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Digital Response to Physical Crises: The Role of an E-Health Platform in the 2023 Southern Turkey Earthquakes

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Abstract

The catastrophic earthquakes that struck Southern Turkey in 2023 highlighted the pressing need for effective disaster management strategies. The unprecedented scale of the crisis tested the robustness of traditional healthcare responses and highlighted the potential of e-health solutions. Despite the deployment of Emergency Medical Teams, initial responders - primarily survivors of the earthquakes - faced an enormous challenge due to their lack of training in mass-casualty situations. An e-health platform was introduced to support these first responders, offering tools for drug calculations, case management guidelines, and a deep learning model for pediatric X-ray analysis. This commentary presents an analysis of the platform's use and contributes to the growing discourse on integrating digital health technologies in disaster response and management.

The 2023 Southern Turkey Earthquakes and Healthcare Challenges

On February 6, 2023, 2 consecutive major earthquakes (EQs) struck Southern Türkiye, impacting 11 primary cities and Northern Syria's bordering regions. The World Health Organization (WHO) announced a level 3 emergency due to the extensive destruction.[1] Based on reports from Turkey up to June 6, 2023, the disaster affected over 9 million people, with an estimated death toll of 50,783 and more than 100,000 injured.[1,2] The EQs severely damaged the region's medical infrastructure as well as supply, and workforce, leaving survivors without adequate medical services. According to the Turkish Health Minister, the tragedy led to the loss of 448 healthcare professionals, with 528 suffering injuries. These numbers were last updated on June 16, 2023.[3]

National and international Emergency Medical Teams (EMTs) and rescue teams were mobilized to counter the medical services deficit. However, damaged transportation routes and adverse weather conditions impeded access to the affected areas. Therefore, especially during the first 72 hours, the initial disaster responders had to be a restricted number of healthcare personnel who had survived the earthquake. These individuals were not adequately trained for mass-casualty disasters, thereby struggling to manage trauma-related disorders such as shock, sepsis, and early fluid therapy, as well as acid-base and electrolyte imbalances, crush syndrome, and fasciotomy. To assist the inexperienced first responders, an online platform named PACMAP (Pediatric Acute Case Management Assist Platform) was developed. This platform was developed in alignment with the recent guidelines, which were established through a consensus by the disaster task force of The Turkish Society of Pediatric Emergency and Intensive Care Medicine (CAYD).[4] In this report, we aim to share this platform's traffic data in the sudden-onset disaster and contribute towards future e-health measures for potential disasters.

The PACMAP, which can be accessed through *depremdoktor.site*, was released in the 48-hour time period following the first EQ. It offered various modules based on patient weight and body surface area. The calculator module assisted physicians with the calculation of critical care drugs, sedatives, and antibiotics dosages. The case management module provided succinct pediatric case management recommendations for Crush Syndrome and Hypothermia based on CAYD guidelines. It also includes a deep learning model for pediatric X-ray images that may be used to identify pneumonia. The platform's traffic data from the calculator module is presented in Figure 1 and Table 1.

In the first phase, despite being released after the disaster, we managed to receive a significant number of queries (4,803). Most of them were about sedative drugs (2,198, 45.76%), which was followed by critical care medications (1,953, 40.66%) and antibiotics (652, 13.57%). In the post-impact period, however, the antibiotics consisted of the majority of all requests (5,999, 85.97%), and there was a gradual decline in the number of critical care medications (e.g., adrenaline, dopamine) and sedatives (e.g., midazolam, fentanyl), and their usage dipped to nearly none per day by the end of the first week after the disaster. However, the antibiotics have remained in their

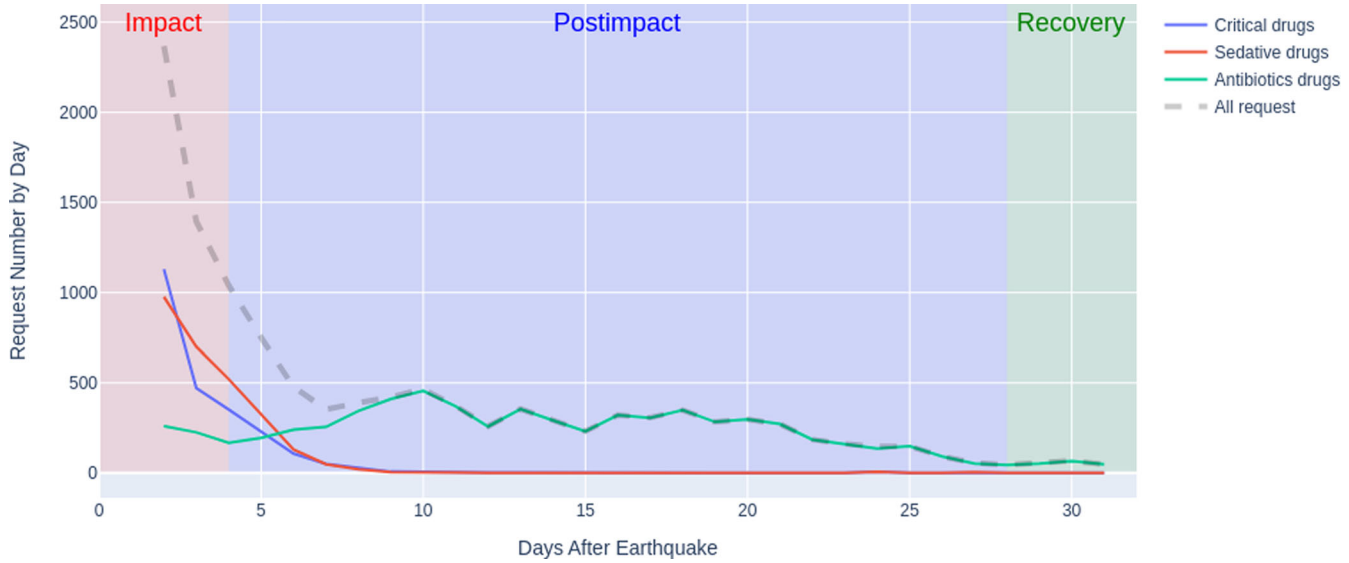

Figure 1. Trends of calculator module requests.

Table 1. The numbers of calculator module requests

Drug Class	Impact n, (%)	Post-impact n, (%)	Recovery n, (%)
Critical care medications	1,953 (40.66)	434 (6.22)	–
Sedatives	2,198 (45.76)	545 (7.81)	1 (0.48)
Antibiotics	652 (13.57)	5,999 (85.97)	209 (99.52)
Total request number	4,803 (100)	6,978 (100)	210 (100)

positions until the recovery phase, despite the platform calculator module's traffic hitting a low of slightly above none per day (Figure 1).

Utilizing PACMAP in the Aftermath and The Role of E-health in Disaster Response

According to the data, there was a noticeable demand for the platform, especially in the first phase. However, this demand declined sharply after the impact period. It may be because of the fact that the first responders (inexperienced physicians) needed to use these calculators at first, and they were replaced after the other professional medical aids came. The other possible cause is that the need for critical and sedative drugs declined after the impact period was completed, or the victims were gradually transferred to other hospitals, where more experienced and well-equipped pediatricians work. As Green et al showed, calculator use is negatively correlated to years of experience, meaning that less experienced clinicians are less likely to consume newly published calculators.[5] With regard to the antibiotics' requests, we observed that the physicians tend to use them, especially after the first week of the disaster. It was expected that the request for antibiotics and usage increase in the post-impact period, when the first wave of infectious disease problems, including airborne, and foodborne, or waterborne infections.[6] Despite minor fluctuations, there was no drastic increase in antibiotic requests throughout the post-impact phase. It can be concluded that efficient public health measures prevent the possible rise in antibiotics; however, this paper does not provide enough data to prove this statement.

Disaster preparedness is essential for minimizing potential fatalities and damage, as highlighted by previous studies.[7,8] The disaster management authority of Turkey, AFAD, released the National Disaster Response Plan (TAMP) on February 24, 2022,[9] and the organization had anticipated a 7.5 magnitude earthquake striking the town of Pazarcık, the epicenter of the first earthquake, and conducted a drill with the anticipation of receiving help from neighboring provinces.[10] However, the recent EQs in Turkey affected 11 neighboring cities including suddenly damaged major logistic centers of the region such as Elazığ, Diyarbakır, Adana, and Hatay. The disasters' spatial distribution and extreme weather conditions had not been anticipated in TAMP,[11] which caused the action plans to fail and led to unforeseen health needs, especially in the first 3 days after the disaster when there was an increased healthcare demand,[12] and lack of qualified first responders in the affected zones.

Our web-based solution effectively overcame the unexpected logistic gaps arising from extreme weather conditions and broader spatial distribution. Herein, we demonstrated that a cloud-based medical decision support can be in high demand by non-qualified first responders, whose needs for medical assistance vary depending on the phase following the disaster.

Digital tools in disaster management represent a new way for rapid decision-making, offering intuitive usability in crisis scenarios. A web application, like PACMAP, offers interoperability with other technological tools by implementing a Cloud-based RESTful API (application programming interface). Our cloud-based web application offers enhanced usability through a user-friendly interface that is responsive in any mobile and desktop device with limited internet connectivity, along with direct access to case-related modules based on recent guidelines. Furthermore, we believe that offline versions of these tools will expand their reach and ensure functionality even in situations with limited or no internet connectivity. In essence, our research shows a practical and reflective example of digital health intervention that can be applied to massive disaster scenarios, which have continued to evolve globally.

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Information technologies have already shown themselves in healthcare management in disasters, including public health risk assessments, electronic triage, and in-hospital case management, as well as locating available health facilities.[13] Telemedicine services have also been successful as an e-health solution in disasters.[14] However, there are a few e-health reports assisting the first responders. Our cloud-based application was operational within 48 hours following the first disaster, and it has brought rapid, effective, and appropriate decision support while national and international aids were struggling to overcome logistics barriers.[15] More importantly, physicians used our application, and it has become widely popular in a short period of time. However, they were not willing to use it in the recovery phase, as opposed to telemedicine solutions which were used in the post-disaster or recovery phase.[14] Despite the benefits of tele-health interventions in disaster, they have been underutilized in the post-disaster recovery phase due to several factors, including barriers of administrative (confidentiality, data privacy, licensing),[16] reimbursement (under-supported by disaster funds and insurance companies),[16] and technological (availability and accessibility of networks).[15]

Conclusion

In conclusion, maintaining healthcare can be challenging, especially after a large-scale disaster. We believe e-health technologies can overcome the hurdles and utilize collaborative and appropriate healthcare where and when needed.

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Abbreviations. AFAD, The disaster management authority of Turkey; CAYD, The Turkish Society of Pediatric Emergency and Intensive Care Medicine; EMTs, Emergency Medical Teams; EQs, Earthquakes; PACMAP, Pediatric Acute Case Management Assist Platform; TAMP, the National Disaster Response Plan; WHO, The World Health Organization

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