Rapid Mobile Response Messaging (RM2)©
SMS-based emergency medical dispatching for low- and middle-income countries

Executive Summary
Prehospital emergency care systems reduce premature death and disability by improving access to trained first responders and reducing delays in hospital transport. While commonly delivered through robust “ambulance services” in affluent countries, emergency care is often unavailable in low- and middle-income countries, largely because the telecommunications infrastructure required for dispatching first responders is not sufficiently established – without such technology, patients with medical emergencies cannot alert trained first responders when medical emergencies occur.

Trek Medics International has developed the Rapid Mobile Response Messaging (RM2) software to provide dispatching systems for communities that do not have access to reliable emergency transport and communications, and similarly lack the funding to acquire them. In short, RM2 improves access to trained emergency medical care and transport through SMS that are relayed from the scene of an emergency to the nearest available first responders. The software functions without an Internet connection, and provides an innovative and cost-effective platform for emergency medical care across a wide range of resource-limited settings. We believe that the minimal human, physical and financial resources required by RM2 makes effective emergency medical system development feasible wherever mobile phones are used. We are currently seeking partners to expand field-testing and development.

Where there is no ambulance
“What would you do if someone was hit by a car right in front of you?”
If you were to ask this question to ten random people on the streets of New York City, ten out of ten would probably all say the same thing: “I’d call 911.” Asking the same question to ten people in London, Paris, Sydney, or virtually any other city in an affluent country would likely illicit responses that also point to a reliable emergency number that can provide quick access to trained emergency medical assistance. In low- and middle-income countries (LMICs), however, things don’t typically work this way – generally speaking, patients with time-dependent medical emergencies are on their own, and especially when outside major cities.

Nonetheless, the need for emergency medical care in LMICs is a top priority: deaths from car wrecks, complicated childbirth, acute respiratory distress, disasters, and a range of other medical emergencies are a major public health threat to LMICs. The soaring fatality rates from time-dependent conditions are also a major threat to these countries’ economic development, as the age groups most affected by preventable death and disability are also the young and working classes, 15-45 year-olds.¹ Consider the following statistics:

- Injury - Injuries are one of the leading causes of premature death and disability worldwide,² with 90% of the world’s 16,000 daily injury-related deaths happening in LMICs.³ That’s the equivalent of more than 20 jumbo jet crashes every day, accounting for more deaths annually than malaria, HIV/AIDS and tuberculosis combined.⁴ In the poorest countries, 80% of injury-related fatalities are reported to occur in the prehospital setting.⁵
- Childbirth – 99% of all maternal deaths occur in LMICs; approximately half of all childbirths are performed without a skilled attendant,⁶ and intrapartum complications are “implicated in 23% of neonatal deaths, 32% of stillbirths, and 42% of maternal deaths”.⁷ Delays in finding basic transportation to healthcare facilities have been identified as a major contributor to maternal and neonatal deaths.⁸

Fortunately, according to the World Bank,² emergency medical services (EMS) can affect up to 45% of all deaths in LMICs, and early successes have demonstrated cost-effective approaches for EMS
development in LMICs. However, the equipment, vehicles, facilities, and trained personnel needed to implement these systems as they exist in affluent countries often come with costs that are simply prohibitive, precluding even the most basic initiatives.

**Improve Emergency Medical Care Anywhere**

Trek Medics International has been working since 2009 to develop emergency medical systems across a range of settings in LMICs, including for both formal and informal systems, and in urban and rural locations. Our work is focused on developing emergency medical response that leverages local resources to address local healthcare realities, with an emphasis on four core programmatic areas: emergency medical care training; transport; communications; and, coordination.

**Rapid Mobile Response Messaging (RM2): An Emergency Call to Action**

In affluent countries, the underlying philosophy for emergency medical response is to find the quickest way to send ambulances to patients needing emergency care in order to bring them back to the hospital, a strategy sometimes referred to as a “System Status” model and which relies on a limited number of designated emergency vehicles and first responders. While effective in reducing mortality rates for a host of emergency conditions, such systems are not usually described as being “cost-effective”. The RM2 software essentially inverts this approach by re-framing the problem: as opposed to finding the quickest way to get ambulances to emergency patients, our focus is on finding the quickest way to get emergency patients to the hospital. Thus, instead of calling for an ambulance and waiting until it arrives, RM2 effectively crowd-sources emergency medical response by drastically increasing the number of available first responders in a given geographic area, and then notifying all of them by SMS when someone in the community sends out a text requesting emergency assistance – an approach we’ve dubbed, “System Saturation”. By relaying SMS from the scene of an emergency to the nearest responders, the RM2 dispatching software bridges the communications gap that commonly prevents communities with limited means from providing rapid and reliable emergency medical care and transport.

The following sequence details the *Emergency Response Cycle*, adapted to operate in coordination with the RM2 software:

1. **Emergency Event** – Someone falls from a moving vehicle and is lying in the street
2. **Alert & Notification** – A witness sends an SMS to an RM2 server
3. **Response** – The server relays the SMS to the nearest trained responders
4. **On-Scene Care** – Trained responders locate the patient(s) to provide triage and basic medical care
5. **Transport** – Responders provide safe emergency transport to hospitals with advanced notification at receiving facilities
6. **Definitive Care** – Patients are transferred to clinical providers at appropriate healthcare facilities.

Using this approach, communities are able to leverage existing resources to improve access to quality emergency care when and where it is needed by increasing the availability of prehospital care providers and reducing delays in transport to definitive care.

**Case Study: Sun City**

The following scenario will help to illustrate an example of RM2’s target community:

*Program Setting* – Sun City is an impoverished coastal fishing village with high fatality rates for preventable causes, including deaths from road traffic injuries, complicated childbirth, envenomation, diseases in the childhood cluster, cholera, and the annual threat of hurricanes. Sun City has a population of 90,000 residents, including a small urban center with 20,000 inhabitants, with the remaining 70,000
scattered sparsely among numerous hard-to-access communities. Several indigenous communities, numbering a few hundred inhabitants each, are living on several islands a few miles offshore. The map below provides some examples of the communities scattered throughout Sun City’s borders, with the traffic light-style coloring depicting a given community’s accessibility by road.

Environmental Assessment – Sun City’s geography is diverse, lying between the sea to the south, and steep mountains to the north, with a single road connecting it to the nearest major cities, running northeast to west. St. Peter’s Hospital, the region’s only public facility, also lies along this main road, making it easily accessible and, therefore, prone to being overwhelmed. This is particularly true during regular storms, flooding and mudslides, when the main road is cut-off in either or both directions, preventing assistance from other parts of the region. A number of additional obstacles impede the development of an effective EMS system:

Prehospital Emergency Care – Sun City has a fledgling community emergency response team (CERT), consisting of 20-30 first responders with varying levels of training, received through sporadic programs provided by local and international non-governmental organizations (NGOs), including the national Civil Protection and the Red Cross. There are two ambulances in Sun City: a Toyota Landcruiser ambulance provided to St. Peter’s by the Ministry of Health, and a Ford F450 TraumaHawk donated by a North American EMS agency. Neither are in service. The CERT team utilizes their own transportation to provide medical care, including motorcycles, pick-up trucks, and other available vehicles. Their work, however, is largely relegated to standby medical care at cultural events, disaster response, and public outreach and education. They are unable to provide reliable response services, as Sun City lacks a public emergency access number, leaving community members reliant on neighbors and family to provide transport to the hospital for patients with even the most critical conditions. When CERT members do respond to single-event emergencies, it is usually the result of incidental timing or because of a prolonged multi-casualty event that requires significant additional resources – for example, a commercial transport vehicle roll-over.

Clinical Emergency Care – St. Peter’s hospital is a 30-bed community hospital that was built more than 40 years ago as a family clinic to serve the Sun City village and its surrounding areas. When the old coastal road was paved over and made into a national highway, access to the hospital improved, which likewise increased the hospital’s patient volume, quickly over-running the facility’s capacity to provide a basic standard of care. Similarly, the smooth new asphalt road improved travel and commerce, but also led to a sharp increase in the incidence and severity of road traffic injuries, with major multi-casualty events becoming a near weekly occurrence along the 40 miles of highway within Sun City’s immediate
catchment area. Since the construction of the road, St. Peter’s hospital has never been able to keep up with the increased volume. A lack of funding for staffing and supplies also impedes quality care, while the waiting room serves as the de facto emergency department, staffed by newly graduated physicians with virtually no formal emergency medical care training, eagerly awaiting placement in a paying specialty, far away from the chaos of the waiting room.

Implementation – “System Saturation”
Listed here is a generic outline of the RM2 implementation process based on our System Saturation model (see Appendix A for a visual comparison of the two approaches):

- Emergency response capacity is strengthened in both the prehospital and clinical settings by training adequate numbers of personnel to provide an accepted minimum standard of quality emergency care
- Training for first responders is focused on basic life-saving skills and interventions for laypersons, and seeks a proportionate distribution throughout the catchment area according to population and availability of appropriate vehicles for safe transport; additional training specifically for RM2 utilization by first responders is conducted, running live simulations throughout the community to familiarize prehospital and clinical staff and other key stakeholders with the dispatching system
- Upon successful completion of the training program, first responders have their phone numbers entered into the RM2 server, which is housed at the most appropriate healthcare facility within the catchment area
- A multi-faceted public outreach and education campaign is launched to educate the community about emergency medical conditions, and how to appropriately access emergency medical care via SMS. The awareness campaign is led by trained CERT members, and is reinforced through a range of mediums, including public service announcements on the radio, TV, mobile phones, public events, literature, and live demonstrations, among others.
- Once prehospital training has reached adequate levels, and after key stakeholders are confident that the community has received adequate education, the RM2 server goes live in a public ceremony.

Features:
- Designed specifically for low-literacy populations, and includes multiple languages and foreign font sets (currently available in English, Spanish, French and Haitian Creole)
- Ability to handle simultaneous events, multi-victim incidents, and complex emergencies
- Can designate “Incident Commander” and request additional resources/mutual aid when needed
- Caller Identification to monitor first responders and discourage system utilization abuse
- Advanced notification capabilities for receiving facilities and online medical direction
- Ability to be utilized by multiple healthcare facilities in same catchment area
- Administrative functions
- Detailed data collection call logs for each incident
- Minimal IT requirements for implementation:
  - A basic laptop computer with GSM modem (no internet connectivity required)
  - Guaranteed power source to ensure continuity of operations
  - IT support for troubleshooting
- Customizable features for non-traditional deployment configurations (e.g., cruise ships, cultural events, mass gatherings, tours)

Currently in development:
- Patient care reports
- Remuneration for services
- Mapping features
Join Our Efforts – Become Involved and Benefit

RM2 represents a veritable sea change in how prehospital care systems are developed in LMICs, and we are eager to find strong partners willing to work with us as we continue to develop what promises to be a venture with huge potential for impact:

- **Field-Testing** – Partner with us in controlled field-testing with opportunities for continued support and collaboration
- **Software Development** – Become an IT-/Technical Partner in future RM2 enhancements
- **Support Us** – Become a Friend, Supporter or Delegate of Trek Medics International and help us to continue improving emergency medical care anywhere.

Note: due to a lack of GPS positioning technology, we are currently limited to non-major urban settings with defined geographic borders. Potential sites for RM2 implementation are LMICs marked in blue.

If you’re interested in learning more about the RM2 software, or becoming involved in our field testing, please feel free to contact us by phone or email at any time.

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About the Software
The RM2 software was designed by Trek Medics international and developed in partnership with Vision Point Systems (Blacksburg, VA).

Trek Medics International is dedicated to reducing the global burden of premature death and disability in vulnerable communities through the development of prehospital and emergency care services. We are a 501(c)(3)-registered, non-profit, humanitarian organization, and make our services available to all, regardless of race, religion, gender or creed.

Vision Point Systems has been engineering software solutions for the Pharmaceutical Industry since 2002. VPS specializes in systems designed for managing communications with your customers- Interactive Voice Response, Contact Center Management, SMS-based applications, and Business Process Management. Available services include custom application development, communications technology consulting, and software quality assurance.

http://ses.visionpointsystems.com
Appendix A

**Transport Access: “System Status” Model**

- Principal Problem: “How do we get ambulances to emergency patients as quickly as possible?”
- Ambulances are positioned using algorithms based on population density, call volume patterns, response history, and other factors
- As call volume increases, remaining ambulances re-locate to locations where there is a higher probability of receiving a call.

**Assumptions:**
- Accessible roads
- Accurate maps
  - Street names
  - House numbers
- Affordable gas
- Uniform ambulances
- Excess spare parts
- Expert mechanics

**Transport Access: “System SATURATION”**

- Principle Problem: “How do we get emergency patients to the hospital as quickly as possible?”
- First responders with basic emergency care training and access to appropriate transportation are spread proportionally through communities, leading to increased availability of quality prehospital care and reduced delays in transportation

**Assumptions:**
- Limited accessibility roads
- Reliable maps unavailable
  - Street names intermittent and/or not well-known
  - House numbers non-existent
- Gas costs are prohibitive
- Limited ambulances
- Limited maintenance and fleet support
- Mechanics with minimal formal training
- No dispatch or public access number
- Adequate mobile phone penetration
Appendix B
Telecommunications in LMICs

Many of the telecommunications systems currently being used in LMICs for emergency dispatching mimic those that have been used over the past 40 years in North America and Europe, including short-band, two-way, and commercial vehicle radios. At the same time, mobile phone penetration in LMICs is upwards of 80%. Yet ineffective and inappropriate telecommunication systems that have been transplanted from high-income systems to low-income communities regularly result in unreliable and redundant systems, leading to inevitable delays and making it near impossible to coordinate multiple units during complex emergencies. As a result, “unskilled labour” is regularly the primary mode of transport for the sick and injured in LMICs.

References

9. For emergency care, training includes all personnel regularly treating emergency medical conditions in the clinical setting, as well as 1% of the population in the prehospital setting.