Harnessing the Electronic Health Record to Advance Integrated Care

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Introduction: Integrated health care is utilized in primary care clinics to meet patients' physical, behavioral, and social needs. Current methods to collect and evaluate the effectiveness of integrated care require refinement. Using informatics and electronic health records (EHR) to distill large amounts of clinical data may help researchers measure the impact of integrated care more efficiently. This exploratory pilot study aimed to (a) determine the feasibility of using EHR documentation to identify behavioral health and social care components of integrated care, using social work as a use case, and (b) develop a lexicon to inform future research using natural language processing. *Method:* Study steps included development of a preliminary lexicon of behavioral health and social care interventions to address basic needs, creation of an abstraction guide, identification of appropriate EHR notes, manual chart abstraction, revision of the lexicon, and synthesis of findings. *Results:* Notes ($N = 647$) were analyzed from a random sample of 60 patients. Notes documented behavioral health and social care components of care but were difficult to identify due to inconsistencies in note location and titling. Although the interventions were not described in detail, the outcomes of screening, referral, and brief treatment were included. The integrated care team frequently used EHR to share information and communicate. *Discussion:* Opportunities and challenges to using EHR data were identified and need to be addressed to better understand the behavioral health and social care interventions in integrated care. To best leverage EHR data, future research must determine how to document and extract pertinent information about integrated team-based interventions.

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Public Significance Statement
This paper assesses the feasibility of EHR (electronic health record) documentation to better understand aspects of integrated care that address behavioral health and social needs. More information on these aspects of care can help health systems identify, track, and evaluate the delivery of integrated care and how it may be improved to meet an individual's whole-health needs.

Health systems are rapidly implementing integrated health models in primary care clinics (Balasubramanian et al., 2017; Blount & Miller, 2009; Butler et al., 2008), and with good reason. Evidence indicates that integrating health services improves access to and quality of care (Hunter et al., 2018; Manderscheid & Kathol, 2014), reduces health care costs (Basu et al., 2017; Hunter et al., 2018; Unutzer et al., 2008), and improves population health outcomes (Balasubramanian et al., 2017; Valentijn et al., 2013). Although integrated care has been described in several ways, the United States Agency for Health Care Research and Quality developed a national lexicon that defines integrated care as "care resulting from a practice team of primary care and behavioral health clinicians, working together . . . [in] a systematic and cost-effective approach to provide patient-centered care for a defined population" (Peek & National Integration Academy Council, 2013, p. 2).

A key feature of integrated service delivery is the team (Bodenheimer & Laing, 2007; Peek & National Integration Academy Council, 2013). Team members work interdependently and collaboratively to provide comprehensive and coordinated care that meets the quadruple aim of health care delivery—improved care, reduced cost, increased population health, and reduced provider burnout (Bodenheimer & Sinsky, 2014). Integrated team-based primary care requires changes in the culture and organization of care delivery, team interactions (including patients and families), and the definition of roles among all team members (Schottenfeld et al., 2016). Further, ways to measure the effectiveness and efficiency of integrated and team-based care models in practice settings require refinement due to expanding health-related services to regularly include behavioral health treatment and social care interventions. As health

systems become increasingly attuned to the social determinants of health (SDOH)—the conditions in which we live, grow, work, and play (Office of Disease Prevention and Health Promotion, 2018)—and how the SDOH impact patients' lives and outcomes, they must also work to understand the social conditions affecting the delivery of health care (National Academies of Sciences, Engineering, and Medicine [NASEM], 2019). Social care interventions include the actions taken on behalf of a patient's SDOH and can include, for example, assistance to food, housing, transportation, or other social supports that impact health (NASEM, 2019).

Health informatics may offer a way to harness data that allows researchers to better understand integrated care in practice settings. Informatics tools and methods can retrieve and analyze large health care data sets such as those found in electronic health records (EHR; Edgcomb & Zima, 2019; Raghupathi & Raghupathi, 2014). Yet the ability to evaluate EHR's utility in integrated settings is impeded by the lack of standardized documentation processes and how EHR data are collected, analyzed, and applied. Determining how best to harness this data could strengthen the field of integrated care, optimize health systems, and inform patient health care decisions. The NASEM (2019) consensus study on integrating social care into the delivery of health care identified EHR as an essential resource needed to successfully address both physical and social needs to improve health outcomes. Unfortunately, no standardized processes currently exist to efficiently gather, analyze, and leverage integrated care EHR data to achieve this aim. Therefore, it is important to harness informatics tools to better understand and measure the impact of behavioral health and social care interventions conducted by behavioral health providers in integrated settings.

Integrated Health in Primary Care

Behavioral health care includes mental health and substance use disorder conditions, stress-linked physical symptoms, and other health behaviors (Health Resources and Service Administration [HRSA], 2018). Considerable evidence supports integrating behavioral health care into primary care settings (Balasubramanian et al., 2017; Blount & Miller, 2009; Miller et al., 2014). Two prominent models highlight the role of behavioral health providers in integrated primary care: the collaborative care model (Unutzer et al., 2001, 2008) and the primary care behavioral health model (Hunter et al., 2009, 2018; Reiter et al., 2018; Robinson & Reiter, 2016; Strosahl, 1996). Common types of behavioral health providers include psychiatrists, psychiatric nurse practitioners, psychiatric physician assistants, psychologists, licensed addiction counselors, mental health counselors, school counselors, social workers, and marriage and family therapists (HRSA, 2018). Between 2016 and 2021, a quarter million people (276,400) are expected to enter the behavioral health workforce, approximately half (136,000) of whom will be social workers (HRSA, 2018).

Integrated care has established the importance of behavioral health providers that address the SDOH (NASEM, 2019; Stanhope et al., 2015; Zerden et al., 2018). Recent literature has documented social workers' roles and impact on integrated primary care teams (Fraher et al., 2018; Fraser et al., 2018), although specific content about the roles and practices utilized within these integrated models remains limited (Rowe et al., 2019). As such, EHR offer a data source to help identify the current roles and impact of behavioral health providers in integrated settings (Rowe et al., 2019; Steketee et al., 2017).

Informatics, Electronic Health Records, and Natural Language Processing

Health care informatics is a core competency of integrated care (Hoge et al., 2014). To better understand and improve health care delivery, researchers use multiple types of data within and outside the health system, including data from large sources such as the EHR (Raghupathi & Raghupathi, 2014). Informaticians have used EHR to understand the roles and outcomes associated with several health professions, such as physicians (Bae & Encinosa, 2016; Mennemeyer et al., 2016) and nurses (DesRoches et al., 2008; Harris et al., 2018), but behavioral health providers remain comparatively understudied.

Natural language processing (NLP), a machine learning method that can be used to identify and extract targeted EHR data (Friedman, 2000), offers one avenue for examining health provider roles using large EHR data sets. NLP allows computers to translate "narrative data" from EHR notes into "quantifiable variables ([or] structured data)" (Edgcomb & Zima, 2019, p. 347). A systematic review by Iroju and Olaleke (2015) offers a detailed description of NLP methods and applications for health care. To identify and extract concepts of interest from narrative EHR data, NLP can employ a lexicon: a collection of words and phrases relevant to the concept of interest. The lexicon can be iteratively developed using multiple sources including domain expert knowledge (interviews, surveys, or focus groups of experts from the field of interest), literature reviews, and content from EHR notes or relevant text-based clinical documents. NLP has already been used in EHR-based research in multiple fields including hypertension care and lifestyle modification (Shoenbill et al., 2020), radiology (Elkin et al., 2008), HIV/AIDS care (Hyun et al., 2003), and nursing (Hyun et al., 2009). Recent work has described how assessing EHR data using machine learning and NLP methods can advance mental health research (Edgcomb & Zima, 2019). However, to date, NLP has not been used to evaluate EHR documentation or the roles performed by behavioral health providers conducting behavioral health and social care interventions as members of integrated care teams in primary care settings.

Study Aims

To understand how integrated care services are documented in the EHR, this exploratory study analyzed the documentation of behavioral health providers and care coordinators integrated into a family medicine clinic. Specifically, all of the behavioral health providers were trained as master's-level social workers. The aims were (a) to determine the feasibility of using EHR documentation to identify behavioral health and social care components of integrated care, using social work as a use case, and (b) to begin developing a lexicon to inform future integrated care research using NLP. The goal of this work was to assess the feasibility

and methods needed to harness EHR data to better understand the behavioral health and social care components of integrated care. This study presents new evidence to the barriers and opportunities researchers may encounter with integrated care EHR data.

Method

Setting

The study site is a family medicine clinic in a large health system in the southeastern United States. The clinic employs a population health model of care that integrates the treatment of physical, behavioral, and social needs. In this clinic, master's-level social worker clinicians provide both behavioral health and social care interventions. The care team includes physicians, nurses, pharmacists, dieticians, clinical psychologists, social workers, and other front-line staff. All team members use the same EHR system, are physically colocated within the same office space, and share an understanding of the clinic's model of care and treatment goals.

This study was reviewed and approved by the University of North Carolina Institutional Review Board. The study team worked in partnership with a university Translational and Clinical Sciences Institute, which is the data repository for a large health system.
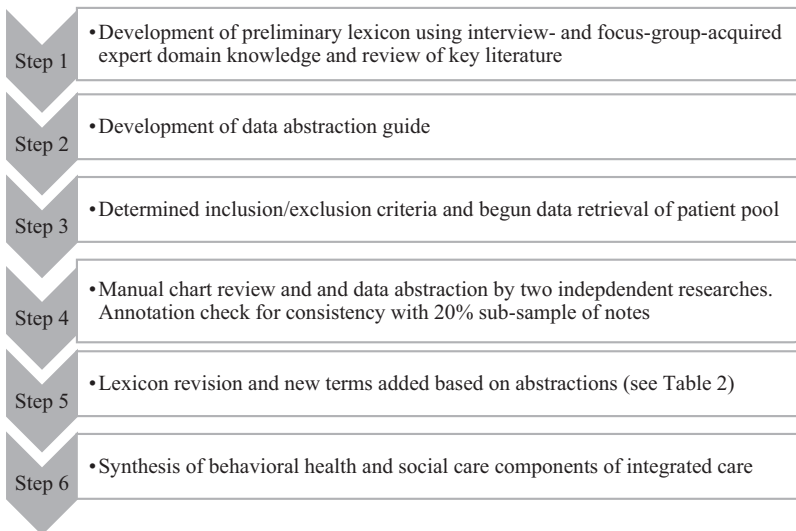
Study Process

The multistep approach is displayed in Figure 1, and each step of the process is described below. Shoenbill et al. (2020) provided a model for our study design, and the lexicon development was informed by Cheng et al. (2016). To answer Aim 1, Steps 1 through 3 sought to determine the feasibility of using EHR documentation to identify behavioral health and social care components of integrated care. In Steps 4 through 6, notes were abstracted and synthesized to inform future NLP research (Aim 2).

Step 1: Development of Preliminary Lexicon

The preliminary lexicon was based on multiple sources including interviews with domain experts and focus groups with 30 practicing social workers from 20 primary care clinics in which they described their documentation practices. The study team (three PhD social work researchers, a primary care physician informatician, and a workforce expert with a faculty appointment in family medicine) also conducted a thorough review of relevant literature. Seminal literature that informed the

Figure 1

Overview of Study Steps to Find Behavioral Health and Social Care Notes

Step 1 • Development of preliminary lexicon using interview- and focus-group-acquired expert domain knowledge and review of key literature

Step 2 • Development of data abstraction guide

Step 3 • Determined inclusion/exclusion criteria and begun data retrieval of patient pool

Step 4 • Manual chart review and and data abstraction by two independent researches. Annotation check for consistency with 20% sub-sample of notes

Step 5 • Lexicon revision and new terms added based on abstractions (see Table 2)

Step 6 • Synthesis of behavioral health and social care components of integrated care

lexicon included work by Horevitz and Manoleas (2013), key features of integrated physical and behavioral health in primary care (Peek & National Integration Academy Council, 2013), Fraser et al.'s (2018) systematic review of social workers' roles in integrated primary care teams, and the work of Stanhope et al. (2015). Based on these sources, it was determined that the lexicon would focus on two themes and associated terms of practice commonly found in integrated primary care settings: behavioral health and social care interactions and interventions (Theme 1) and communication among the integrated care team (Theme 2).

Step 2: Development of Data Abstraction Guide

The data abstraction guide was developed in consultation with a clinical informatician and NLP researcher who was part of the research team. The data abstraction guide systematically organized information collected, including note author, note type, domain of practice, and additional terms and phrases used in the EHR note that described behavioral health and social care interventions (see Figure 2 for summary; see online Supplemental Materials 1 for detailed abstraction guide).

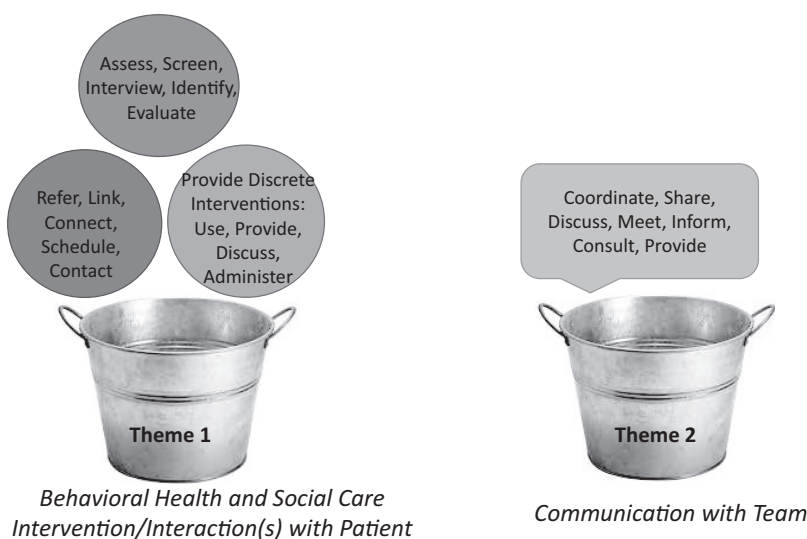### Step 3: Establishing Inclusion Criteria and Retrieving Data

Data for the manual chart review were retrieved by the university data broker. The team worked iteratively to identify a patient cohort with documented social work contact in the EHR. A random sample of 60 patients was selected based on a list of eligible patients by medical record numbers. The first 60 patients were included as determined by a random number generator. To be included, patients had to be at least 18 years of age, have visited the family medicine clinic, and had contact with a social worker at least once between September 1, 2016 and August 31, 2017. All demographic descriptions were extracted from patients' records.

Step 4: Manual Chart Review, Data Abstraction, and Interannotator Agreement Tasks

This study analyzed data collected from Epic EHR Software (Epic Systems Corporation, 2018). A total of 647 notes were manually reviewed. After reviewing those that met study criteria, 425 notes remained. Two independent researchers with social work experience in integrated primary care and EHR documentation practice read and abstracted

Figure 2

Two Themes of Behavioral Health and Social Care Providers' Notes: EHR Terms Associated With Interventions and Communication

Behavioral Health and Social Care Intervention/Interaction(s) with Patient

Communication with Team

EHR notes using our preliminary behavioral health and social care intervention lexicon and data abstraction guide. A subsample of notes (20%) underwent a second annotation to check for consistency. During this process, inconsistencies were reconciled with a third and final annotation made by a third researcher.

Step 5: Lexicon Revision and Additions Based on Abstractions

As notes were abstracted, new relevant terms were identified and added to the lexicon. For example, several screening activity terms were added (e.g., "inquired," "scored," "conducted," "reported," and "endorsed"; see Table 1). The lexicon was also updated to include terms and phrases commonly found within the documentation.

Step 6: Synthesis of Behavioral Health and Social Care Components of Integrated Care

Findings on content and description of practice documented in the EHR were synthesized both quantitatively and qualitatively. Count data were used to describe the number of notes within each theme of the lexicon (see Figure 3). Examples of note texts were examined to understand how behavioral health and social care interventions were documented (see Table 2).

Results

The goal of this study was to assess the feasibility of using EHR documentation to identify behavioral health and social care components of integrated care. This type of analysis was possible but not without sizable challenges. Foremost, identifying a subset of patients who met inclusion criteria posed a significant challenge for several reasons including note authorship and note type.
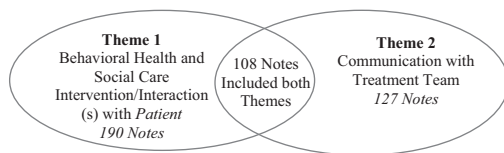
Note Authorship

It was often difficult to discern the author of an EHR note due to multiple "author types" for notes abstracted. Clinicians were not consistently referred to as "social workers" but as "case managers," "care managers," or other titles. To ensure comprehensive data retrieval, all social workers employed by the study clinic and their notes that meet inclusion criteria were reviewed. However, this process still yielded some notes not written by a social worker despite efforts to filter notes

Table 1
Examples of Words Added to the Working Lexicon

	Assess or screen	Refer	Intervene	Team communication
Beginning terminology for lexicon				
Iterative language added to lexicon	Inquire(d), scored, conduct(ed), reported, endorse(s or d), mental status	Fax(ed), submit(ted), mail(ed), email(ed), request(ed), receive(d), message(d), contact(ed)	Counsel(ed), explore(d), develop(ed) collaboratively, normalized, empathized, encouraged	Request(ed), spoke, notify (ied), call(ed), contact(ed), followed up

Figure 3
Synthesis of Abstracted Notes by Themes (N = 425)

Note. A total of 647 notes were manually reviewed but only 425 met inclusion criteria.

appropriately. For instance, some notes were incorrectly attributed to a social worker when another provider referenced the social worker in discharge instructions, but the social worker did not author the note. These challenges made it difficult to identify notes written by one clinician type (i.e., social workers) on the integrated primary care team.

Note Type and Clinical Encounters

Documentation of behavioral health and social care interventions was found in multiple locations within the EHR, including (but not limited to) providers' notes, discharge plans, treatment plan summaries, and diagnostic reports. In this study site, social workers were salaried employees and only rarely billed for their services, meaning that they typically did not have billable clinical encounters. Instead, these providers often documented their work as part of the documentation for a patient's billable clinical encounter with another provider. Associated notes fell under other note types (e.g., "documentation" or "telephone en-

counter"). These factors limited the ability to identify clinical notes uniformly.

Findings From Chart Review and Data Abstraction

To revise and update the lexicon, a manual chart review of notes from 60 randomly selected patients with at least one social work contact was conducted. There was a mean of 11 notes per patient, ranging from three to 52. Abstracted notes represented patients across racial backgrounds (53% White, 43% Black, 4% did not report) and gender (76% were female) and had a mean age of 64 years (ranging from 28 to 97 years). Figure 3 shows the distribution of abstracted notes across associated themes. Most notes (70%, $n = 298$) included content from Theme 1 (i.e., documentation of behavioral health and social care interactions and patient contact), 55% ($n = 235$) of notes included content about interprofessional communication between social workers and other members of the integrated team (Theme 2), and a quarter of all notes included both themes.

In Theme 1, 32% of notes documented screening or assessment for social or behavioral health needs. Referrals and coordination of services were documented in more than 65% of Theme-1 notes. Interventions such as cognitive behavioral therapy, motivational interviewing, and intensive behavioral counseling were mentioned in 31% of the notes in Theme 1. Table 2 provides representative example terms and phrases related to direct patient contact (Theme 1).

Notes from Theme 2 showed that while social workers were most likely to communicate directly

Table 2
Examples of Documentation of Direct Patient Contact Involving Behavioral Health and Social Care (Theme 1)

Screening and assessment	"[Patient] contacted social worker endorsing worsening anxiety without clear trigger . . . She feels restless and is experiencing racing and intrusive thoughts"
Referral (community supports and programs to address social needs)	"[Patient's] family member contacted SW requesting assistance with food insecurity, in-home assistance and eye-glasses. SW submitted Diabetic Shoe application. SW contacted meals on wheels [county name], discussed case with [name]; no current routes for home delivery, [Patient name] or a neighbor/family member would have to pick up meals at senior center. SW discussed [agency] as resources for low-cost eye glass options; [patient] has already received a Rx for glasses. SW manager will facilitate a referral via Medicaid."
Discrete behavioral health intervention	"Used CBT and interpersonal therapy techniques in discussion of grief, relationship difficulties."

with physicians (56%), communication was bidirectional. Typically, social workers communicated with other team members about a patient's immediate need. For example, "[Patient] called that there was no prescription at pharmacy to pick up." Often, documentation was a vehicle for sharing information about a patient's progress: "Care manager will notify Dr. of concern for worsening pain and need for results from MRI." When other team members initiated communication with a social worker, they often requested assistance. For example, "Primary care provider requested social worker follow-up with [patient] regarding no-show to appointment."

Findings From Lexicon Development

The preliminary lexicon was expanded with terms and phrases abstracted from the EHR (see Table 1). This process was difficult because many notes did not include the activity of the clinician and instead recorded the patient-reported issue(s) and the outcome of the contact. For instance, instead of stating that a social worker screened for depression, a note would indicate that a patient reported depression. Further, it was difficult to determine the number of steps and activities associated with referrals. In some cases, the documented note did not reflect the time, complexity, or actual activities required to address the need. For instance, "Patient reported being homeless. Social work care manager made a referral to [named] homeless shelter." Despite the conciseness of this note, this referral likely required multiple steps that likely occurred over hours—work the note did not capture. The brevity of this and similar notes meant that the expanded lexicon likely failed to capture salient terms and phrases describing social workers' roles on integrated care teams.

Discussion

The use of informatics and EHR data can help garner knowledge to better understand the interventions involved in integrated models of care and the health outcomes associated with this model. Increasing knowledge about the methods and process of accessing EHR data can help health systems operationalize integrated care and optimize the practices and communication of integrated care team members. This exploratory study had difficulty identifying the behavioral health and social care interventions performed by the behavioral health providers in an integrated family medicine clinic. Findings highlight both challenges and opportunities for leveraging EHR documentation to examine integrated care interventions and team communication.

Three notable factors impeded the ability to use EHR data to examine the interventions and communication patterns involved in today's integrated care settings: (a) varied titles for clinicians within notes, (b) inconsistencies in the location of notes describing behavioral health and social care components of integrated care, and (c) the notes' oversimplification of behavioral health or social care team members' contributions to patient care. Despite these difficulties, analyses identified communication patterns that corroborate recent work describing how EHR documentation serves as a communication tool among members of interprofessional integrated health care teams (Adamson et al., 2020; Rashotte et al., 2016). Earlier work has reported the benefits of EHR for care coordination between clinicians, facilitating patients' access to their own records and fostering communication within a collaborative environment (Silow-Carroll et al., 2012). Additionally, while this pilot study explored EHR documentation generated by social workers, findings may apply to other types of behavioral health providers on integrated care teams. The following recommendations are potential ways to further leverage EHR data to evaluate integrated care delivery.

Applicability and Usability of the EHR for Research

Allowing clinical encounters to be created by providers regardless of billing permissions could increase the data abstraction process and general usability of EHR data. Creating a common and consistent place to document the behavioral health and social care components of integrated care could assist with systematic data extraction and collaboration (Adamson et al., 2020). In this study, job title had profound implications for identifying notes. Because clinicians in this study were referred to in a multitude of ways, it was difficult to identify this role consistently. This is further complicated when considering that multiple professions may fulfill this role. Consistently titling the providers who address behavioral health and social care needs on the integrated team could assist in the ability to clearly pull notes for future research.

As health systems move away from fee-for-service toward value-based care that prioritizes interventions that are efficient and promote population health measures, EHR data and informatics methods have the potential to facilitate research on integrated team-based approaches and identify mechanisms to improve quality of care. Given that not all the components of integrated care are easily (or equally) identifiable in the EHR, additional evidence is needed to demonstrate the value of behavioral health and social care interventions. Results in this study demonstrate how complex social care and/or behavioral health interventions were reduced to the outcome or short description. As researchers continue to use EHR data to study integrated care, it is important to recognize EHR documentation is currently insufficient to understand the breadth, complexity, and time intensiveness of all providers. This is likely true for other roles on the integrated team such as dieticians and peer support specialists, among others. Given the many and varying documentation tasks of clinicians using the EHR, health systems and EHR vendors must continue to improve the usability and completeness of EHR documentation by soliciting end users' input about design, testing, and workflow development and standardization whenever possible.

This study initiated the process for NLP, which requires the development of a lexicon to systematically and electronically search thousands of notes. Our study uniquely focused on defining a lexicon that captures the dual role (i.e., balancing behavioral health and social care needs) of behavioral health clinicians in integrated care teams. The lexicon in this study was tested using documentation by master's-level social workers in an integrated family medicine clinic. Because several roles could perform behavioral health and social care services, the lexicon needs to be further expanded to describe additional components of behavioral health and social care practices. To strengthen this lexicon, input from various team members (e.g., psychologist, peer support specialist) is needed as well as replication across other integrated primary care settings.

The EHR as a Communication Tool for Team-Based Care

This study highlighted the use of the EHR data in evaluating team communication. Because the EHR remains a key source of data across health systems, identifying ways to document team-based care and the contributions of individual team members in the EHR is increasingly critical. This will require training in clear and consistent documentation protocols, which will also facilitate collaboration among integrated care clinicians (Adamson et al., 2020) and learners. Although each health system has a unique EHR platform, health education programs could establish didactic and clinical training to share expectations for EHR documentation and team-based care. Such educational opportunities could reinforce why documentation is necessary and how it can be effectively utilized to inform treatment plans and communication among team members.

Conclusion

This exploratory study is among the first to evaluate EHR data as a way of examining behavioral health and social care interventions within integrated primary care settings. Despite the promising potential of EHR data, current documentation standards and practices limit researchers' ability to easily abstract large quantities of desired data. As others have noted, locating specific data with the EHR remains challenging and time consuming and requires "intimate knowledge of the data structure of the HER . . . for even the simplest of queries" (Milinovich & Kattan, 2018, p. 42). By continuing to refine a lexicon that describes all components of integrated care, and greater standardization in EHR documentation practices, informatics methods have great potential to advance integrated care delivery and address patient and population health outcomes.

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