Apps for Rapid Epidemiological Analysis (AREA)

Joseph V. Cohn[1,*], Amos Freedy[9,**], Timur Chabuk[9], Gershon Weltman[9,**],
David J. Combs[2,*], Antonio Anglero Jr.[3,***], Brian R. Johnson[4,*],
David Rozovski[5,*], Stephen Eggan[6,*], Brennan Cox[5,*],
Kirsten Carlson[7,*], and Elizabeth O'Neill[8]

[1] Office of Naval Research, Arlington, VA
[2] Naval Research Laboratory, Washington, DC
[3] Naval Safety Center, Norfolk, VA
[4] United States Air Force Academy, Colorado Springs, CO
[5] Naval Aerospace Medical Institute, Pensacola, FL
[6] Naval Medical Research Unit–Dayton, Dayton, OH
[7] Naval Air Warfare Center Aircraft Division, Patuxent River, MD
[8] Strategic Analysis, Inc., Arlington, VA
[9] Perceptonics Solutions, Inc, Sherman Oaks, CA
eoneill@sainc.com

Abstract. Communication is difficult in low income areas, given the lack of land based telecommunication and distances between population centers [1]. New methods to monitor/forecast epidemiological trends will enable our military to execute emerging operational requirements. Hand held devices, such as cell phones, smart phones and personal data assistants (PDAs) provide an effective source for collecting, analyzing and widely disseminating healthcare information, because of their widespread use in the very regions to which our military forces are, and will be, deployed. This effort develops handheld device applications that provide health surveillance, epidemiological analysis and forecasting capabilities.

Keywords: Mobile Device, Applications, Epidemiology, Data Collection, Forecasting, Military Health System, Medical Readiness, Humanitarian Aid, Disaster Relief.

1   Introduction

1.1   The Importance of AREA

The US Military is continuing to expand it efforts into non-kinetic operations to include emphasizing Stabilization, Security, Transition, and Reconstruction Operations (SSTRO) and Humanitarian Aid / Disaster Relief Operations. The

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* Ph.D., Medical Service Corps, United States Navy.
** Ph.D.
*** Psy.D., Medical Service Corps, United States Navy.

development and surveillance of the healthcare landscape forms a cornerstone of any strategy developed to support these actions (Figure 1). Hand held devices, such as cell phones, smart phones and personal data assistants (PDAs) provide an effective source for collecting, analyzing and widely disseminating healthcare information, because of their widespread use in the very regions to which our military forces are, and will be, deployed. For example, in Africa, over 75% of telecommunications are conducted using mobile devices [2]. Today's mobile devices have significantly expanded computational processing capability over earlier devices [3]. As well, the infrastructure for developing applications – "Apps"; a piece of software executable on a mobile device - is also rapidly maturing, with predictions of a threefold increase in the quantity of mobile apps by the end of 2012 [4]. Moreover, the types of information collectable by current mobile devices have expanded to include: high resolution pictures; video; text; geo location; and, in most cases, text-based annotations. The key to realizing this potential of mobile devices in supporting epidemiological efforts is to develop Apps that can fully exploit the various hardware and processing capabilities of today's mobile devices.

Problem	*Opportunity*
• Health crises are characterized by uncertainty • Convergence problem (people, materials, information,…) • Data collection to support decision making is critical • However, field crisis management is typically: - Chaotic and ad hoc - Unresponsive to changing needs - Slow in collection and reporting - Error and loss prone - Limited reach	Support crisis management in the field to be more: • <u>Efficient</u>, through integrated support for situation-dependent collection methodologies • <u>Expansive</u>, through data collection from multiple sources (field teams, crowd-sourced, government and institutions) • <u>Focused</u>, through continually re-adapting collection requirements based on acquired data and analysis • <u>Responsive</u>, through enhanced coordination between operations center and field units

Fig. 1. Examples of current problems in epidemiological data collection/analyses and opportunities for improvement via AREA development. (Figure courtesy of Perceptronics Solutions, Inc.)

1.2   Primary Focus

This effort is focusing on developing apps that will enable: rapid data collection capabilities from multiple sources (e.g. web or text based files, manually input information and information collected using technologies inherent to hand held devices); artificial intelligence / machine learning approaches for data mining, analysis and forecasting; information visualization, to include geospatial localization for epidemiological pattern tracking; and real time capabilities for collaborative and

interactive decision making. The output from these applications should enable users to better understand disease processes and progress; to map disease patterns; to better understand proximate and distal risk factors; and to develop effective courses of action. Ultimately, this technology will have broad application in commercial as well as military settings.

1.3   Field Use

The ability to develop assessments, forecasts and courses of action using real time epidemiological data collected across many different areas of operation will allow military decision makers to more effectively account for military medical readiness as part of their overall planning strategy. More locally, this technology should allow for faster and more accurate responses to potential disease outbreaks in the close-quarters common to military facilities, and ships. Commercially, this technology will provide similar levels of support, enabling health care providers, including Non-Governmental Organizations, charged with working in remote, impoverished and under-represented areas to better understand the moment-to-moment disease challenges they may encounter, and to plan effective treatments plans accordingly (Figure 2). As well, health care providers charged with supporting large, densely packed populations (such as may be found in Universities or urban settings) will benefit from having this technology to detect early-on possible disease outbreaks, like Meningitis and Influenza, and plan treatment strategies as necessary.
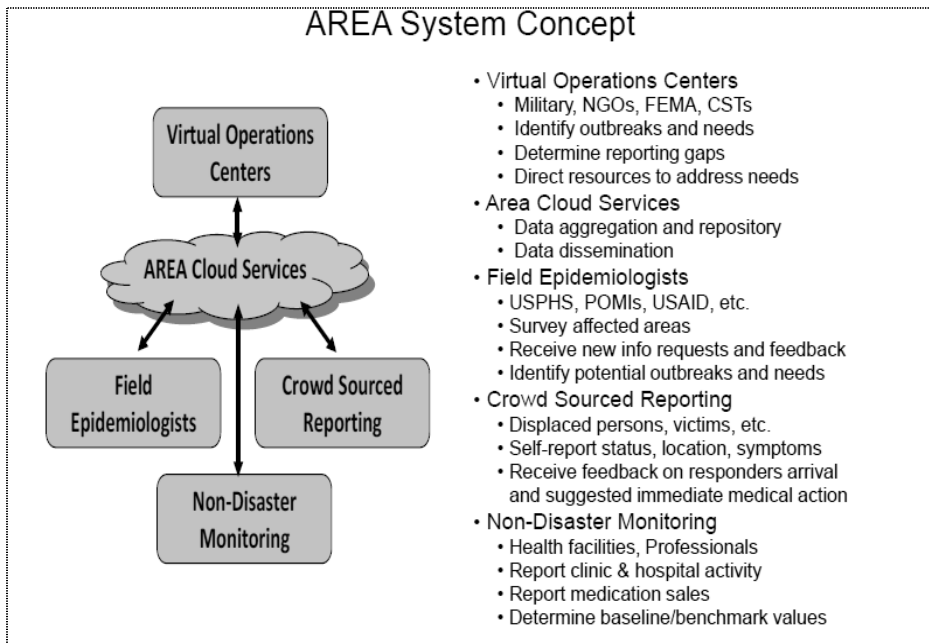
Fig. 2. Outline of AREA concept and capabilities (Figure courtesy of Perceptronics Solutions, Inc.)

References

1. Tomlinson, M., Solomon, W., Singh, Y., Doherty, T., Chopra, M., Ijumba, P., Tsai, A.C., Jackson, D.: The use of mobile phones as a data collection tool: A report from a household survey in South Africa. BMC Medical Informatics 9, 51–58 (2009)
2. White, D.: Telecommunications: A dynamic revolution,
   `http://www.ft.com/cms/s/0/1868125e-6e5f-11db-b5c4-`
   `0000779e2340,dwp_uuid=1f2588a0-765d-11db-8284-`
   `0000779e2340.html?nclick_check=15`
3. Uti, N.V., Fox, R.: Testing the Computational Capabilities of Mobile Device Processors: Some Interesting Benchmark Results. In: 2010 IEEE/ACIS 9th International Conference on Computer and Information Science, pp. 477–481 (2010)
4. Horowitz, B.T.: Mobile health apps to triple by (2012), presenting challenges for mobile networks: Report, `http://www.eweek.com/c/a/Health-Care-IT/Mhealth-`
   `Apps-to-Triple-by-2012-Presenting-Challenges-for-Mobile-`
   `Networks-Report-869725/`
5. Anhøj, J., Møldrup, C.: Feasibility of collecting diary data from asthma patients through mobile phones and SMS (short message service): response rate analysis and focus group evaluation from a pilot study. J. Med. Internet Res. 6(4), e42 (2004)