (0.7)
1	Best practices & resources for writing a DMP	0	4% (1)	35% (8)	61% (14)	3.6 (0.6)
2	Why organizing your data is important for enabling high quality research	0	60% (3)	20% (1)	20% (1)	2.6 (0.9)
2	Recommended practices for keeping your data organized	0	0	60% (3)	40% (2)	3.4 (0.5)

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2	Ways to describe your data	0	0	60% (3)	40% (2)	3.4 (0.5)
2	Practical strategies to start organizing your data	0	20% (1)	40% (2)	40% (2)	3.2 (0.8)
3	Why share your data	7% (1)	21% (3)	43% (6)	29% (4)	2.9 (0.9)
3	What is involved in successful data sharing	7% (1)	7% (1)	29% (4)	57% (8)	3.4 (0.9)
3	Where to deposit your data	0	21% (3)	50% (7)	29% (4)	3.1 (0.7)
3	Availability of a local data repository	7% (1)	7% (1)	43% (6)	43% (6)	3.2 (0.9)

The response number was small for the second workshop, which had about a 10% response rate compared to response rates of roughly 30% for the first and third workshops. We believe this is due to the second workshop running the full hour, resulting in more people leaving the Zoom call before we shared the evaluation link.

In addition to rating their increase in understanding for the learning objectives, the evaluation survey also provided space for attendees to share comments. A few comments indicated that the workshop was a success:

> "I was brand new to data management plans, and I felt like it was a very clear, well-paced overview for someone without any experience." - Attendee 1 (Workshop 1)

> "This was really great! Thank you for putting this workshop series together. It makes the idea of writing a DMP much less daunting." - Attendee 2 (Workshop 1)

> "This was great; thank you." - Attendee 3 (Workshop 3)

We also produced a video recording of each workshop. In addition to sharing the recording and slides with the registrants via email after each workshop, we posted them on a dedicated online guide page [15] and broadly advertised their availability during the following fall semester. As of January 29, 2025, the three workshop recordings have a combined total of 128 views (66/39/23, respectively). Appendix F provides an overview of numerical outcomes for each workshop.

To make the workshop materials available in a way that was adaptable and reusable for other contexts and institutions, we deposited the unbranded workshop slides and evaluation forms into U-M's institutional repository, Deep Blue Documents. The files are licensed for reuse and available to librarians and researchers at our own and other institutions [17–19]. We publicized the reusable materials via a presentation at the Midwest Chapter of the Medical Library Association's conference [20] and at the American Chemical Society's conference [21]. As of January 2025, the materials have been downloaded 485 times in total.

Lessons Learned

The timing of our workshops was one key to our success in reaching more researchers, so we will be continuing to monitor relevant updates to funder policies in order to provide useful and timely instruction and outreach. We will continue to share our workshops broadly with the various channels that we have access to. We now know that it's best to share an evaluation form with dedicated time in the workshop for attendees to fill it out before they leave. Additionally, in reflecting on our experience, our interdisciplinary team allowed for broader outreach about the workshops and provided us with more expertise to draw from for the development of the workshops.

Limitations

As this is a case study, we are sharing our experience with one set of workshops at our specific institution, and there are limitations. Our experience may not be replicable at a smaller institution or one that is less affected by funding requirements from federal agencies, and also because this opportunity was time-bound and would depend on a similar new large-scale data sharing requirement or initiative in the future. As noted above, the registrant status and affiliation data from the workshop registration system may not be completely accurate. We also recognize the low response rate to the second workshop's evaluation survey.

Future Directions

We have used the workshops' slides and recordings to start conversations with researchers about how to best write their data management plans and prepare their data for sharing, and the recordings continue to receive views. Having these materials publicly available also allows us to scale up our support of the increasing number of researchers now subject to data management planning and sharing requirements, without additional time and effort from the authors or our colleagues. We have also refined and taught versions of the workshops to additional groups on campus. Building on our success, we are now planning another collaborative workshop series to share about specific data repositories that U-M researchers can use to share and preserve their data.

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We took the initiative to develop these workshops at an opportune time on campus and were successful in reaching many researchers. These workshops gave us an opportunity to demonstrate the library's expertise in data management and sharing by harnessing current events and offering timely educational opportunities, as evidenced by the increased attendance and positive feedback for these sessions. We hope our experience is useful for other librarians who wish to provide effective outreach and instruction at their institutions.

DATA AVAILABILITY STATEMENT

The workshop materials discussed in this paper, including the evaluation surveys, are available from Deep Blue Documents:

- Samuel S, Sevryugina YV. Be prepared! Writing a data management or data sharing plan [Internet]. 2023. Available from: https://dx.doi.org/10.7302/8680.
- Samuel S, Saylor K. Data, data everywhere! Managing & organizing data [Internet]. 2023. Available from: https://dx.doi.org/10.7302/8684.
- Woodbrook R, MacEachern M. Help! I Have To Share My Data: Preparation For Sharing and Choosing a Repository For Long-Term Data Storage [Internet]. 2023. Available from: https://dx.doi.org/10.7302/8685.

AUTHOR CONTRIBUTIONS

Mark MacEachern, Kate Saylor, & Rachel Woodbrook: Conceptualization, Project administration, Resources, Writing - original draft, Writing - review & editing. Sara Samuel & Yulia Sevryugina: Conceptualization, Formal analysis, Project administration, Resources, Visualization, Writing - original draft, Writing - review & editing.

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SUPPLEMENTAL FILES

- **Appendix A**
- **Appendix B**
- **Appendix C**
- **Appendix D**
- **Appendix E**
- **Appendix F**

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CASE REPORT

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Librarians collaborating with instructors for course integration of virtual reality

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See end of article for authors' affiliations.

Background: Health science libraries have invested in virtual reality technology and spaces to support use of this technology for teaching, learning, and research. Virtual reality has many uses within health sciences education such as simulation, exploration and learning, and soft skills development. It can also be used to build empathy in health sciences students through applications that provide an immersive, first-person perspective.

Case Presentation: This case describes how a health sciences library and liaison librarians partnered with a course instructor to support a class utilizing the library's virtual reality resources. Librarians were collaborators in the development of the class and facilitated class sessions in the Virtual Reality Studio. Class sessions utilized the Beatriz Lab by Embodied Labs to increase empathy in medical students who were interested in working with geriatric or Alzheimer's patients.

Conclusion: Liaison librarians support teaching and learning through a variety of tools and resources, including virtual reality. By partnering with instructors, librarians can use their instruction and collection knowledge to design and facilitate classes that are meaningful and interactive. Virtual reality applications provide another resource that librarians can incorporate into their course-integrated instruction sessions.

Keywords: Libraries; Medical Education; Virtual Reality; Instruction; Librarians

BACKGROUND

Virtual reality (VR) is an immersive technology that provides unique opportunities for learning through the simulation of being physically present in computer-generated environments with realistic sensory experiences. The 2016 Horizon Report identified virtual reality as an emerging trend revolutionizing medical education, allowing students to visualize and interact with complex real-world data, train in adaptive immersive scenarios, and receive real-time feedback [1]. Today, VR is utilized in a variety of ways in medical education, such as augmenting anatomy instruction [2], teaching surgical training techniques [3], and enhancing empathy [4].

Virtual reality has potentially promising means for facilitating experiential learning, an area of emphasis for many academic libraries and in the health sciences [5]. Over the last two decades, libraries have increasingly transformed their role from repositories of information into centers for the creation of new knowledge [6]. As a result, many academic libraries made investments in VR over the last decade, continuing their role of providing access to new technology [7]. VR's educational potential has been particularly prominent in the health sciences, prompting libraries to acquire VR applications for health sciences education [8,9]. Immersion in virtually simulated scenarios allows students to experience the mindset and perceptions of patients by engaging users in sensory experiences that simulate the lived realities of medical conditions. For example, virtual reality's use as a perspective-taking educational tool has shown a demonstrated impact on empathy for people living with dementia [10].

VR simulations of patient experiences create unique opportunities for medical students to practice competencies and build empathy unavailable in other forms of training. For example, many medical school simulation programs include standardized patients, or actors, to play the part of a patient in medical scenarios while the students play the role of the health care provider. While this is important training, it does not put medical students in the shoes of the patient to help them understand the patient's lived experiences. The first-person perspective of wearing a VR headset can strongly influence students' affective response to patients with dementia through simulating disease symptoms, sensory distortions, internal narratives, and social frustration. This helps students be more conscious of how they interact with patients and their caregivers due to a firsthand understanding of how they might be feeling. As a result, students may emerge from a VR learning experience more confident in making informed person-centered clinical decisions [10].

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This case report contributes to the ongoing discussion of VR as an educational resource and instructional tool within medical librarianship, describing how librarians at the University of Minnesota Health Sciences Library partnered with a geriatrics instructor on course-integrated virtual reality instruction sessions.

CASE PRESENTATION

In Fall of 2023, the University of Minnesota Medical School launched a new curriculum for medical students. Becoming a Doctor (BaDr) is a new series of classes woven throughout the undergraduate medical curriculum that empowers students as they transition into practicing medicine. BaDr has four learning objectives: professional identity formation, reflective practice, clinical skill advancement, and community building. One week per semester is dedicated exclusively to BaDr classes, with a mix of required and elective class sessions that address one or more of the learning objectives. Methods of instruction include lectures, discussions, case-based learning, and simulations. Sessions are standalone classes that require all student work to be completed within the session's allotted time. Instructors cannot include pre-work or homework, and assessments or evaluations must also occur during class time.

Instructors interested in creating and leading a BaDr class submit proposals describing the audience, facilitators, content, and class learning activities. BaDr course directors review and accept proposals and assist in the administration of approved class sessions. Librarians have partnered with faculty and co-developed several BaDr classes. Examples of previous partnerships include a class on evidence-based clinical information and a class on integrating traditional health knowledge in oral histories into clinical practice. Once approved, course instructors fully develop their proposals, including finalizing titles, descriptions, and learning objectives; designing instructional content and active learning activities; and recruiting additional facilitators.

The Health Sciences Library (HSL) at the University of Minnesota moved to a new building in 2021. The newly relocated library supports multiple spaces for emerging technology, including a Virtual Reality Studio (VR Studio) (Figure 1). One role of the VR Studio is to support teaching, learning, and education around immersive technology in the health sciences. In addition to the VR Studio space, HSL also received an allocation to acquire and license virtual reality applications. As a result, HSL licensed Embodied Labs [11], a VR application which provides first-person perspective simulations. One of the labs included in HSL's subscription is the Beatriz Lab, which allows users to embody the perspective of Beatriz, a middle-aged Latina woman diagnosed with Alzheimer's disease. The lab progresses through three modules that reflect the stages of Beatriz’s Alzheimer’s: early-stage, mid-stage, and late-stage (Table 1). Learners gain insights into her daily struggles, internal thoughts, interpersonal relationships, and sensory experiences — including alterations in visual and auditory processing. Through witnessing Beatriz’s sensory and cognitive changes, along with her struggles to communicate her confusion to her family, the VR simulation highlights what individuals with dementia may experience. In summer 2023, an instructor specializing in geriatric education contacted HSL about using the Beatriz Lab for a BaDr class session proposal. The instructor was interested in VR as a tool for first-person simulation and enhancing student learning about dementia.

Figure 1 Class in VR Studio

Table 1 Embodied Labs Beatriz Lab Content

Module Title and Runtime	Experiential and Interactive Components
Module 1: Early-Stage Alzheimer’s (8:00 minutes)	Experiential components: Confusion, memory issues, and loss of cognitive function at work. Difficulty recognizing and engaging in interpersonal communication with family members, such as children and grandchildren. Disorientation and loss of independence while grocery shopping. Inability to carry out familiar, multi-step tasks such as cooking and planning for family celebrations. Changes to sensory and emotional processing, such as distortion of voices and inner monologue demonstrating increased worry and frustration. Interactive components for users: Prompted to respond as Beatriz in conversations. Interact with objects while grocery shopping or preparing dinner.

Module 2: Mid-Stage Alzheimer's (11:00 minutes)	Experiential components: Appearance of sundowning symptoms, including distortion of audiovisual processing and significantly increased fear. Beatriz perceives a visiting family member as a home intruder. Beatriz loses independence and now lives with her daughter and grandson. Beatriz becomes disoriented and falls while showering, demonstrating functional loss surrounding self-care tasks. Beatriz participates in a family care plan meeting, but feels isolated and confused when she is unable to understand the discussion due to mishearing words and not understanding why home health care professionals are present. Beatriz's inner thoughts become more emotionally intense and disoriented. Interactive components for users: Engage in a coloring activity during the family meeting.
Module 3: Late-Stage Alzheimer's (4:15 minutes)	Experiential components: Beatriz receives care from a certified nurse assistant. Beatriz experiences significant audiovisual disturbances during a family Christmas celebration. Beatriz experiences some reduction in symptom severity while familiar music plays. Interactive components for users: None

This BaDr proposal was accepted in November 2023 and the class sessions were offered in early January 2024. The overall objective of the class was for students to engage in a meaningful immersive experience and reflect on their clinical approach to individuals with dementia. Two identical sessions were offered at separate times on the same day to third- and fourth-year medical students with an enrollment cap of twenty students per session. Enrollment was limited to ensure all students had sufficient time to engage with the Beatriz Lab in the VR Studio.

The students began the ninety-minute class as a large group, and after an introduction from the instructor, they completed the Dementia Attitudes Scale as a pre-assessment [12]. Next students were divided into two groups of ten students, with one group remaining in the classroom for a small group exercise led by the instructor, while the other group completed the Beatriz Lab facilitated by librarians in the VR Studio. Each group switched locations halfway through the class to give students an equal amount of time in the VR Studio and the classroom.

The Beatriz Lab was divided into segments of equal duration, so that each individual student could experience immersion in the VR headset for one to two scenes within each module of the Beatriz Lab. These scenes showed the progression of her Alzheimer's Disease. Two synchronized groups of students engaged with the VR content simultaneously in the VR Studio so that students who were not wearing the VR headset could watch their classmates' experiences in the Beatriz Lab projected on a large screen in the VR Studio.

Two clinical geriatricians facilitated small group discussions in the VR Studio, prompting students to think about how they would interact with a patient like Beatriz and making connections between the content shown in the Beatriz Lab and their clinical experiences. One facilitator, reflecting on the content of Module 3, commented on how music had a profound effect on Beatriz and triggered memories, even though she was in the late stage of Alzheimer's. Students actively engaged in these brief facilitated discussions with the geriatricians and learned from the geriatricians' clinical experiences. Formative assessment of student learning took place during these conversations, in which instructors were able to gauge student understanding of patient experiences of Alzheimer's and students had the opportunity to ask clarifying questions as needed.

Students adapted quickly to the use of virtual reality for the Beatriz Lab, especially as they watched their classmates through a screencast of the Lab as it progressed. While most students immersed in virtual reality spent time looking around and experiencing the perspective of Beatriz, some needed reminders that they could use hand tracking controls to interact with some of the features. Because Embodied Labs utilizes Leap Motion Controllers (Figure 2) mounted to the front of the headsets, students did not have to hold handheld controllers. This increases realistic immersion but is not as intuitive unless students lift their hands high enough to see the virtual representation of their hands in the VR application. Students also needed prompting to understand voice recognition cues within the Lab. Despite this, students remained focused and immersed in the Lab content whether or not they were actively wearing the headset.

The virtual reality experience was accompanied by a classroom activity led by an instructor who asked students to cut paper into twenty-five pieces [13]. On these pieces of paper, they were asked to write five things they love, five of the most important people in their life, five activities they enjoy, five tasks of daily living, and five places that are important to them. Students were then asked to organize their pieces of paper and lay them out in front of them. The instructor led the class through a scenario where they needed to give up the pieces of paper in response to various prompts guiding students through a process of forgetting and loss. The purpose of this exercise was to build empathy through a self-reflective process. Throughout the session students were quiet and as the activity progressed many of them had downcast expressions or put their hands on their faces. At the end of the exercise many students expressed emotions of sadness and frustration, with some hoping that they would not have to give everything up.

Figure 2 Valve Index Headset with Leap Motion Controller

At the end of the class, students reconvened as a larger group to debrief with the geriatrician facilitators and instructor about their experience with the Beatriz Lab and the classroom activity. Students shared that they experienced frustration, lack of authority in decision making, loss, and sadness in both activities. Facilitators shared approaches from their own clinical experiences such as the importance of slowing down so patients can take in information, the frustration that caregivers and patients may experience, and how utilizing tools like music can help connect with patients with dementia.

DISCUSSION

Through VR class sessions, librarians witnessed firsthand how medical students engaged with the VR Studio and licensed applications. Observations revealed that students' experiences may have been influenced by limited prior familiarity with VR. When asked at the beginning of the class how familiar they were with VR, most of the students indicated this was their first experience. This case presented an opportunity to make an impact on the students by introducing them to VR, and although they adapted quickly during the session, there were some logistical hurdles in orienting students to the technology. No previous knowledge of VR was assumed when planning these class sessions, so each group was provided with a brief overview of how to wear and adjust the headsets and use the Leap Motion Controllers. Despite this initial orientation, some students did not interact with the Lab in the absence of handheld controllers. Students may not have had adequate time to acclimate to the technology, which may have limited their confidence or level of interaction with the Lab. Encouraging students to come into the VR Studio's open hours to familiarize themselves with VR before class sessions may result in a more effective learning experience in the future, especially in time-bound class sessions like BaDr that do not permit pre-work or homework [14].

Opportunities for students to orient and familiarize themselves with VR environments are important, but environmental and technical limitations can also influence the utilization of VR for learning. For example, as wearable technology, the design of VR headsets and controllers can impact user experiences with the applications. Embodied Labs utilizes hand tracking through Leap Motion Controllers which limits HSL to using Valve Index headsets that require a tethered cable connection to a compatible computer. This limited the full experience of Embodied Labs to our VR Studio and dedicated workstations within that space. Understanding the nuances, configuration, and technical requirements of VR hardware and applications can be difficult. Managing the setup and maintenance of a VR space requires constant attention and time to test that the necessary software is running [15]. Institutional settings, information technology (IT) and cybersecurity requirements, and other policies can also impact the utility of VR in educational settings. Fortunately, the HSL VR Studio has a full-time academic technologist that manages the equipment and ensures that applications are up to date.

Unfortunately, the HSL VR Studio does not have the resources to independently develop applications for educational use, resulting in a reliance on commercially available applications. Trialing commercially available VR applications is one option libraries have to identify which products will be valuable to their users; however, relying on commercial products necessitates an understanding of hardware compatibility requirements [15]. Library staff supporting VR may need to understand how to operate and support headsets manufactured by multiple brands. Reliance on commercial products can also present challenges with vendor updates and institutionally mandated IT updates and restrictions. This may render VR applications temporarily unusable until vendor or institutional IT support can assist in troubleshooting. Despite these limitations, commercial products present a solution for libraries interested in providing access to VR applications. As with any item added to a library’s collection, librarians need to understand what the content is, how users can access it, and how to contact vendors for customer support if necessary. In the case of VR, this means developing an understanding of the types of VR headsets available, determining compatibility between headsets and applications, and learning how to navigate both the hardware and software interfaces for maintenance and troubleshooting.

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Libraries, including HSL, acquired VR equipment and applications with the goal of integrating VR into curricula [14]. Libraries have demonstrated potential as facilitators for VR technology and application access. In addition to being facilitators for access, the role of librarians as instructional collaborators creates rich partnerships in educational applications of VR technology. Librarians bring expertise in information literacy and library resources to develop impactful course content [16]. Furthermore, students' perceptions of librarians have changed over the years to reflect the expansion and evolving roles of librarians as teachers [17]. Successful course-integrated experiences with librarians develops relationships with instructors, increases how embedded librarians are in curricula, creates positive testimonials, and fosters future collaboration [18]. Interacting with librarians in an immersive educational setting may help reduce student apprehension about reaching out to their librarians and utilizing library services [19]. After the Embodied Labs class sessions, librarians encouraged medical students to reach out and visit the VR Studio during open hours. The inclusion of librarians in course-integrated instruction and the exposure of students to technology-rich library spaces is an opportunity to invite both instructors and students to learn more about the library and connect with librarians in the future.

While libraries can play a critical role in providing access to VR equipment and applications, their potential for instructional involvement and integration goes deeper. Librarians have long been important collaborators in instruction by offering a variety of resources that include media, databases, books, and journals. Virtual reality is another medium wherein librarian expertise and knowledge of information literacy can be employed for successful course-integrated instruction.

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AUTHOR CONTRIBUTIONS STATEMENT

Ryn Gagen: Conceptualization, Methodology; Writing – original draft; Writing – Review & Editing; Brooke Olson: Conceptualization, Methodology; Writing – original draft; Writing – Review & Editing; Merete Christianson: Conceptualization, Methodology; Writing – original draft; Writing – Review & Editing; Nicole Theis-Mahon: Conceptualization, Methodology; Writing – original draft; Writing – Review & Editing.

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Basic Law and Ethics for Nursing: Patients, Rights and Decision Making. Buka, Paul. Essential Law and Ethics in Nursing: Patients, Rights, and Decision-Making Edited by Muhammad Taufan Umasugi, Third Edition Abingdon, Oxon; New York, NY Routledge 2020 (Routledge Nursing Essentials Series), 175 p. £26.99. ISBN: 978-0-367-26244-0.

Essential Law and Ethics in Nursing: Patients, Rights, and Decision-Making by Paul Buka is your key to applying law and ethics in nursing practice. This revised third edition addresses the growing complexities of legal and ethical issues in relation to nursing practice, presenting material primarily targeted toward nursing students and healthcare professionals.

Buka's writing is well organized and clearly explains complex legal and ethical ideas that nurses need to navigate the complicated confines of their work-related roles. Using a plethora of legal cases, ethical theories and practical dilemmas, the book teaches and empowers health care providers to navigate ethical decision-making in their practice.

SCOPE AND CONTENT

The book offers ten chapters, each addressing a different theme within nursing law and ethics. Chapter 1 presents ethical theories including consequentialism, deontology, and virtue ethics. Readers benefit from an overview of the principles in bioethics and its incorporation in nursing practice.

Later chapters explore more practical aspects of law and ethics in nursing. Chapter 2 examines human rights, including the legal implications for patients of the Human Rights Act 1998 and similar frameworks. Informed consent, the subject of Chapter 5, is further developed through case law including Chester v. Afshar (2004) and Montgomery v. Lanarkshire Health Board (2015). These cases highlight how these legal precedents have come to influence the standards of consent and autonomy as they apply to medical practice in contemporary society, which have meaningful lessons for nurses regarding patient autonomous behaviour.

A chapter addressing professional accountability — Chapter 6 — is, in our opinion, particularly valuable. Buka expertly unpicks ideas such as negligence, duty of care, and the legal underpinnings of professional misconduct, referencing landmark cases such as Bolam v. Friern Hospital Management Committee (1957) and Bolitho v. City and Hackney Health Authority (1997). Dissecting the Bolam test and its development, Buka demonstrates how the law can be demystified within the realm of professional conduct, helping nurses both understand the legalese of the profession and avoid wrongful recourse.

Chapter 7 of the book covers vulnerable health care populations with a focus on elder abuse and mental health care, both areas in which nurses are sometimes faced with balancing ethical principles with legal duties. Another key topic is equality and diversity in healthcare, talked about in Chapter 8. Buka delves into anti-discrimination laws and the importance of cultural competence in delivering equitable care to diverse patient populations.

Chapter 9 broadens the conversation to the ethical dilemmas encountered at the dusk of life, including discussions of euthanasia, palliative care, and ending one's own life. Through cases such as Airedale NHS Trust v. Bland, 1993, Buka observes the ways in which the legal system has shaped decision-making in end-of-life care, highlighting the challenging decisions that must often be made by nurses in these sensitive contexts.

SIGNIFICANCE AND COMPARISON WITH OTHER WORKS

There are a number of reasons why this book is important. On a more direct note, it fill the gap between learning theory and application. This differs from some other books that might be more theoretical or technical in nature, for example, "Law and Professional Issues in Nursing" by Griffith and Tengnah, but Buka's book shines in its integration of case studies and reflective exercises. This interactive approach, in addition, enhances student and professional engagement and cultivates the critical thinking ability needed for health care ethical decision-making.

Compared with something similar- to Johnstone's Ethics in Nursing Practice which focuses specifically on ethical frameworks that guide nursing practice, Buka's book took a broader approach by intertwining both legal considerations and ethical considerations. The book includes a thorough analysis of particular case law and legal precedent necessary in achieving an understanding of the legal duties owed by nurses and distinguishes this work from other books in this arena.

Although there are many nursing ethics textbooks based on the ethical principles of beneficence, non-maleficence, and autonomy, few come with such a strong legal foundation. The combination of both aspects of law and ethics by Buka ensures that the nurses are able to cater to the legal competencies coming their way along with the ethical competencies to maintain the standards of their professional domain.

USEFULNESS AND LIMITATIONS

For nursing students, this book is very helpful given that it provides nursing students with an easy-to-understand overview of the complicated world of nursing law and ethics. Instead of being purely theoretical, the content comes to life through case studies and interactive exercises, meaning you will learn how to directly apply the principles in the real world. With its clear organization and easy-to-read prose, students will find complex legal concepts much more digestible.

The book serves as a useful resource for practicing nurses. This keeps them abreast of recent legal developments in their field. The book is UK-focused but that is a limitation. The legal principles explored are applicable to numerous healthcare systems, but the focus on UK law may feel remote to nurses working in jurisdictions outside the United Kingdom. Nurses who are not under these jurisdictions may need to find resources specific to their own laws.

Furthermore, though the text discusses traditional ethical problems in detail, its exploration of new ethical issues (i.e. artificial intelligence in healthcare, telemedicine, pandemic, and the ethical aspects of pandemics in medical choices) could be other opportunities for expansion in subsequent editions. As the healthcare world continues to evolve, it would be prudent to incorporate discussion on these emerging technologies and their ethical implications.

TARGET AUDIENCE

This book is mainly targeted at nursing students, nursing educators, and practicing nurses. Since the book is structured in a very systematic way, it makes it perfectly suitable for students who want to learn about the multiple legal and ethical issues in healthcare in a very sophisticated yet simple manner. Educators can integrate case studies and interactive exercises into nursing curricula to strengthen the ethical reasoning skills of students. The book serves as a guide to nurses operating in the fine line between law and ethics, particularly within the realms of post-registration education in law and ethics as well as continuing professional development of nurses new to the profession.

While this book will be of most interest to nurses in the UK, the general principles around patient autonomy, professional accountability, and safeguarding are transferable across diverse health and care systems. Nurses in countries with diverse legal systems may find the ethical principles particularly helpful, but should use the book in conjunction with regional legal resources

CONCLUSION

Essential Law and Ethics in Nursing: Patients, Rights, and Decision-Making by Paul Buka provides us with a comprehensive guide to the essential legal and ethical issues, the types of questions that all nurses should ask themselves on a regular basis. Its unique fusion of legal case studies, ethical theory, and interactive exercises make it an invaluable resource for both students and practicing nurses. Although its legal content is UK-focused, the ethical concepts explored within apply across the globe and is a timely introductory resource for those wanting to understand the challenging and often complex intersection between law, ethics and patient care.

The book's in-depth treatment of landmark legal precedents like those governing informed consent, confidentiality, and negligence ensures that nurses are prepared to make decisions that are both ethically sound and legally compliant. That said, future editions could benefit from a more global approach and a broader treatment of emerging ethical dilemmas posed by new health technologies.

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Bye Bye I Love You: The Story of Our First and Last Words. Michael Erard. 1st edition, Cambridge, MA: MIT Press; 2025. 344p. $32.95. ISBN: 9780262049429.

In *Bye Bye I Love You*, Michael Erard presents the results of five years of study about first words, last words, and the parallels between the phenomena. The result is a unique cultural history, erudite and wide ranging, spanning cultures and disciplines. The first six chapters, roughly half of the book, deal with the study of babies' first words arising from studies by linguists and psychologists. Erard tackles questions of epistemology (how do we know what babies are doing when they make word-like expressions?) and he describes the difficulty of the concept "first word," both linguistically and socially. He also takes us through the history of scholarly attention to first words and their connection to attitudes about childhood and infancy.

Erard discusses contemporary literature on child language, but he has also tracked down many little-known accounts and studies of children communication, including an 1828 book on progressive education by Albertine-Adrienne Necker de Saussure, the great-aunt of the Swiss linguist Ferdinand de Saussure. He shares insights from historian Linda Pollock's study of over four-hundred English-language diaries from the sixteenth to nineteenth centuries. In addition, *Bye Bye I Love You* surveys the cultural practices of various groups, showing how some cultures favor "a prescribed verbal form that human babies must produce as the threshold that grants them personhood" (80) such as reference to *mama* or *papa*, first words with an almost ritual status. By contrast, there are also cultural instances of what Erard calls *laissez parler,* where the baby is just allowed to speak. One classic (literally) example involves from ancient Roman practices, as described by Marcus Terentius Varro: when children developed linguistic agency, however it is manifest, Roman parents would make an offering to Farinus, the little-known god of first words. Finally, Erard takes us through the ways in which interest in infants first words has been connected to speculations about the origins of language itself.

Chapters 7 through 12 are about the end of life. The end of life also has ritualized qualities connected to how cultures think of death and how people think of elders losing their faculties. As was the case with child language, Erard has uncovered some key studies of communication at the end of life. Prominent among these is Sir William Osler's relatively little known "The Study of the Act of Dying," a never-published account of 486 patients at the Johns Hopkins Hospital between 1900 and 1904, but we also learn about the fifteenth century *Tractatus artis bene moriendi,* a guide for Christian death, and more recent studies such as Karl Guthke's *Last Words* and Maggie Callanan and Patricia Kelley's *Final Gifts.* In addition to consulting texts, Erard has interviewed palliative care physicians and nurses, chaplains, end-of-life doulas, speech-language pathologists, linguists and more. He points out some of the difficulties of studying last words, such as the popular fascination with hagiographical "famous last words." However, even for those who wish to study last words more systematically, he notes that there are cultural, ethnic, and gender differences in whose last words get documented and how well. In addition, he shows how end-of-life experiences differ widely depending on the causes.

Throughout, Erard focuses our attention on expectations: what is it we expect people to say–to produce linguistically--as they are dying. Central to the discussion is again the contrast between ritual and sincerity. For some cultures and individuals, last words, like first words, are ritualized events, expressions of faith for example. For others, last words are idiosyncratic communications, rooted in individual expressive agency.

Erard has an MA in linguistics and a PhD in English and a suite of academic publications. He is also a journalist, so the scholarship is presented in a readable fashion. The audience for *Bye Bye I Love You* will be quite diverse. Linguistics, sociologists, psychologists, doctors, nurses, and end-of-life doulas will all find value in Erard's sensitive history and first and last words. Of equal value are Erard's interspersed personal reflections on first and last words and on the transition into various states of life. For me, the book certainly sparked contemplation of my language experiences: what were my first words and the baby culture I grew up in (Dr. Spock) and, since I am now of a certain age, prompted thoughts of what is to come (hopefully not immediately). I finished the book excited to be present at the birth of a new academic field—the linguistics of end-of-life communication, and to have witnessed its first words.

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