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Reports

Leveraging mobile applications in humanitarian crisis to improve health: a case of Syrian women and children refugees in Turkey

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The open-door policy of Turkey has made it an attractive destination for millions of Syrians to escape the war. In Turkey, refugees can utilize health services free of charge, as individuals under temporary protection. However, the low uptake of preventive services including prenatal visits and childhood immunizations is a critical threat to the health of Syrian refugees and Turkish citizens. We designed an open-sourced mobile health (mHealth) platform, (HERA App), for Syrian women and children refugees in Turkey, to increase uptake of available preventive health services. HERA App is uniquely designed to reduce demand-side barriers that refugees encounter in relation to healthcare access and improve outcomes related to vaccine-preventable diseases and maternal health. HERA App provides solutions for healthcare navigation, health education, and behavioral nudges, such as automated reminders to increase timely childhood immunizations and pregnancy related doctor visits. HERA App is the first mHealth solution that has been designed for Syrian refugees in Turkey and is currently still in the data collection phase. We discuss its design and implementation and analyze the enablers and barriers of adoption systems, health systems access, and cultural norms for implementing a demand-side mHealth intervention in this context.

Since 2011, following the war in Syria, the Syrian refugee crisis has led to forcible displacement of 11 million people, nearly half of Syria's population.[1] Refugee women and children have a higher risk of illness due to their double vulnerability as members of multiple population groups with disproportionately higher disadvantage.[2]

Of the 5.6 million Syrian citizens who became refugees during this crisis, 3.8 million relocated to Turkey.[1] The Syrian refugees in Turkey are mostly dispersed in the cities bordering Syria and metropolitan Istanbul, and the majority of the refugees reside outside of refugee camps.[3]

Although Turkey's open-door policy to Syrian refugees has helped to save many lives, barriers to healthcare access exist even after eight years of implementation of comprehensive programs to support the Syrian refugees. Turkey offers free healthcare to registered refugees under its National Insurance Scheme. However, Syrian refugees in Turkey have higher health risks due to language barriers, xenophobia, socioeconomic status, and difficulties navigating a complex new health system, with incomplete knowledge of available services.[3,4] Furthermore, changes in rules and regulations in the health system are challenging for the refugee population to follow. Lack of reliable or complete health records and knowledge about the available healthcare services is a large barrier to providing public health and preventive health services.

In order to increase the success of immunization campaigns or other preventive interventions, such as antenatal care, there is a need for innovative approaches to provide services in order to bridge the gap between demand and supply. The World Health Organization (WHO) defines mobile health (mHealth) interventions as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices,"[5] with increasing utility for the provision of health services in low resource settings.[6,7] Mobile applications, SMS text messaging, or telephone-based programs have been shown to increase uptake of preventive services such as smoking cessation,[8,9] immunization,[10] and antenatal care.[11]

Mobile health interventions that could be implemented both rapidly and cost-effectively are particularly promising in introducing health prevention interventions in humanitarian settings, given the widespread availability of mobile phones, and as the solutions can be adapted to different contexts.[12] However, while new mHealth interventions are currently undergoing field testing, to date there are no published studies on their full integration in health services provided for refugees.[13]

In this paper, we describe a novel mHealth application, HERA App, and discuss the potential uses of mobile technologies in refugee populations. The HERA App is currently completing its proof of concept phase; data collection from April 2019 through February 2020 is currently undergoing

analysis. Evaluation of the efficacy of HERA App is examined using multilevel analytical models, including a qualitative user experience component in order to understand the bottlenecks in care delivery and uptake of the application. We use the "Conceptual Framework on Integration of Interventions" developed by Atun et al. to discuss the enablers and barriers in implementation of a demand side mHealth intervention for refugees.[14]

INTEGRATING TARGETED HEALTH INNOVATIONS TO EXISTING HEALTH SYSTEMS

As part of the proof of concept study, we analyzed the introduction and scale up of the HERA App using the "Conceptual Framework on Integration of Interventions."[14] This framework allows for deep understanding of demographic, social, economic and other factors associated with adoption of novel interventions into the existing health system by analyzing 1- The Problem, 2- The Context, 3- Adoption System, 4- Health System Characteristics and 5- The Broad Context. The framework (Figure 1) uses an analytical approach to examine contextual, health system, and institutional factors, as well as the characteristics of the adoption system that influence the integration of a health intervention (HERA App, in our study) in health systems.[14] The framework has been used to assess effectiveness of different interventions and to inform introduction and integration of different interventions in health systems.[15]

Using the framework, we identified in factors influencing uptake of the HERA App by Syrian refugees in Turkey, and its integration with the Ministry of Health services currently provided for refugees in Turkey.

PROBLEM

Syrian refugee women and children suffer higher mortality and morbidity due to low uptake of preventive health services, such as childhood vaccination and maternal antenatal check-ups.[16,17] This low uptake is mostly due to demand side barriers to healthcare access in Turkey, such as language barriers and lack of knowledge about the health system, despite the fact that healthcare is free of charge for refugees.

CONTEXT

Context is favorable at the moment in Turkey, as a major destination point for Syrian refugees. Turkey has funded Syrian refugees from the government budget and has received financial and technical assistance from the European Union (EU) and United Nations.[18] In 2019, around US$665 million was allocated to Turkey through the Syria *Refugee Response and Resilience Plan* (3RP), from its US$2.3 billion fund.[19,20] The EU has also indicated it will continue to fund Syrian refugees needs for at least the near future.[21]

INTERVENTION

HERA App is a mobile application that can be used with Android and Apple smartphones. Users input sociodemographic and health data into the application. It then uses this information to calculate the dates of vaccination according to the Turkish Vaccination Calendar from date of birth of the child or, if the user is pregnant, antenatal checkups from the date of last menstruation. To increase timely uptake of these services, HERA App uses SMS text messaging to send push notification reminders 15 days prior, one day prior, and on the day of the recommended appointment. In addition to this, HERA App can inform the user of the nearest health center in real time, as well as be used to call 911 emergency services. Users can use the "health-health system information" education feature to learn about common maternal child health problems and first aid, warning signs, and their right to access healthcare services in Turkey.

Following multiple iterations and user feedback surveys, through HERA App, users can now receive appointment reminders for immunization or antenatal visit dates, receive health information, keep track of their medical records, call emergency services, and navigate the healthcare system depending on specific individualized needs and language report. It is designed to squarely meet the most common challenges and current problems faced by Syrian refugees under temporary protection in Turkey (see Figure 2). The application is further meant to empower refugees, providing them a voice to express individualized needs and wants.

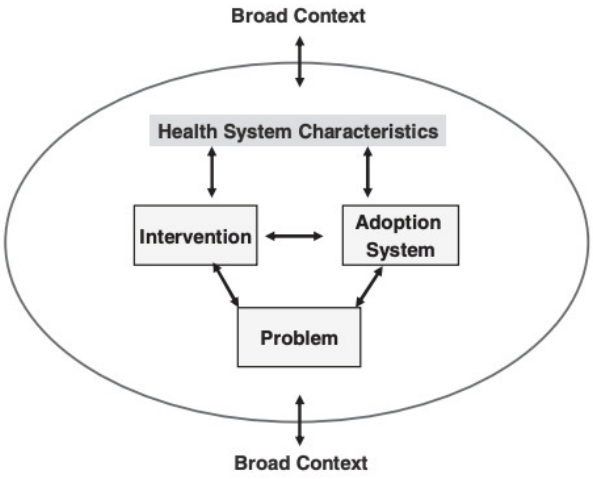

Figure 1. Conceptual framework for agile integration of targeted health interventions.

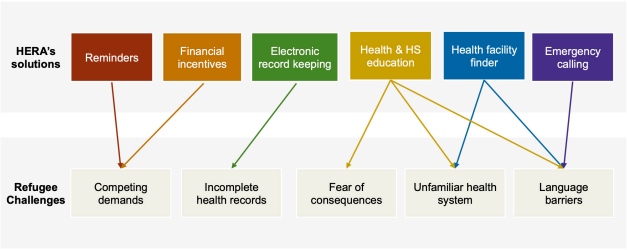

Figure 2. HERA's alignment with current refugee challenges.

IMPLEMENTATION

HERA is envisioned as an "agile design project"[22] that can react to changing context and feedback from different stakeholders. Through a deductive process with iterative revision, features of the initial application were restructured to guide the most current implementation and scale up strategies.

1. **Primary design**: In its original form, HERA App offered 20 different features through the mobile app itself. It allowed users to visualize health information and provide real time guidance on legal and regulatory issues. This design was incorporated into development of simple features for the "best use", mainly by focusing on what could improve the quality of life of the users.
2. **Distillation process**: In order to better understand the target group needs and expectations from the initial innovation, investigators held preliminary meetings with key stakeholders, including end user refugee women and healthcare providers. The basic intervention plan and the mobile app was introduced to a small group of Syrian refugee women, and healthcare professionals working in areas of pediatrics and obstetrics and gynecology (OBGYN). In-depth interviews of these key informants (n=24) were performed and coded for thematic analysis, as part of a user experience design study. These interviews provided formative information that was used to prioritize the features identified as being the most useful for the users. Interviewers also asked whether participants have used other innovations with similar features. The features that appeared easily accessible through other means were deleted to prevent duplicity.
3. **Proof of concept study**: After final decisions on application features and designs were made, a feasibility study was planned, and funding for implementation was obtained. This study and the first field tests of HERA are funded by Grand Challenges Canada (https://www.grandchallenges.ca). Currently the project is ongoing, and the study is in its analysis phase. Field tests involve a multinational multidisciplinary team from researchers from McGill University and Harvard University.
4. **Scale-up plans**: Concurrently with the proof of concept study, the project team is also working on scale up plans for sustainable development and growth of the solution. These plans include partnerships with Turkish Ministry of Health, United Nations agencies, and international humanitarian donors.

ADOPTION SYSTEM

The HERA App is designed as a bridge between the refugee population and the healthcare services available to them. In addition to desirable features for the users, its successful and effective implementation also depends on other factors, including the continued provision of free national healthcare services and uninterrupted access to vaccines for the children of Syrian refugees in Turkey.

Mobile apps are not commonly used for healthcare services in the Turkish health system. Implementation of such a novel intervention depends heavily on the acceptance of all stakeholders (Ministry of Health, end users, the healthcare professionals, managers, and the funders), who believe that using HERA App will be more beneficial than the 'usual practice'. As a link in healthcare access, HERA App's implementation also depends on alignment with the already existing health information and scheduling systems. For its sustainability, the integration of HERA App within the existing infrastructure is of high contextual importance.

SMARTPHONE USAGE

Smartphone usage is particularly high among the Syrian refugee communities around the world. Smartphones are also the primary way the refugee population receives information and updates about the rules and regulations concerning them, making mobile applications an attractive platform for communicating with the refugee populations.

The potential of mobile health interventions in humanitarian contexts is being recognized; though they are not yet widely applied, some instances of their use exist. For example, interventions using short message reminders have been used to increase the uptake of services for vaccination , smoking cessation, and adherence to medical treatment in in low-income countries with demonstrable cost effectiveness.[23,24] In humanitarian crises, international organizations such as Doctors Without Borders have begun to use smartphones and mobile applications to increase quality of care.[25] There are also a myriad of mobile apps designed for helping refugees access available services in their host countries, but few studies exist on their uptake, effectiveness or cost-effectiveness.[26]

United Nation charters working with refugee populations have also started to incorporate mobile health interventions in their services. A similar mobile app to HERA App, called UNRWA-EMCH (United Nations Relief and Works Agency E-Maternal and Child Health), is being used by United Nations Relief and Works Agency in Palestine to track health records for maternal and child health.[27] A summary of a literature review of currently used mHealth interventions in humanitarian context is presented in Table 1.

HEALTH SYSTEM CHARACTERISTICS

HEALTHCARE ACCESS FOR REFUGEES

Syrian refugees are under temporary protection in Turkey.[37] Under the current laws, all registered Syrian refugees (100% of the refugee population) are included in the National Social Insurance Program (Sosyal Güvenlik Kurumu) and have the right to use public health services free of charge. While the reports of local practices preventing refugee communities from accessing public services have diminished over the years, in some settings pockets of xenophobia still persist.[38]

THE TURKISH HEALTH SYSTEM

Since 2003, Turkey has achieved major improvements in equity, user satisfaction, and health improvements, specifically with declines in child and maternal mortality, as underpinned by its 'Transformation in Health' Program.[39] Com-

Table 1. Literature on effect of reminders and other mHealth innovations in humanitarian contexts

Title of Article/ Author (Year)	Context / Country	Intervention	Conclusion
Evaluating the use of cell phone messaging for community Ebola syndromic surveillance in high risked settings in Southern Sierra Leone.[28]	Sierra Leone	Cellphone alerts for surveillance	More effective tool for community epidemic surveillance than traditional sentinel surveillance
Pilot Testing and Implementation of a mHealth tool for Non-communicable Diseases in a Humanitarian Setting.[29]	Syrian refugees in Jordan	Provider tool for better diagnostics for NCDs.	Better recording and follow up of health records. Increased end user satisfaction.
UNRWA's innovative e-Health for 5 million Palestine refugees in the Near East.[30]	Palestinian refugees in Middle East	Health record keeping for non-communicable diseases, antenatal care and reminders.	Increased efficiency and time saving for health services.
Assessing American Red Cross First Aid mobile app user trends: Implications for resilience.[31]	N/A	Alerting for disasters	Increased usage of mobile apps during disasters.
Using Mobile Health (mHealth) and Geospatial Mapping Technology in a Mass Campaign for Reactive Oral Cholera Vaccination in Rural Haiti.[32]	Rural Haiti	Electronic registry creation	Increased uptake of Oral Cholera Vaccination.
Sijilli: A Scalable Model of Cloud-Based Electronic Health Records for Migrating Populations in Low-Resource Settings.[33]	Syrian refugees in Lebanon	Cloud-based EHR	
mHealth information for migrants: an e-health intervention for internal migrants in Vietnam.[34]	Vietnam	Reminders, booklets and free counseling	Increased usage of reproductive health services.
SMS-based smartphone application for disease surveillance has doubled completeness and timeliness in a limited-resource setting - evaluation of a 15-week pilot program in Central African Republic.[35]	Central African Republic	Smartphone application-based data transmission system	mHealth tools provide enhanced surveillance data in low-resource setting
Practicing medicine without borders: tele-consultations and tele-mentoring for improving paediatric care in a conflict setting in Somalia?[36]	Somalia	Telehealth support	Decreased risk of death or loss to follow up

prehensive changes to increase uptake of preventive interventions, decentralization of services to more effectively incorporate primary care centers, and new financial allocations have led to an expansion of the number of vaccines available for children in the routine immunization schedule, as well as sharply increased vaccination coverage (>90%).[37] In addition, inclusive maternal health program, antenatal care standardization, and demand increasing incentives (for both provider and consumer) were shown to significantly decrease maternal mortality.[40]

The arrival of 3.8 million Syrians, within an eight-year period starting in 2011, has placed substantial pressure on the Turkish health system. Even with additional funding, it has proved challenging to rapidly scale up healthcare human resources and Arabic translators, with concerns that the achievements of Health Transformation Program has been undermined.[41] The sudden influx of refugees placed a large demand on services to screen and vaccinate incoming refugees at the border crossings. Since 2013, the Turkish Ministry of Health in partnership with the World Health Organization has introduced mass door to door vaccination campaigns for Syrian refugees in order to decrease the risk of an infectious outbreak.[42]

In line with Turkey's "Health Transformation Program", integration of more digital health solutions (telehealth, full digitalization of health record keeping, effective record sharing between hospitals) is a priority area for improvement by the Ministry of Health. This conjuncture makes it increasingly acceptable and feasible for the Ministry of Health and the Turkish Refugee Response Organization to integrate the HERA App into more routine services. A summary of barriers and enablers for adoption of HERA App is presented in Table 2.

DISCUSSION

STRATEGIES TO OVERCOME BARRIERS AND BUILD ON ENABLERS TO SCALE UP THE USE OF THE HERA APP

The HERA App is being developed using an agile design process. This agile approach fosters rapid responsiveness to the dynamic conditions and barriers. It enables iterative changes to the solution unlike traditional planning and implementation, which leads to rigid procedures performed sequentially. In order to ensure scalability of the solution, the team has implemented frequent meetings with the users to receive regular and timely feedback, and interviews with key stakeholders to better understand both the indi-

Table 2. Summary of barriers and enablers for adoption of HERA App

	Adoption systems		Health systems access		Context and cultural norms	
	Smartphone usage	Infrastructure	Supply	Healthcare system	Stigma	Competing priorities
Enablers	Refugee population use smartphones as a way of connectedness with their families in other countries.	MoH is willing to invest in digital health solutions.	Refugee population is entitled to free healthcare under National Insurance Scheme	Turkey's 'Transformation of Health' Program aims to increase usage digital interventions in the health system. HERA is aligned with country's health priorities.		Literacy was high in prewar Syria. Similar culture between countries.
Barriers	Internet access is needed for current app version, which is an extra cost to user.	There aren't any similar apps, even in the for-profit sector in Turkey.	Though sparse, local resistance of authorities to free utilization still exists.	Agility is low due to rapid changing political context and changing priorities of MoH leadership.	Hard to promote services available to refugees without being criticized	Language is different.
		Turkey's data privacy and mobile app regulations are still not sufficient.	Turkey's refugee response is majorly funded by EU which is finite.			

vidual and collective views on the necessary improvements and feasibility of scale up. In parallel, scale up plans are revised with regular frequency with international partners taking into account the feedback obtained. For example, the feedback has enabled the incorporation into the reminder notification system of a conditional credit transfer scheme to create monetary incentives for mothers and expectant women. This plan has yet to be systematically field tested; though bundling financial incentives with behavioral nudges has previously shown to be an efficient way of increasing uptake of a service.[43]

Amongst the barriers that required adaptation and flexibility was the need for the use of multiple information technology and communication platforms used by different telephone companies. Interviews with end-users revealed a concern of not having access to their phone or being able to use HERA for other members of the family who used different mobile telephone providers. To overcome this challenge, a website version of the HERA App was created. In addition, for the users who had non-smartphones, HERA's reminder procedure was programmed to send simple SMS text messages and offer SMS services. Uptake of digital innovations always require connectivity through internet or other forms of data sharing. Access to internet is an important barrier in similar interventions. However, the coverage of internet access was found to be almost 90% in Turkey,[43] well enough to implement interventions that require connectivity.

The HERA App was created in a favorable context with the availability of free healthcare services. This innovation was able to provide behavioral nudges to steer users towards increased uptake of preventive healthcare access.

THE WAY FORWARD

Currently the HERA App's field tests are ongoing in Turkey. Simultaneous scale up plans are being designed and the mobile app is being iteratively improved using regular feedback. Since the beginning, the project was designed for transfer to an entity such as the Ministry of Health in Turkey to integrate into their own services for refugees. HERA is being field tested by a grassroot organization called Medical Rescue Association of Turkey (MEDAK – www.medak.org.tr), with intent to independently scale up the project for the entire Syrian refugee community in Turkey.

CONCLUSIONS

Mobile health interventions such as the HERA App can help improve the health and quality of life in displaced populations by increasing demand for healthcare services, assisting with the navigation through complex health systems, and ensuring continuity of care by digital medical record keeping.

In an era of rapidly changing technology, mobile phones, which are ubiquitous, offer the possibility to develop cost-effective and responsive solutions for underprivileged groups, such as refugees. They offer a low-cost alternative for communication systems, health information sharing,

and assistance for health services. In particular, mHealth innovations present unique opportunities for humanitarian relief work. Rapidly changing environments, mobile populations and complex systems of care organizations can particularly benefit from mobile innovations that can be rapidly designed and be scaled up. Their relatively easy adaptation to different contexts (language translation, modular design), low costs (particularly long term) and minimal infrastructure requirements (already available in most settings) make them attractive and integral tools for implementing effective healthcare and humanitarian interventions.

SUMMARY BOX

1. Syrian refugee crisis has led millions to become forcibly displaced, but women and children suffer the most.
2. HERA App is designed to increase preventive care uptake in Syrian population in Turkey through push notification reminders, electronic record keeping, and help navigating the health system.
3. Refugees are able to utilize health services free of charge in Turkey, and Turkey's integration of digital health solutions to its services provides opportunity for future integration of HERA into routine health services.
4. HERA App is still in data collection phase, but we believe large scale dissemination of HERA in the refugee community could lead to life improvements and decrease preventable morbidity and mortality in maternal and child health.

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AUTHORSHIP CONTRIBUTIONS

A.S. and N.N designed and implemented the intervention and drafted the initial manuscript. A.S and R.A conceptualized manuscript framework and design. R.A provided senior advisory support and manuscript revision. A.J.S. coordinated authoring efforts and provided critical revisions. All authors agree on the submitted version of the manuscript.

COMPETING INTERESTS

The authors completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available upon request from the corresponding author), and declare no conflicts of interest.

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