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RESEARCH ARTICLE

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Classification of patient- and clinician-generated secure messages using a theory-based taxonomy

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Abstract

Background: As secure electronic message exchange increases between patients and clinicians, we must explore and understand how patients and clinicians use those messages to communicate between clinical visits.

Objective: To present the application of a taxonomy developed specifically to code secure message content in a way that allows for identification of patient and clinician communication functions demonstrated to be associated with patients' intermediate and health outcomes.

Method: We randomly sampled 1031 patients who sent and received 18 309 messages and coded those messages with codes from our taxonomy. We present the prevalence of each taxon (ie, code) within the sample.

Results: The most common taxon among initial patient-generated messages were *Information seeking* (29.09%), followed by *Scheduling requests* (27.91%), and *Prescription requests* (23.09%). Over half of subsequent patient-generated messages included responses to clinic staffs' questions (58.31%). Six in 10 clinic staff responses included some form of Information sharing with process-based responses being most common (32.81%). A third of all clinician-generated messages (36.28%) included acknowledgement or some level of fulfilment of a patient's task-oriented request. Clinic staff sought information from patients in 20.54% of their messages.

Conclusion: This taxonomy is the first step toward examining whether secure messaging communication can be associated with patients' health outcomes. Knowing which content is positively associated with outcomes can support training of, and targeted responses from, clinicians with the goal of generating message content designed to improve outcomes.

Patient Contribution: This study is based on analyses of patient-initiated secure message threads.

KEYWORDS
electronic messaging, health IT, patient-centered communication, patient-provider communication

1 | INTRODUCTION

Secure exchange of electronic messages between patients and clinicians provides an opportunity for patients to engage with their clinicians between office visits. The Institute of Medicine (IOM) noted that secure messaging and other forms of health information technology (IT) may improve health care safety, timeliness, efficiency, and efficacy.[1] Health IT may promote patient engagement and empowerment by improving patients' preparation for, and recall of, clinical encounters.[2] Further, patients reported that effective secure messaging communication could reduce unnecessary health care appointments and improve their relationship with their clinicians.[3]

Research demonstrates secure messaging accounts for a significant and growing form of communication between patients and clinicians.[4,5] In one study, patients reported that use of secure messaging helped reduce anxiety and coordinate care between different clinicians.[6] Elsewhere, however, patients noted that some secure message communication could reduce their trust in their clinicians and increase uncertainty.[3] Having a standard coding system—a taxonomy—that supports quantification of content in patients' and clinicians' messages will permit analyses on the types of content associated with patients' outcomes. Knowing this may allow for targeted use of certain types of message content with a goal of improving outcomes.

In this paper, we describe the development and application of a data-driven taxonomy created specifically for secure messages that provides the first step to understanding potential linkages between message content and patients' outcomes. Our goal for this research was to identify the types of content patients included in their initiating messages to clinicians, and quantify the types of content exchanged between patients and clinic staff in subsequent exchanges within the message threads.

1.1 | Theoretical context

In her Uncertainty in Illness theory (UIT), Mishel defines patients' uncertainty in their illnesses as "the inability to structure meaning" around "what will happen, what the consequences of an event are, and what the event means."[7] Patients' uncertainty in illness may result from ambiguity in symptom manifestation, complexity of treatment or administration of care, unpredictability around the course of illness or illness severity, and lack of information about symptoms, diagnosis, treatment, prognosis, or other factors associated with the illness. The UIT[7] posits that patients may opt to reduce uncertainty if they perceive their uncertainty as a risk. If, however, patients perceive uncertainty as an opportunity (eg, an uncertain prognosis may offer hope), they may try to maintain their current state of uncertainty. Trusted authorities like clinicians may have direct and indirect impacts on patients' uncertainty when they provide information and social support to help patients better understand and emotionally manage the factors contributing to their uncertainty. Conversely, if clinicians offer ambiguous information or negative support, patients' uncertainty may increase.[8] The UIT notes that patients' appraisal of their uncertainty leads to different coping strategies and adaptation mechanisms.

The UIT focuses on patients' uncertainty and coping mechanisms. Since its initial publication, the UIT has been the theoretical basis for studies of uncertainty among patients with cancer and a variety of other diseases.[9-30] It focuses, however, less on the types of communication from clinical providers that would be effective to manage patient uncertainty, and more on what we can observe in patients' outcomes when uncertainty is managed. We therefore paired the UIT with a conceptual framework that directly and indirectly associates clinician-based communication functions with improved patient outcomes.[31] These communication functions include information exchange between patient and clinician, response to patients' emotions, uncertainty management, relationship development, self-management promotion, and decision-making support.[31] Researchers identified associations with direct pathways between communication and health outcomes in cases where poor communication or expressions of anxiety from clinicians were associated with increased patient anxiety,[32,33] while patients reported decreased anxiety when they felt their clinician communicated compassion and met their psychological needs.[34,35] On the indirect pathway between clinician communication and patient health outcomes, associations between clinicians' communication behaviors were found with proximal outcomes such as patient satisfaction.[33,36-38] Researchers also demonstrated associations between clinicians' communication and intermediate outcomes such as patients' access to care and services, understanding of their condition.[35,37-39] Finally, health outcomes like improved glycemic levels and blood pressure control were associated with collaborative goal-setting discussions with clinicians and participatory decision-making.[40,41]

Research has found that relationship building is possible through technology-mediated communication like secure messaging.[6,42-45]

1.2 | Objective

We created a taxonomy specific to secure messaging that would identify messages indicative of patient uncertainty. In evaluating the need for a taxonomy, we scanned the literature and identified 21 studies reporting some sort of classification system for secure messaging. Only 29% of those studies coded the clinician side of message thread.[46-51] Among the studies that examined message content, there was inconsistent application of classification systems. One taxonomy cited by several publications was the Consumer Health Information Needs,[52-54] but this taxonomy only included codes for the patient side of message thread. Several studies cited the Taxonomy of Requests by Patients[55] but none applied it in its entirety.[47,48,56-59] We derived our taxonomy based on the theoretical origins described above, and leveraged common themes identified across previously published coding systems. Finally, we pilot tested the taxonomy to ensure that the codes in our taxonomy covered the breadth of message types included in secure message threads within our population.[60]

Our analyses present the distribution of message content types from our taxonomy within a large sample of patient- and clinician-generated messages. Because our premise relies in part on why a patient might initiate a message thread with a clinician, we explored the distribution of message content types associated with patients' initiating messages.

Our use of theory to design our taxonomy is important: theory provides rationale for understanding the world and supports objectivity in research by providing predictive power by outlining the behavior or outcomes that could be anticipated through processes or actions.[61] It is therefore critical that concepts captured in any secure messaging taxonomy are theoretically grounded. That theoretical basis provides the rationale for why it is important for secure message content to be measured. It outlines the process by which message content should be predictive of patients' health care utilization and proximal, intermediate, and health outcomes.

Consistent with the UIT, we expected patients would use secure messaging to communicate with clinic staff between visits to address uncertainty in their health status and manage their care when not uncertain about their health status. Therefore, we aimed to examine the following research question:

RQ1: Do patients' initiating messages include taxa that demonstrate they are seeking information to manage uncertainty in their medical condition or their self-care, consistent with the UIT?

Street, Makoul, Arora, and Epstein[31] note good clinician communication promotes information exchange and builds trust. If clinic staff employ such practices in their secure message communications to patients, we should observe responses that indicate bidirectional information exchange—both information seeking (eg, to seek clarity in answers) and information sharing—between patients and clinic staff.

2 | METHOD

2.1 | Taxonomy development

Figure 1 displays our proposed concept diagram that applies the UIT[7] and the Street, Makoul, Arora, and Epstein[31] framework

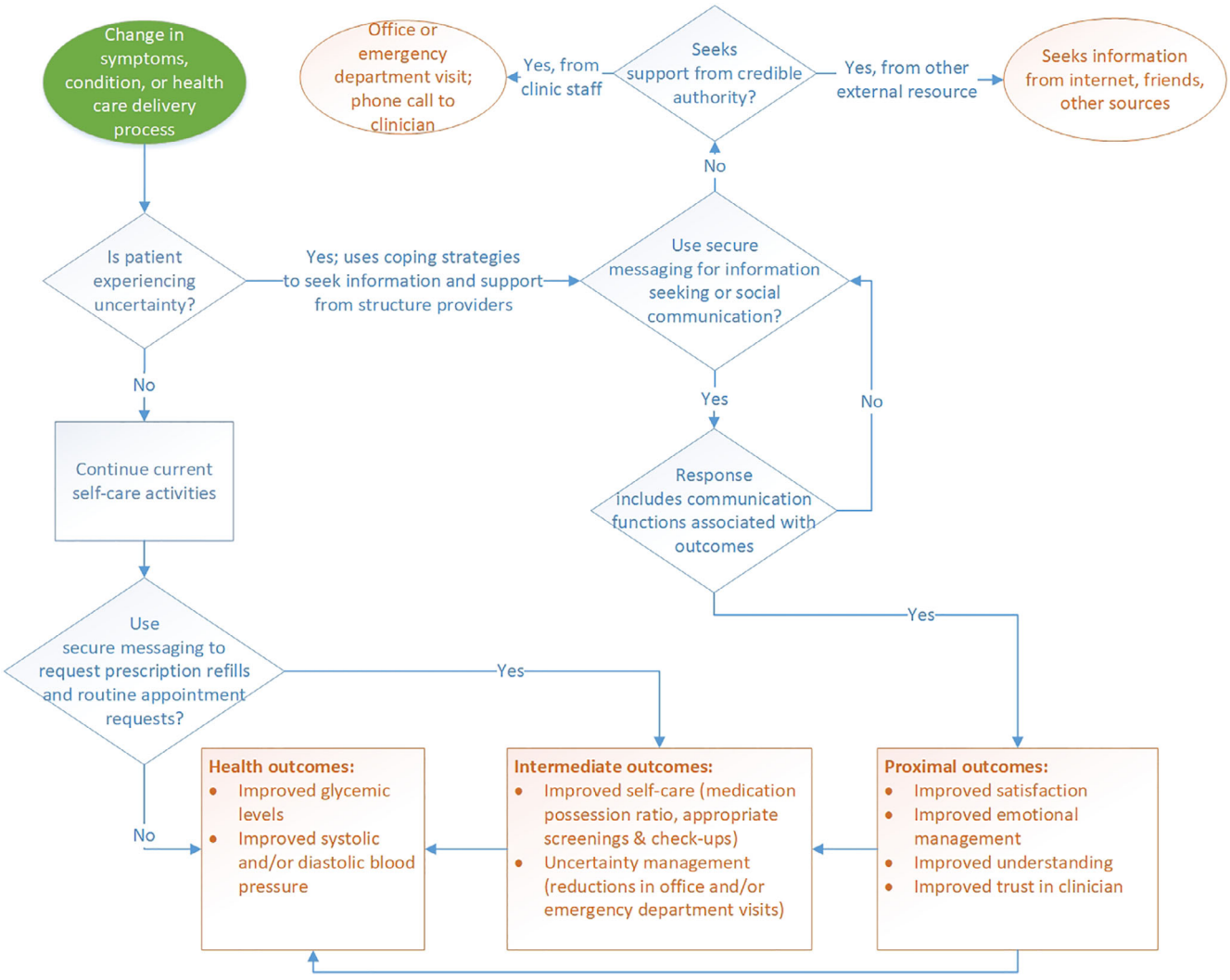

FIGURE 1 Concept diagram for theoretical basis for secure messaging taxonomy

theories to secure messaging use among patients, and links clinician-generated communication functions to health and its intermediate outcomes.

Consistent with Mishel's UIT,[7] our topline codes were indicators for why patients might outreach to clinic staff, and included codes for information seeking and sharing, social communication, and task-oriented functions. Within the information seeking category, we created two codes: medical guidance and logistics. Our taxonomy also accounts for task-oriented activities that may reflect changes in patients' health status and therefore be manifestations of patients' uncertainty, such as requesting an appointment for a new symptom or condition, referral requests, and requesting a prescription change.

Our taxonomy includes codes that may be indicators of a lack of uncertainty and self-care, such as task-oriented requests for prescription refills and routine appointment requests, as well as patients' information sharing activities like biometrics self-reporting and clinical updates.

Secure messaging should support bidirectional communication between patients and clinicians. Because patients' questions or responses in secure messaging may require additional clarification before information is shared, we included categories for clinic staffs' information seeking and information sharing communication. We further sub-divided staffs' information sharing into two codes to account for responses that might require medical training and those responses intended to orient patients to processes, treatments, and procedures. The latter likely do not require medical training to provide an answer. Our taxonomy includes action responses to support patients' task-oriented requests. We based these action responses on the Taxonomy of Requests by Patients,[55] which includes taxa for acknowledgment, partial or complete fulfilment of a request, and request denial.

Finally, we included *Social communication* and *Information sharing* taxa for both patient- and clinician-generated messages since these taxa may indicate communication that fosters trust-building between patients and clinicians.[7,31]

2.2 | Study population

Our study included a random sample of adult patients with diabetes, hypertension, or both conditions from among patients of a large urban medical system. The catchment area for this system includes a population of 47% Black, 2% Asian, and 7% Hispanic people.[62] This research received Institutional Review Board approval with expedited approval based on secondary use of existing data.

Our sampling frame included patients registered with the system's patient portal who had at least two outpatient visits or one inpatient visit within the medical system in 2016 with diagnosis codes for either diabetes (ICD-10-DM E11 and all associated child codes) or hypertension (ICD-10-DM I10 and all associated child codes), and at least one outpatient visit between January and June 2018. Our patient study population included 1031 patients, of whom 23% had both diabetes and hypertension and 39% of patients had only diabetes.

We included all communication threads initiated by the sampled patients that were started, completed, and saved to patients' charts between January 1 and December 31, 2017. Message threads included the initiating message and all patient and clinician responses. Our sampled patients initiated 7335 threads during 2017 that included 18 309 messages, of which slightly more than half (56%) were generated by patients.

We included all 544 unique clinic staff who sent at least one message in response to our patient-initiated threads. We used staffs' names listed in the messages to identify the clinic staff sender and matched those names with the National Plan & Provider Enumeration System (NPPES)[63] and the Virginia Department of Health Professions License Verification system,[64] to identify staffs' credentials. We grouped less frequently occurring clinician types—licensed practical nurses, pharmacists, physician assistants, medical assistants, podiatrists, social workers, and medical technician—into an "other" category.

2.3 | Content analysis

The full message thread provided the contextual unit for coding; coding units could be no longer than a single message and were frequently shorter, with multiple codes applying to a single message. A taxon was assigned only once to a given message. We coded using QSR International's NVivo 12 software, with the first author reading and assigning taxa to all messages and a co-author doing the same for a random 10% sample of messages. Six batches of messages were created; after each batch, the codes from the researchers were compared and discrepancies were reconciled. The first author then re-coded the messages accordingly. Midway through the coding process, and again at the end, the first author recoded all messages based on clarified taxonomy definitions. Once the taxonomy definitions were finalized and all messages coded based on those definitions, a new 10% random sample of messages was coded to estimate retest reliability. We represent taxa in italics throughout this paper.

2.4 | Data analysis

We estimated the prevalence of taxa by counting the number of times each taxon occurred in the sample for the numerator and the total of patient- or clinic staff-generated messages, as appropriate, for the denominator. Because our taxonomy was established in part on the reasons why patients might outreach to clinic staff, we analyzed patient-generated content based on when the message occurred within the thread. Initiating messages accounted for 72.17% of all patient-generated messages. Subsequent patient-generated messages were grouped together for the analyses. We conducted all analyses using SAS v9.4.

3 | RESULTS

3.1 | Taxonomy reliability

We leveraged Cicchetti[65] interpretations of Kappa estimates, with excellent clinical significance associated with a kappa between 0.75 and 1.00, good between 0.60 and 0.74, and fair between 0.40 and 0.59. We estimated intra-rater reliability as primarily excellent (48% of taxa) and good (41% of taxa), with only 11% scored as fair. Taxa with poor interrater agreement were clinician-generated request denials and *Recommendation to schedule*, and patient-generated *Information seeking/Logistics*. We had insufficient sample to estimate an interrater kappa for five taxa. Table A1 presents these results.

3.2 | Patient-generated content

This section presents the distribution of, and content examples for, patient-generated taxa within our sampled messages. Table 1 presents the characteristics of our patient population and the number of messages sent by patient characteristics. On average, patients initiated 7.12 threads, which included 9.86 patient-generated messages.

Table 2 presents the percentage of patient-generated messages that were coded with each taxon. Among initiating messages, *Information seeking* content was the most common and appeared in almost 30% of messages. *Information seeking/Medical guidance* was included in almost three-quarters (71.79%) of all initiating messages with *Information seeking* requests. We coded content with the *Information seeking/Medical guidance* taxon when patients were seeking information that likely required medical training to provide an answer. Examples included asking about the presence (or absence) of symptoms, symptom severity, general questions about whether a treatment is available to manage illness.

Information seeking around the *Logistics* of health care delivery was slightly more common in subsequent messages than initiating messages (13.83% vs 9.33%, respectively). These messages included topics about timing and process for medications and processes for medical treatments or services and included messages asking about when a clinician is working at a particular location, when a patient might be notified that an appointment was scheduled, or the process by which follow-up would occur and which clinic staff would provide follow-up.

More than half of all patients' *Information sharing* content (54.60%) occurred in subsequent messages. This taxon reflects different ways patients may share information with their clinic staff, including responding to clinic staffs' questions in preceding messages (*Response to clinician's message*) and *Sharing clinical updates* that do not require immediate action. These included sharing test results or outcomes from visits with other clinic staff. Fewer than 2% of *Response to clinician's message* content occurred in initiating messages. Initiating messages coded with *Response to clinician's message* typically reflected response to a prior conversation or thread and began with patients making statements such as "In response to your previous question…."

In contrast, 81.36% of *Sharing clinical updates* content occurred in initiating messages. Examples of *Sharing clinical updates* included noting scheduled appointments with other clinicians and providing status updates on completed procedures. Similarly, more biometrics *Self-reporting* (eg, reporting self-measured blood pressure, weight, glucose, or food diaries) occurred in initiating messages and accounted for only a small portion of all *Information sharing* content.

Most *Scheduling requests* appeared in initiating messages, with the *Reschedule* subtaxon occurring most frequently. Also common among initiating messages were prescription-related requests, with 17.44% related to *Prescription refill or renewal requests*. Only about 6% of initiating messages included requests for a *New or change prescription request*, which included requests by patients to shift to an entirely new medication.

Social communication accounted for less than 5% of initiating and subsequent messages. The subtaxon *Life issues* accounted for most of the *Social communication* content (42.52% within the *Social communication* taxon). Messages were coded with *Life issues* when patients

TABLE 1 Patient characteristics

Characteristic		Number (%) of patients (n = 1031)	Number (%) of messages sent (n = 10 163)
Age	18-59 years	540 (52.38)	5389 (53.03)
	60+ years	491 (47.62)	4774 (46.97)
Sex	Female	670 (64.99)	6678 (65.71)
	Male	361 (35.01)	3485 (34.29)
Race	Black	416 (40.35)	4215 (41.47)
	Other	50 (4.85)	385 (3.79)
	White	563 (54.61)	5557 (54.68)
Insurance type	Other	271 (26.29)	3100 (30.50)
	Private	331 (32.10)	2814 (27.69)
	Public	412 (39.96)	4159 (40.92)
	Uninsured	17 (1.65)	90 (0.89)
Health condition	Diabetes only	398 (38.60)	3953 (38.90)
	Hypertension only	394 (38.22)	3592 (35.34)
	Both conditions	239 (23.18)	2618 (25.76)

TABLE 2 Definitions and Percentage of Patient-Generated Taxa

Patient-generated taxa	Definition	Total messages with taxon	Percentage of initiating messages (n = 7335)	Percentage of subsequent messages (n = 2828)	Percentage that were the initiating message (n = 10 163)
Information sharing	Provision of information to clinic staff	3716	23.00	71.75	45.40
Response to clinician's message	Response to clinician's question in preceding message within the thread. Does not apply when message includes information seeking content; unless it's a new ask from the patient, additional requests are "response to clinician"	1757	1.47	58.31	6.15
Sharing clinical update	Sharing information with clinician that does not require immediate action or a response (and may not require action at all); do not code as clinical update if used as context for the question/request; clinical update with symptoms only if there's a new concept broached in addition to the symptoms question	1572	17.44	10.36	81.36
Self-reporting	Sharing biometrics or other health-related self-measurements; information with clinician that does not require immediate action or a response; implicit expectation that the clinician is expecting the information; should not be coded when biomedical information is provided in context of asking an information seeking question	504	4.77	5.45	69.44
Information seeking	Questions seeking information from clinic staff	2781	29.09	22.88	76.74
Medical guidance	Questions that seek medical guidance or information; it is likely that the patient expects a physician or advanced medical training to provide a clinically based answer	1809	20.89	9.79	84.69
Logistics	Questions about timing, clinical processes, health care settings, or a patient's care plan; questions for which a patient might reasonably expect most clinic staff to be able to provide an answer (does not necessarily require a physician's response)	1075	9.33	13.83	63.63

TABLE 2 (Continued)

Patient-generated taxa	Definition	Total messages with taxon	Percentage of initiating messages (n = 7335)	Percentage of subsequent messages (n = 2828)	Percentage that were the initiating message (n = 10 163)
Scheduling request	Appointment scheduling-related request	2224	27.91	6.26	92.04
Reschedule	Request for appointment to be changed to another date or time	904	11.08	3.22	89.93
Follow-up	Request for an appointment relative to an existing health condition	379	4.77	1.03	92.35
New condition or symptom	Request for an appointment relative to a newly identified health condition or new symptom for existing condition; new patient appointment	323	4.23	0.46	95.98
Cancellation	Request to cancel existing appointment with no associated request to change the date or time.	317	4.06	0.67	94.01
Laboratory test or diagnostic procedure	Request for a laboratory test or diagnostic procedure (eg, x-ray, ultrasound) order	220	2.64	0.92	88.18
Preventive care	Request for a preventive care or routine physical exam	103	1.36	0.11	97.09
Prescription request	Prescription-related request	1819	23.09	4.42	93.13
Prescription refill or renewal	Request for prescription refill or renewal	1340	17.44	2.16	95.45
New or change prescription	Request for a new prescription or switch to a different medication/ treatment	495	5.84	2.37	86.46
Other administrative request	Process-related requests that are administrative in nature; includes requests for sick notes, contact information, medical records, patient portal access, or information about billing or insurance; technology-related questions related to interfacing with the patient portal or other patient-facing technology; requests for call or email	613	6.73	4.21	80.59
Social communication	Communication not related to patients' health	468	4.74	4.24	74.36
Life issues	Communication about aspects of the patients' life not specifically related to health	199	2.13	1.52	78.39

(Continues)

TABLE 2 (Continued)

Patient-generated taxa	Definition	Total messages with taxon	Percentage of initiating messages (n = 7335)	Percentage of subsequent messages (n = 2828)	Percentage that were the initiating message (n = 10 163)
Complaints	Expressions of frustration or displeasure about service	191	1.94	1.73	74.35
Appreciation of praise	Content that expresses gratitude or offers acknowledgment or appreciation of a service provided, health status, or another act. Code "thank you" only when it references a specific action/service; general message closings of thank you should not be included	98	0.87	1.20	65.31
Referral request	Request for referral to other health care facility or clinician	202	2.39	0.95	86.63

used secure messaging to communicate about aspects of their life not directly related to their health (eg, commenting about retirement events, career changes), and included apologizing for actions, sharing jokes, and in one situation, reporting a fire in a neighboring apartment. Approximately three-quarters of each the *Life issues* and *Complaints* sub-taxa occurred among initiating messages. We defined *Complaints* as expressions of dissatisfaction about service or care provision, which included comments noting that a clinician was unpleasant or "a jerk," or that the patient did not appreciate being treated like a child with respect to their medication requests.

Across the three *Social communication* sub-taxa, the *Appreciation or praise* taxon had a slightly lower occurrence among initiating messages. Examples of *Appreciation or praise* included gratitude for clinicians' understanding, providing the patient peace of mind, and praise for an intervention program, noting the significant impact the program had on the patient's life.

TABLE 3 Clinic staff type by number of messages sent

Staff type	Number (%) of staff (n = 544)	Number (%) of messages sent (n = 8146)
Registered nurse	169 (31.07)	2678 (32.88)
Physician	163 (29.96)	2380 (29.22)
Administrative staff	79 (14.52)	1927 (23.66)
Other clinician type	64 (11.76)	632 (7.76)
Nurse practitioner	50 (9.19)	503 (6.17)
Unknown	19 (3.49)	26 (0.32)

3.3 | Clinician-generated content

This section presents the distribution of clinician-generated taxa within our sampled messages and examples of the content coded for each taxon. Table 3 presents the clinic staff types who responded to patient-initiated message threads. Registered nurses, physicians, and administrative staff were the most common staff types and sent most messages. Clinic staff responded to an average of nine sampled patients (median = 3, max = 223) across an average of 15.8 threads (median = 3.5, max = 348). Staff averaged 21.5 response messages (median = 5, max = 416) across the sampled patient population.

We present the distribution of taxa within the clinic staff-generated messages in Table 4. The most common type of content was *Information sharing* (59.29). *Orientation to processes & procedures* accounted for 55.34% of staff-generated *Information sharing* content. This type of response included process-based answers, such as providing guidance on insurance processes and requirements, directing patients on whom to call, how to reach a staff member, or anticipated next steps in a medical service or treatment (eg, how and when to find information on the patient portal, and when clinic staff could be expected to provide follow-up responses).

Information sharing/Medical guidance accounted for two of every 10 staff-generated messages and included information requiring medical training for an answer, such as treatment recommendations, care instructions (eg, guidance on appropriate levels for fasting glucose and how to adjust), interpretation of test results, or information about symptoms or health status (eg, providing information about why a symptom might be occurring as a result of a medication change). *Information sharing/Deferred*—in which the response referred the patient to a different clinic staff or postponed an answer until additional information was available or a subsequent clinical visit—occurred in almost 16% of all messages.

Two of every 10 clinic staff-generated messages included *Information seeking* content—questions from the clinic staff for clarity on the patient's status or request (eg, asking about any negative side

TABLE 4 Definitions and distribution of clinician-generated taxa

Clinician-generated taxon	Definition	Percentage of clinician-generated messages (n = 8146)
Information sharing	Provision of information to patients	59.29
Orientation to processes & procedures	Process answers: responses explain what a patient might expect during a treatment or diagnostic procedure, or in a new health care setting or situation	32.81
Medical guidance	Answer requires medical training/ provision of clinical information; requires medical decision-making	21.91
Action responses	Responses indicative of an action related to a task-oriented request	36.28
Fulfills request	Responses include documentation that the request action was completed	24.80
Acknowledge	Responses include a recognition that the request for action or information is made, or that the message was received, but no indication is provided about whether the request will be fulfilled. Should not be paired with another action response.	5.81
Partially fulfills request	Response indicates additional steps are necessary to fulfil the request, or that only part of the request can or has been completed; partially if there's a chance that the step does not happen	5.79
Information seeking	Requests for information of the patient; when no response is expected, then not coded as information seeking (eg, ending a declarative sentence with "OK?")	20.54
Deferred information sharing	Responses refer the patient to another clinician for a response, postpone an answer pending additional clinical information (eg, wait for laboratory test results)	15.74
Recommendation to schedule an appointment	Suggestions that patient schedule an appointment; a deferred recommendation to schedule (eg, if-then statement) is medical guidance, not recommendation to schedule	3.11
Social communication: Encouragement	Expressions of positive reinforcement or good feelings of the provider in regard to patient's actions, possessions, or self	2.55
Request denial	Response indicates that the request will not be fulfilled	1.50

effects the patient had previously during a treatment or procedure, or asking about biometrics patients measured at home). *Action responses* were the next most common category of clinic responses, with indications of request fulfilment being the most common (24.80%). Acknowledgment of the patient's request (5.81%) provided indications to patients that their messages were received and included content indicating receipt of a message or image or noting that a message was forwarded on to the physician. *Partial fulfilment* of a request (5.79%) included notations from clinic staff that some action was made in terms of responding to a request but that further action was needed (eg, that a prescription refill would be sent to the pharmacy following approval by the physician). Request denials (eg, indication that a medication refill request could not be fulfilled since the patient was no longer in the care of the clinic) accounted for a small percentage of all messages (1.50%).

Less common taxa included clinic staffs' *Recommendation to schedule an appointment* (eg, come back in for a 6-month check-up to receive additional medication refills and recommendations to seek emergency treatment and care) and *Social communication/Encouragement*. *Encouragement* content included clinic staffs' expressions of support and positive reinforcement, such as "Blood pressures are great!", acknowledgements of patients' hard work in smoking cessation or weight loss, and exhortation of continued practice of positive health behaviors.

4 | DISCUSSION

Our research is the first to present the distribution of patient- and staff-generated content classified by a theory-based taxonomy and to present that information based on the location of the message in the thread. Our findings demonstrate that, as expected, patients primarily used secure messaging to address uncertainty, as evidenced by the fact that the most prevalent initiating message taxon was *Information seeking*. The application of our taxonomy also revealed evidence of asynchronous bidirectional information exchange between patients and clinic staff. *Social communication* by both patients and clinic staff accounted for only a small percentage of all messages.

Our taxonomy employs concepts from both the UIT[7] uncertainty antecedents constructs and the Street, Makoul, Arora, and Epstein[31] clinical communication functions indirectly and directly associated with patient outcomes. In this way, we were able to identify content likely associated with patients' uncertainty (eg, *Information seeking* taxa) or self-management (eg, *Task-oriented requests*) as well as clinical responses linked to communication functions that are part of patient-centered care.[31] Through our conceptual framework, we provide a plausible pathway for linkage of message taxa and patients' intermediate and health outcomes. Indeed, preliminary research demonstrates associations between message content coded with these taxa and patients' health outcomes.[66]

A critical feature in managing patients' uncertainty around their illnesses includes the availability of trusted authorities (eg, clinicians).[7] Use of electronic communication mechanisms such as secure messaging improves patients' access to their trusted clinical authorities between office visits. Access to those trusted authorities helps patients adapt to their health status through information exchange that reduces uncertainty and promotes better self-management.[7,31] We found that most *Information seeking* patient-generated content within initiating messages revolved around seeking *Medical guidance*, compared to the more process-based questions found within the *Logistics* taxon. This may be because there is less process to manage outside the health care delivery environment (eg, patients only need to worry about process when in the health care environment), or that patients find other trusted authorities (eg, internet or friends and family) to help them answer those questions.

Street, Makoul, Arora, and Epstein[31] identified the communication functions of information sharing, uncertainty management, decision-making, and self-management support as related, both directly and indirectly, to health outcomes. Our research indicates that clinic staff employ some of these communication functions in their exchange with patients via secure messaging. Clinic staff responded most frequently with *Information sharing* content. In addition, a quarter of clinic staff responses indicated fulfilment of patients' task-oriented requests, thereby supporting patients' ability to self-manage their health condition.

We found evidence of asynchronous bidirectional information exchange between patients and clinic staff (eg, patients' and clinic staffs' *Information seeking* and *Information sharing*, and patients' *Response to clinician's message*). This is consistent with the UIT[7] and the Street, Makoul, Arora, and Epstein[31] framework that indicates that such bidirectional communication supports patients' understanding of their condition and their decision-making and self-management skills. We found that patients' initial outreach to clinic staff led with *Information seeking* and *Task-oriented* content more frequently than *Information sharing*, which is consistent with patients using secure messaging to manage their uncertainty according to Mishel's UIT.[7] More than half of clinic staff responses shared information, which both Mishel and Street et al note is crucial to improved patient outcomes and self-management. Further, clinic staff sought additional information from patients and over two-thirds of patients' responses included either a *Response to clinician's message* or *Sharing clinical update*.

We also found evidence of potential disruptions to that bidirectional exchange, with a small percentage of request denials and deferred information sharing to another individual or until a later date. It is important to note, however, that we analyzed the taxa in isolation. In reality, secure message communication encompasses an initiating message and all subsequent responses, and it is only analysis of that full message thread that can determine whether patients' questions and requests were addressed. It is possible, for example, that threads with information deferrals or request denials subsequently included *Information sharing* from clinic staff. Future analyses should consider the full thread to evaluate the appropriateness of the clinical response to specific patient-generated taxa.

Potential evidence of this disconnect lies with our findings between patient *Information seeking* and clinic staff *Information sharing*. Although almost three-quarters of patients' initiating *Information seeking* messages sought *Medical guidance*, slightly more than half of the clinical *Information sharing* responses included process-based answers (*Orientation to processes & procedures*). However, process-based information is critically important to the communication process. Street, Makoul, Arora, and Epstein[31] noted that access to care includes not just referring patients to necessary tests or treatment, but also providing information about how to get those services, providing appropriate clinical referrals and coordination between health care teams, and advocating for the patient to receive necessary services. Several studies noted that when clinicians did not communicate about a follow-up plan, patients assumed (sometimes incorrectly) that no follow-up was necessary.[37,38] A clear description from the clinician of next steps is therefore necessary to ensure that the patient receives appropriate treatment and follow-up.

4.1 | Limitations

We present descriptive lists of taxa prevalence among patient- and clinic staff-generated messages. Epstein and Street[67] noted intrinsic and extrinsic patient and clinician characteristics that can influence communication practices. Walther[68] noted that males and females have different habits when authoring messages. Further, some studies have found that senders' gender impacted receivers' perception of messages.[69,70] When the support received was counter to the expected norms (eg, if messages sent from a sender with a female-gendered name had low person-centered content), the evaluation for sensitivity and appropriateness was rated lower than similar support received in person.[69] Future studies should examine whether taxa use and response varies based on patients' and clinic staffs' characteristics.

We identified poor interrater reliability for three taxa. Patient-generated *Information seeking/Logistics*, and clinician-generated *Action response/Denies* and *Recommendation to schedule* had Kappa estimates below 0.4 which puts them into the unreliable range based on Cicchetti.[65] Results for those three taxa should be interpreted with caution. Also, since almost 30% of patients' initiating messages included information seeking content, there may be value to further specifying the types of patient information seeking to provide more granularity in the analyses. Future studies should work on refining the definitions and further building out the descriptions for these taxa to improve reliability.

Finally, it is important to note that this work focuses on patients who use secure messaging to communicate with their clinicians. There are known disparities in the use of secure messaging based on race, primary language, sex, age, insurance type, and education,[4,71-83] which could lead to disparities in care and health outcomes if those patients lack a comparable mechanism to communicate with clinician between visits. According to the UIT,[7] patients will seek out trusted authorities and social supports when facing uncertainty in their illness. We should expect that patients not using secure messaging will use other mechanisms to address their uncertainty, whether that be to call or schedule visits to speak with their clinician, or find other sources of information through friends, family, other trusted authorities, or the internet. Our work is not intended to address those other communication modalities which remain important to ensuring patients' understanding and self-management of their health condition. Rather, we focused on secure messaging because it improves patients' access to their clinicians by offering a convenient mechanism for patient-clinician communication for patients comfortable with this communication modality.[1] Further, both clinicians and patients support secure messaging as a useful and valuable communication modality.[3,6,84-92] Given that secure messaging accounts for a growing and significant portion of patient-clinician outpatient encounters,[4,5] the application of our taxonomy provides important insights into (1) patients' use of this modality to self-manage their condition and address their uncertainty, and (2) how clinicians' responses to patients through this mechanism incorporate communication functions associated with promoting patients' indirect and health outcomes.[93]

4.2 | Future research

The impact of a communication mismatch can be significant. For example, research found that patients' anxiety increased when clinicians did not respond in a patient-centered way and patients who perceived that their clinicians addressed their psychological needs were more likely to adhere to screening recommendations.[32,35] Message responses that did not address patients' concerns reduced trust in clinicians and increased patients' uncertainty and frustration.[3] Conversely, patients were less likely to book unnecessary appointments if they received effective secure messaging communication.[3] Future analyses would benefit from pairing content analyses using our taxonomy with patient interviews to understand patients' assessment of whether the clinical responses met their needs.

Brown, Fuller, and Thatcher[94] found that message recipients' perceptions of message senders' methodologic (eg, grammar, spelling, emoticons), social, functional, and political competence changed with the senders' writing style. Writing styles that included emoticons, appropriate capitalization, and error-free writing were perceived more positively by recipients. Further, emoticons may be interpreted differently based on recipients' age, sex, or culture. Therefore, patients' satisfaction with clinical responses and uncertainty management via secure messaging may not be dictated solely on content alone. To truly understand if message communication meets the criteria for good clinical communication, future studies should incorporate analysis of methodologic factors of writing style for a more comprehensive assessment of whether messages meet patients' communication needs.

5 | CONCLUSION

We present the application of a theoretically based taxonomy developed specifically to code secure message content and demonstrate the content that patients use to initiate message threads and clinical responses. Our findings empirically support the principals applied from the theories upon which the taxonomy was based. The analysis also confirmed the presence of asynchronous bidirectional information exchange between patients and clinicians through secure messages. Finally, we identified potential discrepancies at an aggregate level between the types of information seeking questions sought by patients compared to the information sharing content included in clinic staffs' responses.

Secure messaging is an increasingly common form of communication between patients and clinicians.[5,78] Given the associations between patient-centered communication functions and health outcomes,[31] it is important that we identify whether the communication shared by clinic staff meets those tenets of good communication. This taxonomy is the first step to beginning to assess communication types when patients initiate secure messages with clinic staff. Application of this taxonomy across research will ensure comparability of results. The theoretical framework used as the basis for this taxonomy allows us to objectively anticipate linkages between message content assigned with codes from the taxonomy, and patients' health care utilization and proximal, intermediate, and health outcomes.[93]

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

AUTHOR CONTRIBUTIONS

Conceptualization: Dawn Heisey-Grove, Jonathan DeShazo.
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Dawn Heisey-Grove had full access to all data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

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TRANSPARENCY STATEMENT

The lead author, Dawn Heisey-Grove, affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX

TABLE A1 Secure message taxa interrater and intrarater reliability

Taxa	Interrater reliability		Intrarater reliability	
	Final round Kappa estimates [95% CI]	Reliability interpretation	Kappa estimates [95% CI]	Reliability interpretation
Patient-and clinician-generated Social communication				
Appreciation/praise	0.57 [0.28, 0.86]	Fair	0.79 [0.67, 0.91]	Excellent
Complaints	N/A	N/A	0.72 [0.52, 0.92]	Good
Life issues	0.50 [−0.10, 1.00]	Fair	0.40 [0.17, 0.62]	Fair
Clinician-generated				
Action responses				
Fulfilled request	0.74 [0.56, 0.92]	Good	0.85 [0.80, 0.89]	Excellent
Acknowledge	0.58 [0.33, 0.84]	Fair	0.75 [0.66, 0.84]	Excellent
Partially fulfill request	0.49 [0.14, 0.83]	Fair	0.54 [0.42, 0.66]	Fair
Denies	−0.01 [−0.02, 0.00]	Poor	0.43 [0.18, 0.69]	Fair
Information seeking	0.85 [0.75, 0.96]	Excellent	0.88 [0.85, 0.92]	Excellent
Information sharing				
Medical guidance	0.86 [0.76, 0.95]	Excellent	0.83 [0.79, 0.87]	Excellent
Orientation	0.47 [0.30, 0.65]	Fair	0.63 [0.58, 0.67]	Good
Deferred information sharing	0.52 [0.20, 0.83]	Fair	0.68 [0.61, 0.74]	Good
Recommendation to schedule	−0.01 [−0.03, 0.00]	Poor	0.69 [0.54, 0.85]	Good
Patient-generated				
Information seeking				
Medical guidance	0.67 [0.51, 0.83]	Good	0.81 [0.76, 0.86]	Excellent
Logistics	0.29 [0.04, 0.54]	Poor	0.69 [0.62, 0.75]	Good
Information sharing				
Self-reporting	1.00 [1.00, 1.00]	Excellent	0.89 [0.82, 0.95]	Excellent
Response to clinician	0.51 [0.33, 0.70]	Fair	0.85 [0.82, 0.89]	Excellent
Clinical update	0.57 [0.36, 0.78]	Fair	0.68 [0.62, 0.74]	Good
Prescription request				
Prescription refill/renewal	0.82 [0.61, 1.00]	Excellent	0.88 [0.82, 0.93]	Excellent
New or changed Rx	0.56 [0.24, 0.87]	Fair	0.69 [0.58, 0.80]	Good
Scheduling request				
Cancellation	N/A	N/A	0.95 [0.89, 1.00]	Excellent
Reschedule	N/A	N/A	0.90 [0.84, 0.95]	Excellent
New condition/symptom	0.66 [0.05, 1.00]	Good	0.86 [0.76, 0.96]	Excellent
Preventive care	N/A	N/A	0.67 [0.39, 0.94]	Good
Follow-up appointment	0.49 [0.06, 0.92]	N/A	0.61 [0.45, 0.77]	Good
Lab or other diagnostic procedure	0.40 [−0.15, 0.94]	Fair	0.60 [0.40, 0.80]	Good
Other task-oriented request				
Referral	1.00 [1.00, 1.00]	Excellent	0.78 [0.64, 0.92]	Excellent
Other administrative	0.48 [0.17, 0.79]	Fair	0.72 [0.62, 0.81]	Good