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The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis

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Abstract

Background: Online health communities (OHCs) provide social support for ongoing health-related problems. COVID-19, the disease caused by SARS-CoV-2, has been an acute and substantial stressor worldwide. The disease and its impact, especially in the beginning phases, left many people with questions about the nature, treatment, and prevention of COVID-19. Unlike typical chronic ailments discussed on OHCs, which are more established, COVID-19, at least at the onset of the pandemic, is distinct in that it lacks a consensus of clinical diagnosis and an existing community foundation.

Objective: The study aims to investigate a newly formed OHC for COVID-19 to determine the topics and types of information exchange as well as the sources of information this community referenced during the early phases of the COVID-19 pandemic in the United States.

Methods: A total of 357 posts from a COVID-19 OHC on the MedHelp platform were annotated according to an open-coding process. Participants' engagement patterns, topics of posts, and sources of information were quantified.

Results: Participants who offered informational support had a significantly higher percentage of responding more than once than those seeking information (P<.001). Among the information-seeking topics, symptoms and public health practice and psychological impacts were the most frequently discussed, with 26% (17/65) and 15% (10/65) of posts, respectively. Most informational support was expressed through feedback/opinion (181/220, 82.3%). Additionally, the most frequently referenced source of information was news outlets/websites, at 55% (11/20). Governmental websites were referenced less frequently.

Conclusions: The trends of this community could be useful in prioritizing public health responses to address the most common questions asked by the public during crisis communication and in identifying which venue of communication is most effective in reaching a public audience during such times.
Introduction

Background

Since the start of the COVID-19 pandemic, the disease has been a topic of unceasing concern worldwide. The onset of SARS-CoV-2 created many uncertainties, particularly pertaining to the epidemiology of the virus and its impact on people. Especially in the beginning phases of the SARS-CoV-2 epidemic, the symptoms and severity of the disease varied from person to person, and the transmission of the virus was not well understood [1]. The impact of COVID-19 has been shown to cause psychological distress by vicarious trauma not only among health care workers but also in members of the general public [2]. As the novel circumstances created by COVID-19 evolve, these unknown factors continue to be a point of discussion and revelation in efforts to mitigate health concerns and apprehension among the public [3]. Coping with the effects of COVID-19 has become a new challenge globally, and one coping method among many is seeking social support [4]. With the ongoing pandemic, efforts to disseminate and provide support have become increasingly important to offer solace and guidance.

Particularly, given the current climate, transitioning many aspects of pre–COVID-19 life to a web-based format has become a movement in itself. With the shift to virtual classrooms, conferences, and clinics (telemedicine), the emphasis on the internet is as dominant as ever. Online support communities offer accessibility to provide comfort to those who are seeking it. Historically, online health communities (OHCs) or forums have been used as a platform for a variety of conditions, particularly chronic diseases. OHCs provide empathic peer-to-peer support by giving participants a safe space to offer shared connections and emotional understanding [5]. In addition to the emotional aspect of social support, these communities provide informational support to those who are seeking advice [3]. Analysis of the interaction within these communities has provided insight about information exchange and behaviors for many established diseases [6,7].

However, given the novelty and impact of COVID-19, the response of COVID-19 support communities may not be similar to those of established diseases. The departure from the norm of chronic diseases presents a unique opportunity to observe the needs of this community (eg, where participants are getting their information and how outlets of information may be directed in these scenarios in the future). The presence of these communities dedicated to COVID-19 appears to have a wide spectrum of focus and social support. In social media platforms such as Reddit, many public health issues have emerged as popular topics for discussion [8]. However, the public nature of these popular platforms makes them susceptible to an infodemic, or the spread of misinformation across media [9]. In contrast, dedicated OHCs, such as MedHelp, offer expert-moderated content to improve the accuracy of information. The participants are typically patients, caretakers, and health care professionals, who may form another layer of resistance to misinformation. Research has been active on popular social media platforms (eg, Twitter and Weibo) and COVID-19 [10-15]; however, there appears to be a gap in knowledge about how established, health-tailored communities have been responding to COVID-19. For these reasons, we will focus on a new COVID-19 community on MedHelp.org [16] for this study.

Social support can be organized into four broad types of supportive behaviors: emotional, instrumental, informational, and appraisal support. These behaviors are not mutually exclusive and may coexist in a single social exchange [17-19]. Bates [20] argues that information-seeking behavior is not only social and cultural but is also embedded in the biological and physical anthropological layers of human existence. In the context of COVID-19, investigating people’s health concerns and informational needs is particularly important to determine actionable steps to provide reassurance and safety at the emergence of a previously unknown disease. By examining the originating posts in this OHC, our goal is to identify the topics of information that the participants are seeking. Additionally, studying the types of informational support in the form of responding posts would give a sense of how members of this community are interpreting the pandemic as a whole and how they are engaging and managing the information around them. In the participants’ responses, the sources of information would help provide a better understanding of where people are receiving most of their information and what resources might be lacking in delivering patient education materials. Especially given the accompanying infodemic, investigating where most sources are referred to would help formulate possible future directives for information dissemination. To summarize, we aim to address three research questions (RQs) through our investigation:

1. What patterns of engagement did participants have in the newly formed OHC?
2. What were the topics of information-seeking posts and types of informational support?
3. What sources of information were referenced most frequently?

Prior Work

Social Support in OHCs

There is a robust body of literature investigating social support in online health forums or communities. Many are related to chronic health conditions such as cancer, diabetes, or substance use disorder [5,7,21-23]. These established diseases are typically in chronic care or require a degree of maintenance. Acute episodes are possible, but the overall projection is long-term; thus, attention should be paid to factors beyond physical medical

KEYWORDS

COVID-19; informational support; online health; online health communities; health information; online platform; pandemic; social support
treatment, such as the psychological implications, which are garnered through social support.

In terms of the nature of social support in online communities for health causes, Coulson [24] examined five thematic social support categories: emotion, esteem, information, network, and tangible assistance. Among these categories, informational support was used the most for areas of symptom interpretation, illness management, and interaction with health care providers [24]. Online support for alcoholism in an OHC showed subcategories of informational support that included advice, referral, fact, personal experience, and opinions; facts were the most frequently exchanged [6, 25]. Additional studies show that informational and emotional support is the most frequently offered form of social support and is key to the functioning of online groups [26, 27]. In investigating the patterns of social support exchange between OHC participants, Zhang and Yang identified four behaviors, including active giving, active receiving, passive giving, and passive receiving [7]. Empathy analysis of OHCs demonstrated that empathy develops through shared experiences [22], and empathy was perceived through effectiveness of information seeking rather than general social support [28]. Broader functions served by general-purpose online social platforms include raising awareness, fundraising, and commercial promotional content [5, 21].

Information Studies Related to COVID-19

As COVID-19 quickly spread in 2020, an increasing amount of research work was performed to understand how the public was responding to the pandemic by analyzing social media data. Applications of qualitative and quantitative methods to topic identification and modeling were the most common studies, and general-purpose microblogging sites such as Twitter and Weibo served as much of the research corpora. One study identified the top concerns among Twitter users to be the origin of the virus; its sources; its impact on people and society; and ways of mitigating the risk of infection [29]. Xue et al [14] used latent Dirichlet allocation to identify popular unigrams and bigrams representative of salient topics and sentiments in the collected COVID-19 tweets, and they found that confirmed cases and death rates, preventive measures, health authorities and government policies, COVID-19 stigma, and negative psychological reactions (eg, fear) were the dominating topics on Twitter [14]. Chang et al [12] developed online non-negative matrix factorization algorithms to detect the evolving COVID-19 topics over time on Twitter; government policy, economic crisis, COVID-19-related updates and events, prevention, vaccines and treatments, and COVID-19 testing were some of the most important evolving topics identified. Zhao et al [15] explored the types of information most frequently searched by Chinese netizens during the pandemic on Weibo: accessing medical treatment, confirmatory testing, managing self-quarantine, and offline-to-online support.

The public sentiment during the pandemic is another area of focus. Boon-Itt and Skunkan [11] found that Twitter users had a negative outlook towards COVID-19, and fear was the most frequent negative sentiment. Lwin et al [13] found that the emotions of the public shifted from fear to anger over the course of the COVID-19 pandemic on Twitter, and sadness and joy began to surface as people lost loved ones or expressed gratitude and hope for recovery.

In addition to topic and sentiment analysis, social media data were also analyzed for syndromic surveillance, fulfilling the notion of infodemiology [30]. Alanzet et al [10] collected tweets about COVID-19 and found that the 3 most commonly mentioned symptoms were fever, headache, and anosmia. Researchers in China analyzed the symptom descriptions and clinical test results posted voluntarily by Weibo users [31].

Finally, a limited number of studies sought to analyze the characteristics of the information posted on the web, such as its validity and patterns of spreading. Jo et al [32] identified the topics and appropriateness of questions related to COVID-19 at the early stage of the outbreak posted on a popular Q&A web forum (Naver Jisik-In) in South Korea; they concluded that the answers to suspected physical symptoms were relatively accurate, but a high proportion of answers related to self-protection methods contained misinformation or advertisement content. Park et al [33] studied how COVID-19–related news articles circulated on Twitter in Korea; they found that the choice of words for referencing the disease affects the speed of information spread, and medical-themed articles are more popular than nonmedical reporting of the disease.

To summarize, research on COVID-19–related web-based discussions published to date has primarily focused on identifying the topics and public sentiment reflected by the content. The identified topics, while informative, are diverse and lack a common framework to generalize for future public health emergency planning. Furthermore, these studies used general-purpose social media platforms, whose content may be generated by news publishing organizations, commercial accounts, or special interest groups that are not representative of the average health consumers. Meanwhile, studies on social support seeking as a means of disease management have been abundantly studied for many existing health conditions, our understanding of how the public seeks support in the face of an emerging pandemic is limited. In this study, we focus on the characteristics of the informational support exchange related to COVID-19 among OHC participants. In particular, we investigate the patterns of participation, topics of information seeking, types of informational support, and sources of information referenced.

Methods

Data Source

We collected data from MedHelp [16], an online health and wellness forum with more than 150 support communities dedicated to individual health topics, regarding COVID-19 discussions between March 12 and June 25, 2020. COVID-19 began to significantly impact life in the United States in March 2020, and this month is also when the MedHelp COVID-19 community began its activity. The unit of analysis is a post. During this time, there were a total of 83 originating posts and 274 responding posts. The originating posts were questions raised by participants who were seeking information. The
responding posts were answers offered by other participants. In addition to the responding posts, participants were able to provide comments on the responses, which were excluded because they may not have a direct relation to their corresponding post. All data collected are publicly and freely accessible on the internet.

**Data Analysis**

Qualitative content analysis was performed on posts for information seeking and informational support. The posts and responses were exported from the platform into an Excel file (Microsoft Corporation). The variables in this document included a numerical ID of the post, the post topic, the post content, the post creator, the post date, a numerical ID for the response, the response topic, the response content, and the response creator. These variables were then reviewed and coded by one researcher, who is a medical student. Annotations included categorizing the topics of information-seeking posts, the types of informational support responses, and the sources of information for referral posts. The annotated results were randomly sampled and reviewed by another researcher with experience in qualitative data analysis. The researchers discussed the ontology and clarified concepts that might fall under multiple categories. For example, posts inquiring about mask-wearing can be categorized under transmission, protection, and public health practices and psychological impacts, but we focused on their different emphases: transmission is about people wanting to understand the mechanism underlying how a particular protection measure might work; protection is about seeking information on a specific protective measure; and public health practices and psychological impacts is about building consensus on protective practices for group well-being. The coding definitions and examples are provided below. The frequency of each of the topics for information seeking and the types of informational support were then quantified.

**Topics of Information Seeking**

To understand participants’ inquiries about different aspects of COVID-19, the topics of information seeking were coded for the 83 originating posts. Common topics were identified based on the subject matter and context of the post. These included health risk, symptoms, transmission, prevention, prognosis, protocols, disease management, and public health and psychological impacts (Table 1).
<table>
<thead>
<tr>
<th>Name of topic</th>
<th>Definition of topic</th>
<th>Example posts</th>
</tr>
</thead>
</table>
| Health risk  | Having a notable past medical history that includes pre-existing conditions, such as diabetes, lupus, and cancer, or past traumatic events, such as hospitalizations and treatments | “I had a septic blood disease 5 years ago which caused spots on my lung and my brain. I was hospitalized for 32 days over the course of three months...Does this make my immune system more susceptible to catching the coronavirus at this time?...”  
• “So in layman’s terms, who is high risk? Are people of a certain age automatically high risk, even if we’re healthy?...”  
• “I’m in my 70s, but healthy. If I don’t have diabetes, heart disease or lung issues, do I have to stay inside?” |
| Symptoms     | Specific characteristics that are relevant to the presentation of COVID-19, such as cough and loss of smell. These also include differentiating factors from other similar disease presentations, such as influenza. | “I’ve had this left side throat pain for about 4-5 days now...I don’t have any trouble breathing, stuffy/dripping nose, aches/pains, I’m not dry coughing and I’m not running a fever. Should I be worried about this?”  
• “…I was diagnosed with sinusitis on Thursday... Monday morning I woke up with a low grade fever of 100.1 and a sore throat...I have no other symptoms...any advice?...”  
• “Does the normal Flu [influenza] have SOB [shortness of breath]?”  
• “…I’ve lost my smell and taste. Had a mild cough a few days before this. Is it covid19?...”  
• “Covid Toes, what are they?” |
| Transmission | Means by which COVID-19 can be transferred, be passed on, or travel | “…I was washing produce that was brought from the grocery...and water splashed my face. My wife...mentions that’s how this can spread...Is it possible that she may be right?”  
• “My daughter ordered two tee shirts...I put them in the tub with detergent and scrubbed them...and some water splashed into my eye...She [received] the order in only 3 days. How long would it stay on it? And could the germs be that potent to get into my eye?”  
• “…I saw a suspect 10 feet away while walking, he was asking the security guard for Covid 19 testing area. I did not go closer or touch. I was wearing face mask I came home and washed everything and sanitised my self by taking a bath. I’m i [sic] at any risk of catching the virus? Does it transmit through air?...” |
| Prevention   | How to avert or avoid contracting the virus, or prophylactic measures taken to lessen the potential response to the body | “I’m interested in a discussion about how to keep my immune system top notch to help fight the corona covid 19 virus should I get it. Should we use more vitamin C? Drink fluids? Vitamin D? Suggestions?”  
• “… I have been wearing masks when flu season starts, for many years...So is K N95 the same as N95??”  
• “Has there been any study or proof of breathing 1 to 2 deep breaths of diethyl ether fume to kill bacteria or viruses in nasal area or lungs, being as a preventive measure against getting the virus...” |
| Prognosis    | The course of the disease, which includes the timeline, recovery, progression, outcomes, and lasting effects | “Can anyone who RECOVERED from Covid19 please post some info? The community would very much appreciate some actual details about the good, the bad, and the ugly. Is the situation so dire that no one can post details here?”  
• “What is the expectation of longer term lung damage after COVID-19? My experience with the Hepatitis C has taught me a virus can leave its mark even after cured.”  
• “How long do people actually have it? What is the typical recovery time?” |
| Protocols    | The testing for the virus, which may include nasal swabbing, antibody testing, or questions about operations in handling specific scenarios | “How long after exposure would the virus be detected by a PCR [polymerase chain reaction] test?”  
• “A nurse in a nursing home tested positive to covid 19. They had been in direct contact with residents on their unit. What should have been done was it was known that the nurse was positive?”  
• “I…have a deviated septum and possibly some other structural differences in my nose...Could this affect whether the swab can be inserted far enough back to get enough of a sample for the test?” |
### Types of Informational Support

The study of the exchange of seeking and furnishing informational support is not complete without studying the participants’ responses to the originating posts. A total of 274 responses were reviewed and annotated following the types of informational support outlined by Chuang and Yang [6] and Cutrona and Suhr [34], including reference/referral, advice, feedback/opinion, facts, personal experience, and perceptual knowledge (Table 2).

Due to the circumstances of the COVID-19 pandemic, distinguishing the facts remains a challenge because of the many unknown factors, the unique presentations per person, and the fact that information about the disease is constantly changing. Therefore, the definition of *fact* based on previous literature is not applicable. Similarly, the definition of *perceptual knowledge* from previous literature cannot be applied in this context.

<table>
<thead>
<tr>
<th>Name of topic</th>
<th>Definition of topic</th>
<th>Example posts</th>
</tr>
</thead>
</table>
| Disease management                                 | Handling of the disease, such as treatments, medications, therapies, and ventilator use | • “Are there truly any medications or treatments for COVID/19?”  
• “Would hyperbarics [sic] chambers oxygenize in a different way than ventilators, or is it the same thing?...”  
• “…Why not avoid aggravating the lungs by “working with” the symptoms by filling the lungs with high-Oxygen liquid?...” |
| Public health practices and psychological impacts  | Broad range of questions that stem from effects of COVID-19; public health concerns may vary from topics such as social distancing to quarantine/shelter-in-place. Psychological concerns involve discussion about anxiety and depression. | • “There seems to be so much conflicting info on masks. Are you wearing one? Why or why not? What kind are you wearing, if you are?”  
• “What are you personally going to do in order to protect you and your loved ones as so many locations begin coming back online?”  
• “How are you all coping with the inevitable fear. Fear of our health, our finances, life changing forever. What are your coping strategies? Anything you are looking at in a new way now verses before?”  
• “I’m really worried like I’m sure a lot of people are. Anxiety is running high. I’m also feeling really shut in and trapped due to social isolating and distancing. How are people handling this?” |
| Not applicable                                      | Content that is not defined by the other topics of information seeking and is not directly relevant to health matters of COVID-19. These topics may include conversation starters and optimistic ideas. Topics that are not involved in direct information-seeking but are presented as a post are also included here. These may include references or resources that are not linked to specific information seeking. | • “…What have you had positive come from this? Do you know a positive story?”  
• “…Think any of the changes you are making will become new habits? Let me know what you think and which ones will be your new normal habit!”  
• “Washington Examiner article excerpts below suggesting only 70% sensitivity. They don’t mention specificity %. https://www.washingttonexaminer.com/news/health-experts-believe-1-in-3-infected-patients-getting-negative-coronavirus-test-results....”  
Table 2. Types of informational support, their definitions, and examples.

<table>
<thead>
<tr>
<th>Name of support type</th>
<th>Definition of support type</th>
<th>Example post</th>
</tr>
</thead>
</table>
| Reference/referral        | Responses that directly provide a source of information for the user to refer to. These responses also include sources or links embedded in a response. | • “Results from new studies reported in livescience.com say…”  
| Advice                    | Responses that offer suggestions to a specific problem or concern that a user may have     | • “we do want to let you know that if you can’t breath [sic], you should seek immediate emergency care”  
• “definitely talk to your oncologist when you face such an important question. Ask him or her if untreated cancer is more dangerous or if the chemo would be more dangerous for some reason.” |
| Feedback/opinion          | Responses that reflect the responder’s judgment of a certain situation or idea. These include responses that are not directly referenced by a source but through general information heard about the disease summarized and given as information, interpretation of a reference or source, or interpretation of a situation. | • “it's a blood clotting problem from what I've heard. This virus is weird. It affects different people very differently. It can adversely affect virtually every major organ in the body…”  
• “I have read that this loss of smell and taste is definitely commonly reported as an early symptom. This virus has a lot involved with it. This is an easy one to spot.” |
| Personal experience       | Responses that are an anecdotal recounting of a user’s story to provide insight to a post. These may also include conditions relevant for support and reflections on their own experience handling the situation. | • “I had the virus early April…”  
• “I also get allergies when the weather changes…” |
| Fact                      | Responses that reassure the user about the facts of the disease                           | No instances found                                                           |
| Perceptual knowledge      | Responses that provide sensory information to the user that helps reassess the situation. | No instances found                                                           |
| Not applicable            | Responses to originating posts that are in the “not applicable” category                  | • “Fewer cars, clearer air. I also like getting some sleep.”  
• “My hair has gotten longer in quarantine (the last appointment I canceled when we got word that we were about to go on lockdown was a haircut). When it's shorter I have to air style to look presentable…” |

Sources of Information Referenced

We also documented the sources of information referenced in the responses. These sources were reviewed and defined through open coding and then categorized. Among the references, 6 categories were created to categorize the source of information. These categories are listed below.

1. News outlet/website: references to general news sources, health news, international news, etc
2. Government: references to governmental websites, such as the US Centers for Disease Control and Prevention
3. Medical journal: references to peer-reviewed journals, such as The Lancet
4. Health website: references to specific sites about diseases, such as lupus, cardiac disease, and COVID-19
5. World Health Organization: references to the World Health Organization (WHO)
6. Other: references to social media, specific product websites, or other MedHelp communities

Results

RQ1: What Patterns of Engagement Did Participants Have in This New Community?

In the newly formed OHC, participants established meaningful connections by creating and responding to posts about COVID-19 to seek information and offer support. A total of 78 participants contributed to information seeking and offering. Among them, 45% (36/78) only contributed to information seeking, 36% (27/78) contributed only to information offering, and 19% (15/78) contributed to both information seeking and offering.

Furthermore, among the 51 participants who sought information, the majority (86%, 44/51) posted only once, with 1 person making 12 posts (Figure 1). In comparison, a total of 42 participants contributed to information offering, among whom 20 (20/42, 48%) posted once, 14 (14/42, 33%) responded 2-10 times, 4 (4/42, 10%) responded 11-20 times, and 4 (4/42, 10%) responded more than 20 times, with the highest number of responses being 42 (Figure 2). Information seeking and offering by the participants demonstrated similar patterns in that most participants interacted with the community via only 1 thread of conversations, although those who offered information had a significantly higher percentage of responding more than once (P<.001).
RQ2: What Were the Topics of Information-Seeking Posts and Types of Informational support?

The content of information seeking holds importance in evaluating the most pertinent information that needs to be addressed for the general public at the beginning of a pandemic. The responses to these posts are the informational support offered by the members of this community. The distribution of these responses gives insight to how members of this community are offering their support and which information-seeking type elicits the most conversation.

Out of the total 83 originating posts, 65 posts were relevant to participants seeking information. Among the information-seeking topics, symptoms were the most frequent (17/65, 26%), followed by public health practice and psychological impacts (10/65, 15%) and transmission (10/65, 15%) (Table 3).
Table 3. Distribution of the information-seeking types categorized into the number of information-seeking posts, the number of responses corresponding to the information-seeking category, and the response-to-post ratios.

<table>
<thead>
<tr>
<th>Information-seeking topic</th>
<th>Posts (n=65), n (%)</th>
<th>Responses to posts (n=220), n (%)</th>
<th>Response-to-post ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>17 (26.2)</td>
<td>32 (14.5)</td>
<td>1.9</td>
</tr>
<tr>
<td>Public health practice and psychological impacts</td>
<td>10 (15.4)</td>
<td>61 (27.7)</td>
<td>6.1</td>
</tr>
<tr>
<td>Transmission</td>
<td>10 (15.4)</td>
<td>28 (12.7)</td>
<td>2.8</td>
</tr>
<tr>
<td>Health risk</td>
<td>9 (13.8)</td>
<td>29 (13.2)</td>
<td>2.8</td>
</tr>
<tr>
<td>Disease management</td>
<td>7 (10.8)</td>
<td>23 (10.5)</td>
<td>3.3</td>
</tr>
<tr>
<td>Prognosis</td>
<td>5 (7.7)</td>
<td>22 (10)</td>
<td>4.4</td>
</tr>
<tr>
<td>Prevention</td>
<td>4 (6.2)</td>
<td>19 (8.6)</td>
<td>4.8</td>
</tr>
<tr>
<td>Protocol</td>
<td>3 (4.6)</td>
<td>6 (2.7)</td>
<td>2.0</td>
</tr>
<tr>
<td>Not applicable</td>
<td>18 (27.7)</td>
<td>54 (24.5)</td>
<td>N/Aa</td>
</tr>
</tbody>
</table>

aN/A: not applicable.

Within the total 274 informational support responses, 220 responses correspond to informational support (Table 3). The most common informational support responses were related to public health practices and psychological impacts (61/220, 27.7%) followed by symptoms (32/220, 14.5%). There were similar distributions of transmission (28/220, 12.7%) and health risk (29/220, 13.2%) as the next most common categories. Disease management (23/220, 10.4%), prognosis (22/220, 10.0%), and prevention (19/220, 8.6%) were also generally evenly distributed among the total responses to information-seeking posts. The protocol topic had the lowest number of responses (6/220, 2.7%).

The number of responses to information seeking was compared with the number of originating posts in their corresponding categories to evaluate which information-seeking topics offered more discussion than others in terms of response-to-post ratio. Interestingly, the category of information seeking with the highest response-to-post ratio was public health practices and psychological impacts, with a ratio of 6.1 responses per post, while the lowest was symptoms, with a ratio of 1.9 responses per post. Public health practices and psychological impacts generated more discussion than symptoms; however, the latter had the highest number of information-seeking posts.

Among the types of informational support, feedback/opinion was dominant, with 181 responses (181/220, 82.3%; Table 4). Within the feedback/opinion type, the majority (57/181, 31.5%) of responses addressed the topic of public health practices and psychological impacts (Figure 3). Within the topic of symptoms, feedback/opinion was still the most common type (9/32, 28.1%); moreover, compared to the other topics, symptoms received the most referrals (6/32, 19%) and advice (6/32, 19%). Prognosis and symptoms were the only topics that had personal experience responses (2/22, 9%, and 1/32, 3%, respectively). There were no responses for facts or perceptual knowledge.

Table 4. Frequency of the informational support responses.

<table>
<thead>
<tr>
<th>Informational support type</th>
<th>Responses (n=220), n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback/opinion</td>
<td>181 (82.3)</td>
</tr>
<tr>
<td>Referral</td>
<td>20 (9)</td>
</tr>
<tr>
<td>Advice</td>
<td>16 (7.7)</td>
</tr>
<tr>
<td>Personal experience</td>
<td>3 (1.4)</td>
</tr>
<tr>
<td>Fact</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Perceptual knowledge</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Not applicable</td>
<td>54 (24.5)</td>
</tr>
</tbody>
</table>
Figure 3. Distribution of information support for the subcategories of information seeking. The frequency of each is noted on top of the bar corresponding to its color.

**RQ3: What Sources of Information Were Referenced Most Frequently?**

The different types of reference sources reflect how members of the MedHelp COVID-19 community were receiving their information and which venues they may have found to be relevant for informational support. A total of 20 responses corresponded to the reference/referral type of informational support, among which 11 references (55%) used news outlets/websites, 3 (15%) used governmental websites, 3 (15%) used health websites, 2 (10%) used information from the WHO, 1 (5%) used information from other sources, and none used information from medical journals (Figure 4).

Figure 4. Distribution of sources of information by information-seeking topic. WHO: World Health Organization.
Participants referenced news outlets/websites when responding to posts with the topics of symptoms, public health practices and psychological impacts, transmission, health risk, disease management, and prognosis. Governmental sites were referenced in the symptoms and prognosis subcategories. Health websites were referenced in the health risk and prevention subcategories. The WHO was referenced in the symptoms and transmission subcategories. Other sites were referenced for prevention only. There were no direct references to medical journals for information seeking posts, and no references were made to a protocol.

Discussion

Principal Results

In this study, we investigated the characteristics of a newly formed OHC dedicated to COVID-19, including participation patterns, topics of concern, and sources of information. A total of 78 participants generated 83 originating posts and 274 responses during a 3-month period at the onset of the COVID-19 pandemic in the United States. Within these posts, 65 posts were categorized as information-seeking and 220 responses were identified as offering informational support. Among the participants, 65% (51/78) sought information and 54% (42/78) provided informational support, with a large majority of information-seekers (44/51, 86%) and a slight minority of information providers (20/42, 48%) posting only once. The most common topic of information seeking was related to symptoms of COVID-19 (17/65, 26%), followed by public health practices and psychological impacts (10/65, 15%), and mechanisms of transmission (10/65, 15%). The topics that garnered the most responses were public health practices and psychological impacts (61/220, 27.7%), symptoms (32/220, 14.5%), and health risk (29/220, 13.2%). Among these popular topics, public health practice and psychological impacts saw the highest response-to-post ratio (6.1); symptoms had the lowest ratio, at 1.9 responses per originating post. Most informational support was in the form of feedback/opinion (181/220, 82.3%), which reflected the responder’s judgment of a certain situation, followed by information references as a distant second (20/220, 9.1%). The participants primarily relied on news outlets (11/20, 55%) as sources of information.

The participation trends reflect the power law distribution that is common in social networks, where the majority of participants may only contribute once or a few times and there are a few individuals with high numbers of posts (Figure 1 and Figure 2). A few considerations related to the reason for the greater activities of certain members are having a health care background, personally knowing someone infected with or at risk of COVID-19, familiarity with the platform, or other factors. In addition, some participants were members of multiple communities in MedHelp prior to COVID-19, who readily contributed social support in other communities.

The study shows that the general public may be most concerned with the symptoms and manifestation of a disease when confronted by a previously unknown disease at the beginning of an epidemic. Considering the timeframe of these posts, the highest frequency of information seeking in symptoms is understandable because during this time, there were many unknown factors regarding SARS-CoV-2 and COVID-19. Additionally, the devastation in previously affected countries may have led to the development of insecurities and fear in the public. Knowing that symptoms are the first signs of the manifestation of a disease, the frequency of inquiries about this category does seem to be the most reasonable finding given the public’s concern regarding their well-being and how certain symptoms present in association with the disease. Furthermore, symptoms also had the lowest response-to-post ratio, suggesting a paucity of relevant information among the public. Public health professionals may focus on educating the public about known symptoms to reduce the potential of misinformation.

Compared to symptoms, the topics of public health practice and psychological impacts were not only among the most requested topics but also received the highest response-to-post ratios. At the onset of the pandemic in the United States, various levels of health and safety measures were put in place by different states, possibly creating confusion and debate among the public about best practices (eg, whether mask-wearing is effective). Meanwhile, reports of the rising hospitalizations, the lack of protective gear and equipment, and a growing list of newly discovered complications may have taken a toll on the psychological well-being of the general public. The public health practice and psychological impacts of the pandemic were affecting the daily life and social activities of every person. Many participants were responding to this topic, and the majority of informational support was in the form of feedback and opinion. Out of 61 posts offering informational support to the public health practice and psychological impacts, there was only one reference to information from a news outlet or website.

The topic of protocol had the lowest number of posts, which may also be attributable to the timeline. With more information about the disease, there could be better means to expedite patient education information and to implement actions for testing and better management of containment. The responses being primarily driven by feedback/opinion reflects the lack of concrete information during this time as well. It is also possible that the general public views the protocols of testing and hospital operations as requiring the expertise of health care professionals and thus not an area of interest to discuss.

These trends could indicate that among the participants of this community, their concerns pertained not only to the pandemic itself but also to how the pandemic affected their daily lives. The low response-to-post ratio for symptoms could indicate that on one hand, the general public lacked the knowledge to offer support, and on the other hand, the posts for symptoms may have been phrased as recounts of individual circumstances to solicit reassurance, thereby leaving less space for a community discussion on what may be considered symptoms of COVID-19.

Feedback/opinion is the most frequent informational support type (181/220, 82.3%). It is provided as a respondent’s judgment without referencing any information source but only offering their opinions based on what they have heard or interpreted. This finding shows that there is a lack of authoritative information to support the community. Users are mainly relying...
on their own judgment to support others, and theirs interpretations of the information they acquire can be unreliable in some cases.

Referral was the second highest informational support type (20/220, 9.1%). Among all the information sources, news outlets and websites were the most frequently referenced information sources (11/20, 55%) by the participants. Governmental and WHO sources as references appear to be underused or insufficient when referencing circumstances surrounding this pandemic. The trends within this community may demonstrate where information dissemination is most effective. Possible reasons for the frequent use of new outlets and websites include memorable anecdotal accounts of the disease, more immediate coverage, and accessibility. With the changing guidelines in protocols, public health measures, and disease information, it is understandable that there is difficulty maintaining consistency in the shifting landscape. However, maintaining consistency with so many unknown factors and fluctuations is important for safety and reassurance. The news outlets and websites likely provided this community with reassurance and updates more reliably than the other types of sources.

Limitations
Only one coder annotated the study. Although this is helpful in terms of consistency in annotation and interpretation, having more than one coder could have been beneficial in determining nuances in the contents of the posts and responses. The time frame of the study provides only a snapshot of the beginning of the disease progression and is not predictive of the course of how this platform will continue to respond as the disease progresses. The annotated posts do not reflect the views of people who visit the OHC without posting or responding.

Conclusions
The MedHelp OHC for COVID-19 reflects real-time concerns during the pandemic. These concerns are important in understanding how OHCs facilitate the exchange of information at the onset of a pandemic. Among the information-seeking topics, interest in symptoms was highest, followed by the public health practices and psychological impacts. However, there was a higher number of responses per post for posts related to public health practices and psychological impacts compared to posts about symptoms. Feedback and opinion was the most frequent type of informational support, followed by referrals. The most referenced source of information referral was through news outlets/websites. Government websites and the WHO were less frequently used. The referral trends suggest that news outlets/websites are the most effective mode of communication that individuals can refer to. These findings may be useful in prioritizing public health responses to address the most common questions sought by the general public during crisis communication and in identifying which venue of communication is most effective in reaching the public audience during these times.

Acknowledgments
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Conflicts of Interest
None declared.

References


Abbreviations

| OHC: online health community |
| RQ: research question |
| WHO: World Health Organization |

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Impact of Modifiable Risk Factors on the Occurrence of Cutaneous Leishmaniasis in Diyala, Iraq: Case-Control Study

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Abstract

Background: In 2018, an outbreak of cutaneous leishmaniasis (CL) occurred in Diyala Province in Iraq. Several risk factors of CL were identified in a prior study; however, the impact of removing modifiable risk factors on the occurrence of the disease was not measured.

Objective: The aim of this study is to measure the impact of removing modifiable risk factors of CL on the occurrence of the disease.

Methods: We conducted a population-based unmatched case-control study in two conveniently selected districts in Diyala Province. All cases of CL were included. Controls were chosen preferentially according to the site where the cases occurred. A structured questionnaire was used to collect data. The unadjusted odds ratios (ORs) and 95% confidence intervals for each risk factor were calculated using binary logistic regression. We also calculated the attributable fractions and 95% confidence intervals of the modifiable risk factors. A P value <.05 was considered statistically significant.

Results: Data from 844 persons (432 cases, 51.2%) were analyzed. Cases were more likely than controls to report a history of previous displacement (OR 5.18, 95% CI 3.84-6.98), electricity supply for less than 12 hours per day (OR 1.94, 95% CI 1.47-2.55), living in a rural area (OR 1.91, 95% CI 1.45-2.51), living in a clay house (OR 2.41, 95% CI 1.59-3.66), having an unpainted
indoor living space (OR 2.14, 95% CI 1.51-3.02), having rodents inside the house (OR 5.15, 95% CI 3.56-7.47), having chickens, sheep, or both (OR 3.44, 95% CI 2.48-4.75), having a mixture of dogs and sheep or of dogs and chickens within a distance of less than 100 meters (OR 3.92, 95% CI 2.59-5.94), fogging (OR 2.11, 95% CI 1.40-3.19), bed net use (OR 1.72, 95% CI 1.08-2.72), and sleeping outside or a mixture of inside and outside (OR 4.01, 95% CI 1.32-12.19). The data show that the exposure of approximately 70% to 80% of cases was associated with displacement, the presence of rodents inside the house, the presence of animals within 100 meters of the house, the presence of animals (chickens/sheep/both or a mixture of dogs and sheep or of dogs and chickens), and sleeping outside. Approximately 40%-50% of the cases reported living in a clay house, living in a rural area, having an unpainted indoor space, having an electricity supply for less than 12 hours, and using a bed net.

**Conclusions:** Prevention and control of CL requires a multifaceted approach that relies on changing environmental conditions, housing conditions, and human behavior. Fogging and bed net use were not effective because the underlying housing characteristics and human behavior provided a good culture for the disease. We recommend conducting a study to identify the species, reservoirs, and vectors of CL in Iraq; studying vector behaviors before applying environmental control measures; and educating the public on how and when to use bed nets as well as how to accompany their use with behavioral changes.

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**KEYWORDS**
cutaneous leishmaniasis; outbreak; Iraq; risk factors; risk; disease; infectious disease; disease prevention; prevention

**Introduction**

Cutaneous leishmaniasis (CL) is a neglected tropical disease for which approximately 500,000 to 1,000,000 new cases are reported per year worldwide [1,2]. Furthermore, it causes an estimated 2.4 million disability-adjusted life years, placing it among the top 10 in a global analysis of infectious diseases [3]. Countries in the Eastern Mediterranean region contribute approximately 57% of the total CL burden, where *Leishmania tropica* and *Leishmania major* are endemic in 18 countries and territories (including Iraq). Moreover, more than 100,000 new cases of CL are reported annually to the World Health Organization by countries in the Eastern Mediterranean region; however, the actual incidence is estimated to be 3 to 5 times higher [1,4,5]. In Iraq, surveillance data after the 1970s showed an average of 10x00 cases per year [6]. According to internal technical reports released by the Iraqi Ministry of Health, the last country-wide outbreak started at the end of 2014 and continued throughout 2017, when the number of cases per year reached an average of 16,000. In 2018, the number of cases started to decline steadily and reached approximately 11,000.

There are more than 20 *Leishmania* species that can be transmitted to humans, and more than 90 sand fly species that can transmit the protozoa to humans; moreover, approximately 70 animal species, including humans, are natural reservoir hosts of *Leishmania* parasites [7]. The transmission cycle of the parasite in nature can be either zoonotic or anthroponotic [8,9]. In Iraq, data are lacking regarding the most common *Leishmania* species, reservoirs, and vectors. However, evidence from nearby countries suggests that both transmission cycles of CL (zoonotic and anthroponotic) are common in Iraq [5,10,11].

Risk factors for developing CL include residence in rural areas, climate changes, movement of people, conflict areas, deforestation, house characteristics, and human behavior [9,12-14]. Prevention and control of leishmaniasis requires a combination of intervention strategies because transmission occurs in a complex biological system involving the human host, parasite, sand fly vector, and, in some cases, an animal reservoir host. Key strategies for prevention are early diagnosis and effective case management, vector control, effective disease surveillance, control of animal reservoir hosts, and social mobilization and strengthening partnerships among all concerned institutions [14].

Although CL is a self-healing disease, it is potentially disfiguring [1]. The only drug licensed by the Iraq Ministry of Health to treat CL is sodium stibogluconate, a pentavalent antimony compound.

The recent outbreak affected most Iraqi provinces variably, with an overall incidence rate of 0.9/10³ population. The highest incidence rate was in Diyala Province (4/10³ population), while the lowest incidence rate was in Duhok Province (0.01/10³ population). According to internal reports and discussion with the zoonotic diseases section at the Iraq Communicable Diseases Control Center, the lack of infrastructure and municipal services, the presence of hard-to-reach areas, and a lack of prevention programs were blamed for the occurrence of the outbreak. Diyala was subjected to terrorist and military operations from 2014 to 2016, when most of its residents were displaced. Meanwhile, it also encountered a wave of a *Leishmania* epidemic that started in November 2014, reached its peak during 2015, and continued throughout 2017. In response to the rapid escalation of the outbreak, the outbreak response team investigated the outbreak to identify possible risk factors and the impact of removing these factors on reducing the number of cases.

**Methods**

This is a population-based unmatched case-control study. A case of CL was defined as any person who showed clinical signs (skin or mucosal lesions) and was diagnosed by a dermatologist with CL. A control person was defined as any person (or family member) who was proved to be free of these skin or mucosal lesions. Controls were chosen preferentially according to the site where the cases occurred (from the neighboring house or village). The study was conducted in two conveniently selected districts in Diyala Province (Al-Muqadiya and Al-Mansuriya). Those two districts were selected as part of the on-job outbreak
investigation because surveillance data detected an increase in the number of CL cases in these areas, and those areas were in the recovery process after security instability. Approval for conducting the study was obtained from the Public Health Directorate/Ministry of Health and Diyala Directorate of Health. Oral consent was obtained from the cases and controls themselves or from their caretakers.

Field epidemiology training program students interviewed cases and controls using a modified questionnaire of the case investigation form of the zoonotic section of the Iraq Communicable Diseases Control Center. The questionnaire contained questions about the main demographic (age, sex, occupation), clinical (date of onset, signs and symptoms, presence of other cases within the family, treatment, previous visits, number and site of skin lesions), and epidemiological characteristics (displacement history, house and residency data [information about the type of residency area; house construction materials, such as wall type; electricity provided; animals living within the house; painting of indoor areas; presence of rodents inside or around the house]), sleeping habits, and preventive measures implemented in the area (fogging and use of bed nets).

A total of 866 persons were interviewed within the 717 families visited: 451 cases (292 from Al-Mansuriya District and 159 from Al-Muqdadiya District) and 415 controls (182 Al-Mansuriya District and 233 from Al-Muqdadiya District). However, we excluded 22 persons from the sample due to incomplete information. The final sample size used was 844 persons (cases=432, controls=412), with a ratio of almost 1 case to 1 control.

Univariate analysis was used to describe the study sample. Bivariate analysis was used to detect possible associations between each of the risk factors and the disease (CL) using the chi-square test of independence. The unadjusted odds ratio (OR) and 95% confidence interval of each risk factor were calculated using binary logistic regression. The attributable fractions and their corresponding 95% CIs were calculated for the modifiable risk factors. A $P$ value <.05 was considered statistically significant.

Epi Info, version 7.2 was used for data entry and SPSS, version 25 (IBM Corporation) was used for data analysis.

**Results**

Data from 844 persons (432 cases, 51.2%) were analyzed. There were no gender differences between cases and controls. Cases were more likely than controls to report a history of previous displacement, electricity supply for less than 12 hours per day, and living in a rural area. Regarding house characteristics, cases were more likely than controls to report living in a clay house, living in unpainted indoor areas, and the presence of rodents inside the house. As for animal ownership and the distances of the animals from the house, cases were more likely than controls to have chickens only, sheep only, or both and a mixture of animals (dogs and sheep or dogs and chickens) within a distance of less than 100 meters. Regarding possible preventive measures, cases were more likely to report fogging, bed net use, and sleeping outside or a mixture of inside and outside than controls.

Almost all the risk factors were statistically significantly associated with higher odds of having CL. Nevertheless, the strength of the association varied, as it was stronger (4 to 5 times higher odds of having CL) for factors such as displacement, having animals within 100 meters of the house, and sleeping outside the house. Factors that were associated with a 2 to 3 times increase in the odds of having CL included living in a clay house, having an unpainted indoor area, sleeping in a mixed pattern (inside and outside the house), having animals (whether chickens only, sheep only, or both, or mixtures of dogs and sheep or dogs and chickens), and, interestingly, using a bed net and fogging/unknown fogging status. In fact, the use of a bed net was associated with 72% higher odds of having CL in comparison to the lack of use of a bed net (OR 1.72, 95% CI 1.08-2.72). Likewise, fogging and unknown fogging status were associated with statistically significant 2-fold higher odds of having CL compared to no fogging ($P$<.001).

Regarding the impact of removing modifiable risk factors, our results show that approximately 70% to 80% of the cases were associated with displacement, the presence of rodents inside the house, the presence of animals within 100 meters of the house, the presence of animals (whether chicken only/sheep only/both or a mixture of dogs and sheep or dogs and chickens), and sleeping outside. Similarly, approximately 40% to 50% of the exposure of the cases was associated with living in a clay house; living in a rural area; having an unpainted indoor space; having an electricity supply for less than 12 hours per day; and, interestingly, using a bed net. Unexpectedly, approximately 10% to 20% of the exposed cases reported fogging or unknown fogging status. That is, fogging and unknown fogging status were negatively associated with the occurrence of CL.

The characteristics of the study sample are shown in Table 1. The risk factors for CL in the study population are summarized in Table 2.
Table 1. Characteristics of the study sample.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (N=844), n (%)</th>
<th>Cases, (n=432, 51.2%), n (%)</th>
<th>Controls (n=412, 48.8%), n (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cases</td>
<td>Controls</td>
<td></td>
</tr>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age group (years)</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>&lt;15</td>
<td>607 (71.9)</td>
<td>358 (82.9)</td>
<td>249 (60.4)</td>
<td></td>
</tr>
<tr>
<td>≥15</td>
<td>237 (28.1)</td>
<td>74 (17.1)</td>
<td>163 (39.6)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>.74</td>
</tr>
<tr>
<td>Male</td>
<td>437 (51.8)</td>
<td>226 (52.3)</td>
<td>211 (51.2)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>407 (48.2)</td>
<td>206 (47.7)</td>
<td>201 (48.8)</td>
<td></td>
</tr>
<tr>
<td>Residency</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Rural/semiurban</td>
<td>464 (55)</td>
<td>271 (62.7)</td>
<td>193 (46.8)</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>380 (45)</td>
<td>161 (37.3)</td>
<td>219 (53.2)</td>
<td></td>
</tr>
<tr>
<td>Characteristics</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Previous displacement</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>493 (58.4)</td>
<td>332 (76.9)</td>
<td>161 (39.1)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>351 (41.6)</td>
<td>100 (23.1)</td>
<td>251 (60.9)</td>
<td></td>
</tr>
<tr>
<td>Building material of the house</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Clay</td>
<td>117 (13.9)</td>
<td>81 (18.8)</td>
<td>36 (8.7)</td>
<td></td>
</tr>
<tr>
<td>Block/brick</td>
<td>727 (86.1)</td>
<td>351 (81.3)</td>
<td>376 (91.3)</td>
<td></td>
</tr>
<tr>
<td>Indoor space</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Not painted</td>
<td>178 (21.1)</td>
<td>117 (27.1)</td>
<td>61 (14.8)</td>
<td></td>
</tr>
<tr>
<td>Painted</td>
<td>666 (78.9)</td>
<td>315 (72.9)</td>
<td>351 (85.2)</td>
<td></td>
</tr>
<tr>
<td>Electricity supply (hours per day)</td>
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<tr>
<td>&lt;12</td>
<td>394 (46.7)</td>
<td>236 (54.6)</td>
<td>158 (38.3)</td>
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</tr>
<tr>
<td>≥12</td>
<td>450 (53.3)</td>
<td>196 (45.4)</td>
<td>254 (61.7)</td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dogs only</td>
<td>14 (1.7)</td>
<td>8 (1.9)</td>
<td>6 (1.5)</td>
<td></td>
</tr>
<tr>
<td>Chickens only/sheep only/both</td>
<td>254 (30.1)</td>
<td>169 (39.1)</td>
<td>85 (20.6)</td>
<td></td>
</tr>
<tr>
<td>Mixture of dogs and sheep or dogs and chickens</td>
<td>134 (15.9)</td>
<td>93 (21.5)</td>
<td>41 (10)</td>
<td></td>
</tr>
<tr>
<td>No animals</td>
<td>442 (52.4)</td>
<td>162 (37.5)</td>
<td>280 (68)</td>
<td></td>
</tr>
<tr>
<td>Distance of animals from house (meters)a</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>All</td>
<td>436 (51.7)</td>
<td>301 (69.7)</td>
<td>135 (32.8)</td>
<td></td>
</tr>
<tr>
<td>&lt;100</td>
<td>305 (70)</td>
<td>253 (84.1)</td>
<td>52 (38.5)</td>
<td></td>
</tr>
<tr>
<td>100-300</td>
<td>111 (25.4)</td>
<td>39 (13)</td>
<td>72 (53.3)</td>
<td></td>
</tr>
<tr>
<td>&gt;300</td>
<td>20 (4.9)</td>
<td>9 (3)</td>
<td>11 (8.1)</td>
<td></td>
</tr>
<tr>
<td>Presence of rodents in the house</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>648 (76.8)</td>
<td>388 (89.8)</td>
<td>260 (63.1)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>196 (23.2)</td>
<td>44 (10.2)</td>
<td>152 (36.9)</td>
<td></td>
</tr>
<tr>
<td>Use of fogging</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>127 (15)</td>
<td>85 (29)</td>
<td>42 (10.2)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>220 (26.1)</td>
<td>104 (24.1)</td>
<td>116 (28.2)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>497 (58.9)</td>
<td>243 (56.3)</td>
<td>254 (61.7)</td>
<td></td>
</tr>
<tr>
<td>Use of bed net</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Total (N=844), n (%)</td>
<td>Cases, (n=432, 51.2%), n (%)</td>
<td>Controls (n=412, 48.8%), n (%)</td>
<td>P value</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>----------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Yes</td>
<td>108 (12.7)</td>
<td>55 (12.7)</td>
<td>53 (12.8)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>127 (15)</td>
<td>67 (15.5)</td>
<td>60 (14.5)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>609 (72.3)</td>
<td>310 (71.7)</td>
<td>299 (72.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Sleeping habits</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Inside the house</td>
<td>668 (79.1)</td>
<td>318 (73.6)</td>
<td>350 (84.9)</td>
<td></td>
</tr>
<tr>
<td>Outside the house</td>
<td>19 (2.2)</td>
<td>15 (3.6)</td>
<td>4 (1)</td>
<td></td>
</tr>
<tr>
<td>Inside/outside the house</td>
<td>157 (18.6)</td>
<td>99 (22.9)</td>
<td>58 (14.1)</td>
<td></td>
</tr>
</tbody>
</table>

*Percentages in this category are calculated based on the “All” values.

### Table 2. The odds ratios, attributable fractions, and 95% confidence intervals of the modifiable risk factors.

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Odds ratio (95% CI)</th>
<th>Attributable fraction (%) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>5.18 (3.84 to 6.98)</td>
<td>80.6 (73.7 to 85.8)</td>
</tr>
<tr>
<td>Clay house</td>
<td>2.41 (1.59 to 3.66)</td>
<td>58.5 (36.7 to 72.7)</td>
</tr>
<tr>
<td>Residence in rural region</td>
<td>1.91 (1.45 to 2.51)</td>
<td>47.6 (31 to 60.1)</td>
</tr>
<tr>
<td>Unpainted interior</td>
<td>2.14 (1.51 to 3.02)</td>
<td>53.3 (33.8 to 66.9)</td>
</tr>
<tr>
<td>Electricity for &lt;12 hours per day</td>
<td>1.94 (1.47 to 2.55)</td>
<td>48.30 (31.9 to 60.8)</td>
</tr>
<tr>
<td><strong>Animals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dogs only</td>
<td>2.30 (0.79 to 6.76)</td>
<td>56.5 (~28.2 to 85.2)</td>
</tr>
<tr>
<td>Chickens only/sheep only/both</td>
<td>3.44 (2.48 to 4.75)</td>
<td>70.9 (59.7 to 78.9)</td>
</tr>
<tr>
<td>Mixture of dogs and sheep or dogs and chickens</td>
<td>3.92 (2.59 to 5.94)</td>
<td>74.5 (61.4 to 83.2)</td>
</tr>
<tr>
<td>Distance of animals from the house (meters)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;100</td>
<td>5.95 (2.35 to 15.07)</td>
<td>83.2 (57.4 to 93.4)</td>
</tr>
<tr>
<td>100-300</td>
<td>0.66 (0.25 to 1.73)</td>
<td>–51.5 (~3 to 42.1)</td>
</tr>
<tr>
<td>Presence of rodents in the house</td>
<td>5.15 (3.56 to 7.47)</td>
<td>80.6 (71.9 to 86.6)</td>
</tr>
<tr>
<td><strong>Use of fogging</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2.11 (1.40 to 3.19)</td>
<td>52.6 (28.6 to 68.6)</td>
</tr>
<tr>
<td>Unknown</td>
<td>2.25 (1.43 to 3.56)</td>
<td>55.5 (30.1 to 71.9)</td>
</tr>
<tr>
<td><strong>Use of bed net</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1.72 (1.08 to 2.72)</td>
<td>41.9 (7.4 to 63.2)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1.49 (0.86 to 2.60)</td>
<td>32.9 (~16.3 to 61.5)</td>
</tr>
<tr>
<td><strong>Sleeping habits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside the house</td>
<td>4.01 (1.32 to 12.19)</td>
<td>75.1 (24.2 to 91.8)</td>
</tr>
<tr>
<td>Inside/outside the house</td>
<td>2.07 (1.43 to 3)</td>
<td>51.7 (30.1 to 66.7)</td>
</tr>
</tbody>
</table>

### Discussion

**Principal Findings**

To our knowledge, this is the first large population-based case-control study performed in Iraq to determine the risk factors of CL and the impact of changing modifiable risk factors. We identified the main domestic and behavioral characteristics associated with increasing the odds of contracting CL, which provides a guide for preventive and control measures. The main modifiable risk factors were displacement, having animals within 100 meters of the house, and sleeping outside the house. In fact, the exposure of 70% to 80% of the cases was associated with displacement, animals in the house, animals within 100 meters of the house, and sleeping outside. In contrast, preventive measures, such as bed net use and fogging, were not successful in preventing CL, as both were associated with increased odds of having CL. In fact, assuming a causal relationship and no bias, the data show that approximately 42% of the cases who used a bed net and 10% of the cases who reported fogging would not have contracted CL if they had not used bed nets or fogging. This finding could be explained by...
inappropriate timing of fogging, that is, fogging occurred after people returned to liberated areas and had already been bitten by sand flies. In addition, fogging may have been performed in the afternoon, when sand flies are inactive, and the flies were consequently not affected. Bed net use was also not an effective measure of preventing CL, possibly because the patients went to bed late, when the sand flies were not active, and therefore had already been bitten.

The findings in our study regarding displacement, poor housing conditions, and sleeping outside the house agree with findings from studies of risk factors in developing and developed countries [15],[16] (retracted), [17]. Displacement increases individuals’ risk of exposure to environmental and personal risk factors of developing CL. In addition, areas from which people are displaced, usually war zones, provide a suitable culture for the growth of both vectors and reservoirs of CL because of the accumulation of wastes and the destruction of infrastructure, such as sewage systems [7]. These findings suggest that preventing CL requires a multifaceted approach that focuses on modifying environmental, domestic, and peridomestic characteristics and on changing human behaviors. Our findings are similar to findings from studies of risk factors of CL in Morocco [18,19], Spain [20], and Ghana [20].

Our study has several strengths. First, it is the first large population-based case-control study of a leishmaniasis outbreak. We identified the main risk factors and their attributable fractions, providing an estimate of the public health impact of the disease. In addition, the findings from our study help to guide preventive and control measures as to the timing of fogging, keeping animals outside houses, painting indoors, and sleeping inside houses.

Our study also has a few limitations. First, the duration of the study was limited, as all data were collected in only 4 days; this led to missing information for some of the variables in the original sample, and they were thus excluded. Second, two important variables were missed, namely, time of fogging and time of sleep, which led us to hypothesize that both actions were undertaken at the wrong time and consequently both surfaced as risk factors rather than preventive factors for the disease. Third, the hazardous security situation limited the movement of the team to only safe areas, which could have obscured other risk factors we are not aware of. Finally, no species were identified from the patients, reservoirs, or vectors to establish the linking of the transmission cycle; therefore, the link is only epidemiologic. None of these limitations could have affected findings from our study; nevertheless, they are worth mentioning to direct future studies in Iraq regarding variables to consider.

Conclusions and Recommendations
CL is an important public health problem in Iraq, especially in Diyala Province. Most of the cases in our study could have been prevented if they were not exposed to displacement, animals inside the house, animals within 100 meters of the house, or rodents in the house. In addition, the timing of fogging and using bed nets is an important consideration. Prevention and control of CL require a multifaceted approach that relies on changing environmental conditions, housing conditions, and human behavior. Fogging and bed net use were not effective because the underlying housing characteristics and human behavior provided a good culture for the disease.

We recommend conducting a study to identify the species, reservoirs, and vectors of CL in Iraq, studying vector behaviors before applying environmental control measures, and educating the public on how and when to use bed nets and accompany their use with behavioral changes, such as using insect repellents and wearing long sleeves. Furthermore, we recommend studying vector and reservoir behaviors before implementing control measures. In addition, we recommend implementing preventive measures, such as fogging and rodent control, in abandoned areas before people resettle after displacement.

Acknowledgments
This study was funded for transportation and data collection by the Eastern Mediterranean Public Health Network (EMPHNET). We thank them for their financial support of this study.

Conflicts of Interest
None declared.

References


Abbreviations

CL: cutaneous leishmaniasis
EMPHNET: Eastern Mediterranean Public Health Network
OR: odds ratio
This is a peer-review report submitted for the paper “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study.”

Round 1

General Comments
This paper [1] presents a comparison of the limited modified early warning score (LMEWS) versus the standard MEWS in their ability to predict in-hospital mortality in Ghana. The authors demonstrate that LMEWS is a good predictor of in-hospital mortality, especially in lower-resource health care settings.

The study is well executed and well written, but I am not sure whether it aligns with the scope of JMIRx Med—this is a purely clinical study relevant to a public health or anesthesiology journal.

Specific Comments

Major Comments
My main comments are about the methodology of the article:

1. There is no explanation on how the study size was arrived at.
2. It is not clearly described whether there any missing data and how they were handled.
3. It is not clear whether there was an attempt at a blind assessment of the predictors.
4. A flow chart of the patients in the study is absent, including the time of follow-up with patients.
5. The ethics considerations were not sufficiently addressed. What kind of approval was obtained for the retrospective secondary use of data? Minors (patients were aged 13 years and older) were also included so the question of assent is also relevant here.

Round 2

General Comments
This paper [1] presents an interesting observation on the predictive ability of the modified early warning score on in-hospital mortality among critically ill patients.

The revised manuscript addresses some of the concerns, but I am not sure that all of them are satisfactorily answered.

Specific Comments

Major Comments
1. All reviewers expressed concerns about the sample size, and it is still not clear whether the sample size was calculated before the study. The response was that the sample size was calculated to be 82 participants, but it is not clear whether this was for the whole study (all 4 groups in the flow chart representing the flow of participants) or for individual groups. Also, there was a disbalance between the size of the 4 groups (81 with a nonsignificant MEWS and 31 with a significant MEWS, and 79 with a nonsignificant LMEWS and 33 with a significant LMEWS).
2. The question about missing data was addressed, and there was only a single case of missing data.
3. The blinding of the assessor was not performed. Although the authors argue that it was not necessary, it is an important methodological tool to address biases in analyses.

4. I am not satisfied with the response regarding the ethics approval of the study. It is not clear whether the patients or their parents consented to the inclusion of data collected during medical procedures in a research study.

Conflicts of Interest
None declared.

Reference
Peer Review of “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study”

John Mogaka

1Department of Public Health Medicine, University of KwaZulu Natal, Durban, South Africa
2Research Xcellas, Durban, South Africa

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Companion article: https://med.jmirx.org/2021/3/e24645/

(JMIRx Med 2021;2(3):e30785) doi:10.2196/30785

KEYWORDS
modified early warning score; MEWS; AVPU scale; Korle-Bu Teaching Hospital; KBTH; Ghana; critical care; vital signs; global health

This is a peer-review report submitted for the paper “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study.”

Round 1

General Comments
This study [1] is about a measure of illness severity that can potentially promote the early detection of clinical deterioration in critically ill patients. More specifically, the study investigated in-hospital mortality and the predictive ability of a modified early warning score (MEWS) in Ghana. By employing receiver operating characteristic (ROC) curves and other statistical techniques, the authors validated a limited MEWS (LMEWS). Finding a promising measure of instances of clinical deterioration is valuable for the timely and proper management of acute deterioration events in clinical settings. Though this paper seems to have made contributions to the medical field, there are some issues worthy of consideration.

Specific Comments

Major Comments
1. One of the main concerns about this study is that the sample size is relatively small (N=112) for a national referral hospital in Ghana. Authors should provide more evidence on whether the sample and size were representative of the target population. Relatedly, since the authors state that they recruited practically all medical inpatients hospitalized for a period of more than 2 years (January 2017 to March 2019), it would be good to provide the total recorded number of in-hospital patients for that period.
2. In making the case for the validity of LMEWS, the authors have relied heavily on the afferent arm of clinical deterioration in critically ill patients, while not accounting for the efferent arm of medical response. The afferent arm identifies patients at risk of clinical deterioration and activates the efferent arm if necessary. The efferent arm examines the patients and intervenes in the treatment. The functioning of the efferent arm in the study settings ought to have been discussed in drawing up the conclusion and recommendation of the LMEWS.

Conflicts of Interest
None declared.

Reference
https://xmed.jmir.org/2021/3/e30785

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JMIRx Med 2021;2(3):e30785
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doi: 10.2196/30785
PMID:
Peer Review of “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study”

Lincoln Sheets1, MD, PhD
School of Medicine, University of Missouri, Columbia, MO, United States

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- Companion article: https://med.jmirx.org/2021/3/e24645/


**KEYWORDS**
modified early warning score; MEWS; AVPU scale; Korle-Bu Teaching Hospital; KBTH; Ghana; critical care; vital signs; global health

This is a peer-review report submitted for the paper “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study”

**Round 1**

**General Comments**
This paper [1] describes a study of the modified early warning score (MEWS) and the limited MEWS (LMEWS) instruments for predicting mortality in a tertiary hospital in Ghana.

**Specific Comments**

**Major Comments**
1. The two objectives were not described precisely nor were they carefully tied to the methodology. For example, the first objective refers to both “prediction” and “detection” of “deterioration.” It is not clear whether the methodology measures prediction or detection, and it is not clear how deterioration is defined. Mortality is prominent in the results, so this paper might be using mortality as a synonym of deterioration, but that is not clear. In addition, both objectives refer to MEWS, but the results give equal attention to MEWS and LMEWS; it is not clear whether LMEWS is a synonym for the “physiologic measures currently monitored” in the second objective statement; otherwise, LMEWS should be added to both objective statements along with MEWS. In either case, “physiologic measures currently monitored” should be carefully and clearly defined before being used in a statement of objectives.
2. Several statistical measures and tests were reported without being described or explained. I am familiar with some of them, such as the C-statistic, but a reader who is not would need some context for the numbers 0.838 and 0.833—something along the lines of, “where 1.000 means perfect accuracy and 0.500 means perfectly random associations (or ‘the flip of a coin’).” I am not able to suggest explanations for the Pearson chi-square value or the Hosmer-Lemeshow goodness-of-fit test, or the P value of the Hosmer-Lemeshow goodness-of-fit test because I am not familiar with this particular measure. Unfortunately, the reporting of the results did not explain the measure at all.
3. The order of MEWS and LMEWS results is completely inconsistent; please always report LMEWS before MEWS or always report MEWS before LMEWS.

**Minor Comments**
1. The grammar and punctuation should be edited throughout; for example, the second sentence of the Abstract contains an extraneous semicolon, and the third sentence of the Abstract contains an extraneous comma.
Conflicts of Interest
None declared.

Reference
Peer Review of “The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis”

Anonymous

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*JMIRx Med 2021;2(3):e31416* doi:10.2196/31416

**KEYWORDS**
COVID-19; health information; informational support; online health; online health communities; online platform; pandemic; social support

This is a peer-review report submitted for the paper “The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis”.

**Round 1 Review**

**General Comments**

My comments are as follows:

1. The authors [1] did not review relevant existing works carefully. A number of studies on online health communities (OHCs) have been conducted already. You should compare your results with these relevant works.

2. Although you have mentioned that one coder is a limitation, it is an evitable limitation and needs to be overcome, or how can you ensure the accuracy of the results? I suggest that the authors recode the posts and responses by two coders (at least) who are familiar with this field.

3. What are the criteria by which you determine the name of the coding and the definition of the coding?

**Conflicts of Interest**

None declared.

**Reference**

Peer-Review Report

Peer Review of “The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis”

Reem El Sherif¹, MSc, MBBCh
Department of Family Medicine, McGill University, Montreal, QC, Canada

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(JMIRx Med 2021;2(3):e31423) doi:10.2196/31423

KEYWORDS
COVID-19; health information; informational support; online health; online health communities; online platform; pandemic; social support

This is a peer-review report submitted for the paper “The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis”.

Round 1 Review

General Comments
This paper [1] describes an interesting and very important study on the contents of an online health community (OHC) on COVID-19. The authors conducted a content analysis of the community posts in an online health information platform and provide recommendations for public health responses during this, and future, pandemics. I believe this is very important work.

I provide some feedback that would potentially strengthen the paper and improve its readability for the journal audience.

Specific Comments

Major Comments
1. There are some issues with the references: the order needs to be revised, eg, the first reference is number 8.

2. In the fourth paragraph of the introduction (starting with “Although social support…”), there are no references to which definitions of social support or information needs or information seeking are used by the authors. In fact, there appears to be some overlap between these three concepts in this paragraph, while they are actually three distinct concepts in the literature. I would suggest the authors familiarize themselves with some of the seminal work on information-seeking behavior by Wilson and Bates and on social support by Tardy and Barrera:


3. The section titled Prior Work was difficult to read; it lacks organization and coherence. I was unsure what points the authors were making since it seemed to be just a summary of the existing literature without any synthesis of the findings. Perhaps this section can be divided into two subsections: “Social support in OHCs” and “Information needs during the pandemic,” or something similar. The authors can identify the clear knowledge gaps at the end that their study is addressing.

4. In the Methods section, can the authors provide some detail on who did the coding and how the codebooks in Tables 1 and 2 were developed? It is only in the Limitations section that we discover it was one coder; were other researchers perhaps involved in the development of the codebook, was it tested and revised, was the coding checked, etc?

5. In the Results section, the authors state “Those who were in a position to offer information had a significantly higher percentage of responding more than once (P < 0.001).” Can
they provide more explanation on how they defined “being in a position to offer information” and how the information was derived from the posts or user profiles?

6. Were there any incidences of emotional support in the posts? Their presence (or lack thereof) would be an interesting point to add if possible.

7. In the Discussion section, it may be interesting to contrast these findings with those reported in other studies in different contexts.

Minor Comments

8. The whole paper might benefit from professional editorial revision. In the first paragraph of the Introduction, for example, I would suggest revising “trauma in the” to “trauma among healthcare workers” and revising “becomes” to “become increasingly important”.

9. On page 5, “namely sliding-ONMF and rolling-ONMF” is used with no explanation.

10. In the Methods section, a short summary of MedHelp would perhaps be helpful for the journal’s international readers.

11. Do the authors perhaps mean “Types of information seeking topics” for Table 1?

12. Perhaps the authors can reference the method they used for analysis (qualitative content analysis)?

Round 2 Review

General Comments
The authors have addressed all the previous comments made, and the paper is much more coherent and relevant. I especially appreciate the additional section on prior work and the detail added to the methods section for clarity.

The manuscript may still require some professional editing; there are some minor grammatical errors that could be addressed.

Conflicts of Interest
None declared.

Reference

Abbreviations

OHC: online health community

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Authors’ Responses to Peer Reviews of “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study”

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Companion article: https://med.jmir.org/2021/3/e30763/
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KEYWORDS
modified early warning score; MEWS; AVPU scale; Korle-Bu Teaching Hospital; KBTH; Ghana; critical care; vital signs; global health

This is the authors’ response to peer-review reports for “In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study.”

Round 1

The authors of the manuscript [1] are grateful to the editor and reviewers [2-4] for their invaluable input and feedback.
Reviewer AK

Major Comments
1. Thank you for your suggestion. We have simplified the statement of the objectives and have clarified the motivation for the study in the background, including explaining why both the modified early warning score (MEWS) and the limited MEWS (LMEWS) are included. We have revised the objectives both in the Abstract and in the main text. Mortality has been specified as the measured outcome of clinical deterioration and MEWS and LMEWS as the predictors. The Methods section has been clarified to explain the relationship between MEWS and LMEWS.
2. Thank you for your suggestion. We have modified the Methods section to make the statistical approach clearer to readers.
3. Thank you for your valuable suggestion. In all instances where comparisons are made, we have proceeded with MEWS followed by LMEWS, in that order.

Minor Comments
1. Thank you for your suggestion. We have addressed all grammatical errors.

Reviewer BO

Major Comments
1. Thank you for your suggestion. We have included a power and sample size calculation in the statistical analysis (see above response to Reviewer AK [2]). Typically, patients are discharged in possession of their paper health records (electronic health records are not used, limiting study size), accounting for the smaller number of available records; we clarified this as well. However, the power calculation puts the number we were able to review in context as being 50% more than would have been needed for a significant result.
2. Thank you for drawing our attention to the lack of emphasis on the efferent arm in the study. In fact, there is no rapid response team and therefore response to deterioration is not standardized. Thus, there may be biases in the survival (eg, sicker patients getting less attention because of their perceived poor prognosis). We have now included this in the discussion of the limitations of the study.

Reviewer CM

Major Comments
1. Thank you for allowing us to clarify the sample size question. The study proposal submitted to the IRB required a mandatory sample size calculation. As such, this was calculated a priori based on a publication by Kyriacos et al [5]. Based on this study, a power of 80% to detect clinical deterioration in postoperative inpatients, with a significance level of .05 and a delta value of 0.45, will give us a minimum sample size of 46. A post-data collection power analysis was also performed, based on a chi-square test comparing two independent proportions. Based on the resulting analytic sample of 112 participants, with 31 in the significant MEWS category and 81 in the nonsignificant MEWS category, our study achieves a power of 95% to detect a difference in outcome percentages of at least 37% between these two groups.
2. Thank you.
3. Thank you for your suggestion. As with all retrospective study designs, the measurement of outcomes occurred prior to the start of the study; as such, we had no control over how assessments were made including choice of measurement tools, whether tools were valid and reliable, and how results were interpreted and recorded. Blinding of outcome assessors serves to limit detection bias, but this was unemployable in our retrospective chart review, and the determination of which predictors to use in our analysis is based solely on the conceptual framework described in Figure 1.
4. Thank you for your ethical concerns and the effort to maintain the highest standards in clinical research. The confidential nature of patient information, protection of anonymity, and consent are paramount in record reviews; as such, ethical approval was obtained from the Institutional Review Boards (IRB) of Johns Hopkins University and the Korle-Bu Teaching Hospital (KBTH), and clearance was obtained from the Scientific and Technical Committee of the KBTH. Although reporting was anonymous, patients’ records were not, so the researchers involved in data collection and handling needed to sign a confidentiality clause. This is now captured in the Methods section. Data access is limited to me; I abstracted the data and ran the study analysis for a limited duration.

Round 2

Reviewer CM

Major Comments
1. Thank you for your observation. The maximum duration of follow-up was 32 days (included in the first paragraph of the Methods). We have included a flow chart of how the cohort was generated (Figure 2).
2. Thank you for your concern. The confidential nature of patient information, the protection of anonymity, and consent are paramount in record reviews; as such, ethical approval was obtained from the Institutional Review Boards (IRB) of Johns Hopkins University and the Korle-Bu Teaching Hospital (KBTH), and clearance was obtained from the Scientific and Technical Committee of the KBTH. Although reporting was anonymous, patients’ records were not, so the researchers involved in data collection and handling needed to sign a confidentiality clause. This is now captured in the Methods section. Data access is limited to me; I abstracted the data and ran the study analysis for a limited duration.
anonymity, and consent are paramount in record reviews; as such, ethical approval was obtained from the IRB of Johns Hopkins University and the KBTH, as well as clearance from the Scientific and Technical Committee of the KBTH. In addition, we received a “waiver of documented (signed) permission,” which waives the requirements to obtain documented (signed) parent or guardian permission under the same conditions that apply to waiving signed consent from adult subjects. Documentation of assent and permission for adolescents 13 to 17 years of age involves being fully informed about a study and giving a signed assent to participation in a research study. They are, however, equally subject to a waiver of signed permission.

References

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Peer-Review Report

Authors’ Response to Peer Reviews of “The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis”

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KEYWORDS
COVID-19; health information; informational support; online health; online health communities; online platform; pandemic; social support

This is the authors’ response to peer-review reports for “The Exchange of Informational Support in Online Health Communities at the Onset of the COVID-19 Pandemic: Content Analysis”.

Round 1 Review

Responses to Editors
M. Addressed [1].
Q. Addressed.
U. Addressed.

Reviewer AB [2]

Specific Comments

Major Comments
1. Addressed.
2. Addressed.
3. Addressed.
4. Addressed.
5. Addressed. What we were trying to convey is that people who offered information were more likely to post more than once judging by their action of responding to others’ information requests.
6. Emotional support is an interesting topic, but it is out of the scope of this study.
7. We are unable to address this comment at this moment, as studies on other public health emergencies with comparable findings are limited.

Minor Comments
8. Addressed.
10. Addressed.
11. Addressed.

Anonymous [3]:

General Comments
1. Addressed.
2. We are unable to address this comment at this moment.
3. Please refer to the Methodology section, where previous studies on which our coding ontology is based are cited.

References

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In-hospital Mortality and the Predictive Ability of the Modified Early Warning Score in Ghana: Single-Center, Retrospective Study

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Abstract

Background: The modified early warning score (MEWS) is an objective measure of illness severity that promotes early recognition of clinical deterioration in critically ill patients. Its primary use is to facilitate faster intervention or increase the level of care. Despite its adoption in some African countries, MEWS is not standard of care in Ghana. In order to facilitate the use of such a tool, we assessed whether MEWS, or a combination of the more limited data that are routinely collected in current clinical practice, can be used predict to mortality among critically ill inpatients at the Korle-Bu Teaching Hospital in Accra, Ghana.

Objective: The aim of this study was to identify the predictive ability of MEWS for medical inpatients at risk of mortality and its comparability to a measure combining routinely measured physiologic parameters (limited MEWS [LMEWS]).

Methods: We conducted a retrospective study of medical inpatients, aged ≥13 years and admitted to the Korle-Bu Teaching Hospital from January 2017 to March 2019. Routine vital signs at 48 hours post admission were coded to obtain LMEWS values. The level of consciousness was imputed from medical records and combined with LMEWS to obtain the full MEWS value. A predictive model comparing mortality among patients with a significant MEWS value or LMEWS ≥4 versus a nonsignificant
MEWS value or LMEWS < 4 was designed using multiple logistic regression and internally validated for predictive accuracy, using the receiver operating characteristic (ROC) curve.

**Results:** A total of 112 patients were included in the study. The adjusted odds of death comparing patients with a significant MEWS to patients with a nonsignificant MEWS was 6.33 (95% CI 1.96-20.48). Similarly, the adjusted odds of death comparing patients with a significant versus nonsignificant LMEWS value was 8.22 (95% CI 2.45-27.56). The ROC curve for each analysis had a C-statistic of 0.83 and 0.84, respectively.

**Conclusions:** LMEWS is a good predictor of mortality and comparable to MEWS. Adoption of LMEWS can be implemented now using currently available data to identify medical inpatients at risk of death in order to improve care.


**KEYWORDS**
modified early warning score; MEWS; AVPU scale; Korle-Bu Teaching Hospital; KBTH; Ghana; critical care; vital signs; global health

**Introduction**
Critical illness is a leading cause of morbidity and mortality in sub-Saharan Africa, including Ghana [1]. Low- and middle-income countries have a disproportionately higher burden of critical illness with over 90% of global maternal deaths and deaths from trauma and infections [1-3]. In Ghana, the critical care burden is high. Historically, financial investment has been skewed toward primary health care. Less commitment to critical care means that resources for intensive medical care are limited, and their thought-out and appropriate allocation is important [4].

One of the main reasons why patients deteriorate and die in hospitals is delayed recognition of illness severity in understaffed inpatient wards. Early warning tools to help identify patients at the highest risk of death could help countries like Ghana with resource allocation and clinical decision making (Figure 1).

**Figure 1.** Conceptual framework showing predictors of in-hospital mortality and the role of the modified early warning score (MEWS) among ill patients.

Multiple studies have shown that critical illness and serious adverse events in hospitalized patients are preceded by signs of clinical deterioration in up to 80% of those affected [5-8]. Therefore, changes in physiological parameters can be used to predict adverse events such as shock, cardiac arrest, death, and unplanned intensive care unit (ICU) admissions [9].

MEWS is a commonly used illness severity score that is calculated by combining five physiologic bedside parameters: systolic blood pressure, heart rate, respiratory rate, temperature, and level of consciousness assessed by the AVPU (alert, [responds to] voice, [responds to] pain, unresponsive) scale or RASS (Richmond Agitation Sedation Scale) score. These four
vital signs and the observation of consciousness are individually scored and summed to yield a combined score between 0 and 14, with higher scores representing increased illness severity.

In a systematic review conducted by Smith et al [10] in 2014, early warning scores, including MEWS, had strong predictive ability for death and cardiac arrest within 48 hours in academic urban hospitals in economically advanced countries. Early warning scores have also been shown to provide precise, concise, and unambiguous means of identifying and communicating about clinical deterioration to help clinical staff provide special attention and care to patients who need it most (justifiable appropriation of care) [11]. As a result, scoring systems such as MEWS have been adopted in most developed countries and some African countries [12-14].

This study sought to validate the use of MEWS as a clinical decision-making tool to improve early identification of hospitalized medical patients at increased risk for death in Ghana. In addition, since level of consciousness is not routinely recorded in current clinical practice, we aimed to investigate the predictive utility of a limited MEWS (LMEWS) calculation based on vital signs alone. Most studies in similar settings have found that the level of consciousness is generally high (ie, the patient is well oriented) even when other aspects of the MEWS value are abnormal [2]. We therefore hypothesized that the physiologic data currently being monitored in Ghana may be sufficient to improve the early detection of critical illness and help guide resource allocation among inpatients in this setting.

**Methods**

**Study Design and Population**

This was a retrospective chart review study of hospitalized medical patients, aged ≥13 years, admitted to the Korle-Bu Teaching Hospital in Accra, Ghana. The Korle-Bu Teaching Hospital is the national hospital of Ghana and the leading tertiary care referral center in the country [15]. Medical inpatients hospitalized there for at least 48 hours whose medical records were still available from the period of January 2017 to March 2019 were included in the study. During this period, the standard practice was to discharge patients in possession of their written medical records; copies were not often retained. This practical limitation accounts for the smaller study size than might be expected for a tertiary facility. Pediatric patients, defined as those aged less than 13 years of age by the Ghana Ministry of Health guidelines, were not included. Patients with more than one hospital admission in the past month, or those who were admitted for conditions other than medical ones, were also excluded (Figure 2). The maximum in-hospital stay was 32 days, and no follow-up data were collected post discharge.
Demographic data were collected to analyze covariates. Patients' vital signs recorded at 48 hours after admission were recoded and scored to generate the LMEWS value, using thresholds as previously described (Table 1) [2]. To compare the utility of LMEWS with the full MEWS in the absence of routine observation of consciousness and recording of AVPU scores, we generated a full MEWS value using imputation by randomly assigning 92% of the sample to a status of “alert” (AVPU score=0) and the rest to scores between 1 and 3. These percentages were determined based on the findings of a study by Subbe et al [2], which used a similar patient population.

Our study was based on the conceptual framework depicted in Figure 1, which identifies correlational patterns of how different events and experiences may predict mortality in a hospitalized patient. A predictive model was designed using multivariable logistic regression and validated for model accuracy to compare patients with significant MEWS to patients with nonsignificant MEWS, where a significant MEWS was defined as a score ≥4, and a nonsignificant MEWS was defined as a score <4 in the absence of the AVPU [3,16,17]. This cut-off did not vary for the LMEWS versus MEWS values since for most individuals the level of consciousness is normal and therefore contributes 0 points to the total MEWS value.

Due to the confidential nature of patient information, and the need to protect anonymity and obtain consent during health record reviews, ethical approval and waiver of documented permission was obtained from the Institutional Review Board (IRB) of Johns Hopkins University, and from the Scientific and Technical Committee (KBTH-STC 00017/2019) and the IRB of the Korle-Bu Teaching Hospital. Although reporting was anonymous, patients’ records were not, so researchers involved in data collection and handling also signed a confidentiality clause.
Table 1. Scoring scale for the modified early warning score (MEWS) adopted form Subbe et al [2].

<table>
<thead>
<tr>
<th>Physiological parameter</th>
<th>MEWS value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>&lt;70, 71-80, 81-100, 101-199, ≥200</td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>41-50, 41-50, 51-100, 101-110, 111-129, ≥130</td>
</tr>
<tr>
<td>Respiratory rate (cpm)</td>
<td>9-14, 15-20, 21-29, ≥30</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>35-38.4, ≥38.5</td>
</tr>
<tr>
<td>AVPU score</td>
<td>Alert, Reacting to voice, Reacting to pain, Unresponsive</td>
</tr>
</tbody>
</table>

Statistical Analysis

Data were analyzed using STATA (version 15.1, StataCorp LLC). The estimated sample size was determined a priori based on work by Kyriacos et al [18], which yielded a minimum sample size of 46 based on a significance level of .05, delta value of 0.45, and power of 80% to detect clinical deterioration in postoperative patients using MEWS. Post-data collection power analysis was also performed, based on a chi-square test comparing two independent proportions. Based on the resulting analytic sample of 112 participants, with 31 in the significant MEWS category and 81 in the nonsignificant MEWS category, our study achieves a power of 95% to detect a difference in outcome percentages of at least 37% between these two groups. Testing for associations with survival to discharge versus in-hospital mortality was conducted using a two-sample t test for each of the individual continuous physiological parameters. The chi-square test was used to test for differences in the proportion of patients with each outcome in the categories of significant versus nonsignificant MEWS and LMEWS. Univariable log-binomial regression analysis was used to estimate unadjusted risk ratios between each predictor and mortality. Multivariable Poisson regression with robust variance was used due to the failure of convergence of the log-binomial regression model. Logistic regression analysis (odds ratio [OR]) was used to identify an appropriate predictive model. A P value of <.05 was considered statistically significant. The accuracy of the prediction model was determined using the receiver operating characteristic (ROC) curve and C-statistic (where a C-statistic of 0.5 implies the model performs no better than random chance and a score of 1.00 perfectly discriminates between categories). Adjustment was made for the following potential confounders: age, sex, duration of admission, admission to the ICU, presence or absence of other comorbidities, and the organ system involved in the disease process. The Hosmer-Lemeshow test was used to determine model fit for both the MEWS and LMEWS models, with P values ≥0.05 implying satisfactory fit. A sensitivity analysis was done using a cut-off of ≥5 to distinguish significant from nonsignificant MEWS and LMEWS values. Missing values were limited to the reason for admission (organ system) and represented <1% (1/112).

Results

The sample comprised 112 patients admitted for medical reasons during the study period. Of these, 62% (69/112) were male with a mean age of 47 years (SD 17.5), and 38% (43/112) were female with a mean age of 52 years (SD 20) (Table 1). Overall mortality was 41.1% (46/112) and increased with age. Every year increase in age was associated with a 3% increase in mortality rate after adjusting for MEWS (IRR [incidence rate ratio]=1.03, 95% CI 1.02-1.04). For patients who survived, the most common admission diagnoses were genitourinary system abnormalities (17/65, 26.2%), whereas neurologic conditions were most common among patients who died (18/46, 39%). The longest length of in-hospital stay was 32 days, with an average of 8 days. At 48 hours post admission, patients’ mean systolic blood pressure was 125 mmHg (SD 2.9), average pulse rate was 91 mmHg (SD 2), mean axillary temperature was 36.9°C (SD 0.1), and average respiratory rate was 24 cpm (SD 4.7). Only temperature and respiratory rate were individually associated with mortality (Table 2). Physiological parameters measured at 48 hours produced an average LMEWS value of 3 (range 0-11). Imputation of randomly assigned AVPU values increased mean scores by 8% overall, producing an average MEWS of 3 (range 0-14).

A significant MEWS was associated with a relative risk of 2.01 (95% CI 1.33-3.04) for death in the univariable analysis, while a significant LMEWS had a relative risk of 2.19 (95% CI 1.46-3.30) in the univariable analysis (Table 3).
Table 2. Showing baseline characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Survival to discharge (n=66)</th>
<th>Death in hospital (n=46)</th>
<th>P value(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male), n (%)</td>
<td>45 (68.2)</td>
<td>24 (52.2)</td>
<td>.09</td>
</tr>
<tr>
<td>Age (years), n (%)</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>25-64</td>
<td>46 (69.7)</td>
<td>27 (58.7)</td>
<td></td>
</tr>
<tr>
<td>≥65</td>
<td>7 (10.6)</td>
<td>18 (39.1)</td>
<td></td>
</tr>
<tr>
<td>Disease type by system involved, n (%)</td>
<td></td>
<td></td>
<td>.01</td>
</tr>
<tr>
<td>Cardiopulmonary</td>
<td>15 (23.1)</td>
<td>13 (28.3)</td>
<td></td>
</tr>
<tr>
<td>Neuroendocrine</td>
<td>11 (16.9)</td>
<td>18 (39.1)</td>
<td></td>
</tr>
<tr>
<td>Hemaoncological</td>
<td>11 (16.9)</td>
<td>1 (2.2)</td>
<td></td>
</tr>
<tr>
<td>Physiological parameter at 48 hours, mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>127.8 (29.4)</td>
<td>120.7 (32.1)</td>
<td>.23</td>
</tr>
<tr>
<td>Pulse rate (bpm)</td>
<td>89 (17.6)</td>
<td>94 (18.1)</td>
<td>.17</td>
</tr>
<tr>
<td>Axillary temperature (°C)</td>
<td>36.7 (0.7)</td>
<td>37.3 (1.2)</td>
<td>.002</td>
</tr>
<tr>
<td>Respiratory rate (cpm)</td>
<td>23 (4.7)</td>
<td>25 (6.9)</td>
<td>.03</td>
</tr>
<tr>
<td>Average length of admission</td>
<td>7 (6.3)</td>
<td>8 (7)</td>
<td>.60</td>
</tr>
</tbody>
</table>

\(^a\)P values obtained via the t test and the chi square test.

Table 3. Multivariable logistic regression of death using full modified early warning score (MEWS) and the limited MEWS (LMEWS).

<table>
<thead>
<tr>
<th>Covariate</th>
<th>MEWS, odds ratio (95% CI)</th>
<th>LMEWS, odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.08 (1.04-1.12)</td>
<td>1.08 (1.04-1.12)</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>0.44 (0.16-1.23)</td>
<td>0.40 (0.14-1.13)</td>
</tr>
<tr>
<td>MEWS (significant)</td>
<td>6.33 (1.96-20.49)</td>
<td>8.22 (2.45-27.56)</td>
</tr>
<tr>
<td>Duration of admission</td>
<td>0.99 (0.93-1.07)</td>
<td>1.01 (0.94-1.08)</td>
</tr>
<tr>
<td>Diseased organ system</td>
<td>0.59 (0.31-1.13)</td>
<td>0.59 (0.31-1.12)</td>
</tr>
</tbody>
</table>

The death rate calculated by the Poisson regression after adjusting for only age was 2.02 (95% CI 1.40-2.91) times higher in patients with a significant MEWS compared to those with a nonsignificant MEWS. The death rate for a significant MEWS value using LMEWS was 2.13 (95% CI 1.48-3.07) times that of nonsignificant MEWS after adjusting for age.

In the multivariable predictive model adjusting for age, sex, duration of admission, admission to the ICU, organ system involved, and comorbidities, the odds of death among patients with a significant MEWS was 6.33 (95% CI 1.96-20.50) times that of patients with a nonsignificant MEWS. The death rate among patients with a significant LMEWS was 8.2 (95% CI 2.5-27.6) times that of patients with a nonsignificant LMEWS in the multivariable analysis. The best multivariable regression model was selected based on the Akaike Information Criteria, with a value of 116.4. The odds of death for every year increase in age was 8% (OR 1.08, 95% CI 1.04-1.12). Other covariates were not statistically significant.

Both MEWS and LMEWS were found to have good discrimination based on the ROC curves, with a C-statistic of 0.833 and 0.838, respectively (Figures 3 and 4), using a cut-off of ≥4. The Hosmer-Lemeshow goodness-of-fit test yielded P values of .16 and .25 for MEWS and LMEWS, respectively, implying that our model fits the data well (the null hypothesis being that the prediction model is correctly specified).

Sensitivity analyses using a significant MEWS or LMEWS cut-off score of ≥5 yielded a multivariable OR of 12.4 (95% CI 2.5-61.2) and 15.1 (95% CI 2.5-91.8), respectively. The ROC curves for MEWS and LMEWS was found to be 0.838 and 0.840, respectively, when a cut-off of ≥5 was adopted, as captured in Figures 5 and 6. The Hosmer-Lemeshow test to assess goodness of fit yielded P values of .51 versus .77 for MEWS and LMEWS, respectively, when a cut-off of ≥5 was used.
Figure 3. Receiver operator characteristic (ROC) curve for the modified early warning score (MEWS) using a cut-off of 4.

Figure 4. Receiver operator characteristic (ROC) curve for the limited modified early warning score (LMEWS) using a cut-off of 4.
**Discussion**

**Principal Findings**

MEWS has been validated in several settings as a robust predictor of both clinical deterioration and death in hospital [2,18]. This study demonstrates that the approach is useful even in the absence of an observed level of consciousness. Vital signs data collected routinely at the bedside in most facilities in Ghana and throughout sub-Saharan Africa can be used to generate LMEWS, which also has a high predictive value. Serious adverse events and some portion of in-hospital mortality can be prevented by limiting human error, such as failure to recognize the early warning signs of a deteriorating patient or failure to act on this information in a timely manner [19].
MEWS is a low-cost tool that utilizes easy-to-measure bedside parameters to generate a singular value that can identify at-risk patients. This value can be used as a preset trigger in the context of a reporting algorithm.

We found that, in this setting, having a LMEWS value of 4 or greater was highly associated with in-hospital mortality. The area under the curve (AUC) of 0.84 for the LMEWS is consistent with good model accuracy in the discrimination of patients who are critically ill. The combination of LMEWS with clinical judgment is therefore likely to be as effective in Ghana as it has been in other similarly resourced settings [20]. This is encouraging since LMEWS can be implemented without additional training of staff on how to score the level of consciousness and without changing standardized documentation forms already in use for patient monitoring.

The standard inpatient vital signs monitoring charts used in many Ghanaian hospitals includes a 4-hourly graphic to plot temperature, pulse rate, respiratory rate, and blood pressure. Additional parameters may also be serially recorded in some instances or centers; however, the typical bedside observation chart does not record the level of consciousness for patients, as captured in the MEWS by including either the AVPU or RASS score.

Although the original description defined a significant MEWS as any single score ≥5, or any increase of 2+ points in patients with initial scores above 5, a cut-off of 4 was adopted for this study [2,16]. Arguably, a lower threshold for detection would increase the burden of patient re-examination and reassessment on health care providers, potentially making use of the score impractical in settings with severely limited human resources. The decision to adopt a cut-off score of 4 as the definition of a significant MEWS was based on previous work done by Gardner-Thorpe et al [16] in 2006, which showed that raising the threshold reduces the sensitivity to unacceptable levels for patient safety, though an increase in specificity would be observed. Using a cut-off of 4, the number of individuals with a significant MEWS value was 33 (out of 112), and 31 had a significant LMEWS value. In other words, nearly 30% of the patients in our study would have been categorized as high risk for clinical deterioration in the context of a MEWS-based reporting algorithm.

Interestingly, using MEWS or LMEWS with a cut-off of ≥5 did not only yield higher discrimination, based on the C-statistics, but also had better calibration in terms of correctly assessing the risk of disease severity. Based on the receiver operating characteristics and the Hosmer-Lemeshow goodness-of-fit test, LMEWS with a cut-off of ≥5 was superior to both MEWS and LMEWS with a cut-off of ≥4.

Encouraging complete, accurate documentation and a standardized interpretation of vital signs with appropriate actions by nurses, doctors, and other allied staff can potentially improve the outcomes of patients admitted to hospitals, even in a setting that lacks rapid response teams. Many interventions such as fluids or antibiotics do not require advanced equipment or costly supplies, making the implementation of the afferent arm of a rapid response system important even in settings where the efferent arm is more limited [21].

Limitations
This study is subject to all the limitations of a single-center, retrospective chart review. Sources of bias include the potential for differential clinical care based on perceived patient status in the absence of a standardized rapid response team or protocol. In addition, the study only examined vital signs collected at a single time point for each patient. Changes in serially measured physiological parameters were not evaluated. A study published by Ludikhuize et al [22] recommends the calculation of MEWS at least 3 times daily to detect the development of physiological abnormalities. Our study could not have detected any significant MEWS values that may have developed after the first 48 hours upon admission. However, missing additional patients who may have worsened later and then died would bias the study toward the null hypothesis. This makes our study design a conservative one, with results consistent with previously published literature on the topic [2,16].

More prospective research is needed to help define the utility of LMEWS for physicians looking to allocate resources and develop rapid response teams that can act on predictive information to improve patient outcomes and patient care.

Conclusion
This study was the first to examine the ability of an early warning system to predict inpatient mortality based on routinely collected clinical data in a low-resource setting. Early recognition of clinical status decline is critical even in low-resource settings, where bedside interventions may prevent ICU admissions and disease complications including death. Though the MEWS system provides good discrimination, the LMEWS provides better discrimination and calibration in the prediction of mortality and can identify critical illness among inpatients with primarily medical diagnoses. Additional prospective studies will be useful to validate LMEWS among other categories of inpatients and to investigate its impact on health resource allocation and clinical outcomes in low-resource settings.

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review processes at the Korle-Bu Teaching Hospital; and George Mwinnyaa and Seth Bennett, who reviewed the statistical analysis.

Authors’ Contributions
EJA was responsible for the concept, study design, partial data collection, analysis and interpretation, and writing of the manuscript. PA, JSRM, MC, and SES participated in concept development, critical revision, and review of the manuscript. PA, JSRM, and MC also served as academic mentors, while SES was the on-site preceptor as well.

Conflicts of Interest
None declared.

References


**Abbreviations**

AUC: area under the curve
AVPU: alert, voice, pain, unresponsive
ICU: intensive care unit
IRB: Institutional Review Board
IRR: incidence rate ratio
LMEWS: limited modified early warning score
MEWS: modified early warning score
OR: odds ratio
RASS: Richmond Agitation Sedation Scale
ROC: receiver operating characteristic

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