Crisis Warning Signs in mHealth for Military Veterans: A Collaborative Design Approach

Zeno Franco
Medical College of Wisconsin
zfranco@mcw.edu

Katinka Hooyer
Medical College of Wisconsin
khooyer@mcw.edu

Rizwana Rizia
Marquette University
rizwana.rizia@marquette.edu

A B M Kowser Patwary
Marquette University
abm.patwary@marquette.edu

Mathew Armstrong
University of Wisconsin, Milwaukee
armstr66@uwm.edu

Bryan Semaan
Syracuse University
bsemaan@syr.edu

Craig Kuziemsky
University of Ottawa
kuziemsky@telfer.uottawa.ca

Bob Curry
Dryhootch of America
bob@dryhootch.org

Sheikh Iqbal Ahamed
Marquette University
sheikh.ahamed@marquette.edu

ABSTRACT

Crises range from global catastrophes to personal disasters. However, systematic inquiry on crises rarely employs a comparative approach to examine commonalities between these seemingly very different events. We argue here that individual psychosocial disasters can inform a broader discussion on crises. Our approach applies general crisis theory to a smartphone based psychosocial support system for US military veterans. We engaged in a process designed to explore how veteran peer-to-peer mentorship can be augmented with IS support to display potential early warning signs as first step toward preventative intervention for high risk behaviors. To gain a better understanding of how military veterans might benefit from such a system, this article focuses on a community collaborative design process. The co-design process used the Small Stories method, allowing important cultural characteristics of to emerge, illuminating considerations in IS design with military veterans, and highlighting how humans think about crisis events at the individual level.

Keywords

Veterans, psychological crisis, mHealth, peer support, collaborative design.

INTRODUCTION

At every level of human experience, crisis situations defy simple solutions because of their complex, interlocking nature. While very different on the surface, events like major natural disasters and individual mental health crises share important characteristics. These include: 1) pre-existing system vulnerabilities which may be known or unrecognized (Lipscy, Kushida, & Incerti, 2013); 2) early warning signs that are difficult to detect against background noise (Saleh, Saltmarsh, Favarò, & Brevault, 2013); 3) cascading impacts as resources and options degrade (Berariu, Fikar, Gronalt, & Hirsch, 2015); 4) a point of criticality beyond which degrees of freedom to act are profoundly constrained (Arnal, 2015; Sornette, 2002); 5) a clearly recognized crisis event (the period beyond the point of criticality) which requires significant external resources in order to recover or restore order (O'Sullivan, Kuziemsky, Toal-Sullivan, & Corneil, 2013; Quarantelli, 1985). True crisis events have proven quite difficult to accurately predict and intervene on before the point of criticality using human intelligence or computational methods (Boettiger & Hastings, 2012).

Mental health crises profoundly impact US military veterans, with 15-20% of combat veterans experiencing Post-Traumatic Stress Disorder (PTSD; Insel, 2008; Kaplan, McFarland, Huguet, & Valenstein, 2012). PTSD diagnosis is associated with high risk behaviors, including alcohol/substance abuse, impulsivity, and angry outbursts. Veterans experience personal crisis events more frequently than their civilian counter parts, with significantly greater risk for interpersonal violence, suicide and unintentional injury to themselves and others (Kang et al., 2015; Novaco & Chemtob, 2015). Despite improvements in evidence based therapy for PTSD at the Veteran Health Administration (VA), PTSD remains treatment resistant and is typically chronic (Hammarberg & Silver, 1994). As a result, the VA's National Center for PTSD suggests re-conceptualizing PTSD by focusing on associated high risk behaviors (Hartl, Rosen, Drescher, Lee, & Gusman, 2005). However, obtaining accurate, timely information about high risk behaviors from veterans remains an elusive goal in improving detection, prediction and early intervention for psychological crisis events.

This project applied general crisis theory to a examine ways to intervene on individual crisis in US military veterans, mirroring an existing veteran peer mentor social support model and examining ways this model could be enhanced with an Information Systems approach (Semaan, Britton, & Dosono, 2016). The Dryhootch Quick Reaction Force (QRF) smartphone application sought to fill the information gap with veterans by gathering simple psychological and social functioning data from at-risk veterans regularly, and presenting this aggregated information to their peer mentors through a separate QRF mentor app. The community collaborative design process also revealed specific ways veterans think about individual level crisis and early warning signs that can be instantiated in mHealth technologies, but also inform overall theories of interaction between individual and systems level disturbance, disaster, and resilience (O'Sullivan, Kuziemsky, Corneil, Lemyre, & Franco, 2014).

Community Engagement Framework for IS Design: The Dryhootch Partnership for Veteran Health

Dryhootch is a non-profit veteran led, veteran serving community organization headquartered in Milwaukee, Wisconsin. Its name encapsulates its mission to provide an alcohol and drug free ("dry") social space that is safe and inviting for veterans ("hootch" is military jargon describing a hut or safe place to sleep and also plays on the word's association with alcohol). Dryhootch leaders and faculty from Milwaukee's Zablocki VA Medical Center (ZVAMC) and Medical College of Wisconsin (MCW) formalized a community-academic partnership for health in 2008. Descriptions of this partnership, called *Dryhootch Partners for Veteran Health*, its formation process, and lessons learned are detailed elsewhere (Franco, Flower, Whittle, & Sandy, 2015). One common area of interest within the partnership was improving outreach to younger veterans returning from Operation Enduring Freedom (Afghanistan) and Operation Iraqi Freedom (OEF/OIF veterans) using technology. Younger veterans have different expectations about connecting with systems of care after normal business hours, at a distance, and in some cases prefer technology mediated contact.

EXPLORING COLLABORATIVE INFORMATION SYSTEMS DESIGN WITH MILITARY VETERANS

The desire on the part of Dryhootch to reach out to veterans using web and mobile technology was clear, but it rapidly became apparent that while the veterans wanted an app to be built, *what this app might be* was notional at best. Ideas ranged from geo-locating other veterans, to gamification strategies designed to engage younger veterans in ways that would encourage both online and face-to-face activities, and elements of veteran-to-veteran peer mentorship. This dramatically clashed with our laboratory's approach, which was requirements driven. Weekly meetings involving lead peer mentors from Dryhootch, social scientists (largely as facilitators), and CS lab members were established, but for the first several months the veterans would engage in free-ranging

discussion about the long-term possibilities of the app and insist that "you should just build it!", without an understanding of the complexity of the task.

Similarly, the programmers often dismissed key design elements suggested by the Dryhootch veterans, insisting that the alpha version of the app was "working" even when the veterans reported serious errors and problems, and did not account for "real world" considerations such as backward compatibility with older smartphones that veterans often owned.

Ultimately, the veterans declared the alpha version of the app a failure (Rizia et al., 2014). Complex systems design such as collaborative information design needs to be done through a participatory lens that understands and incorporates the perspectives of all who will engage with the system (e.g. users, designers, administrators) (Camara & Abdelnour-Nocera, 2013). System design that is truly collaborative often requires trade-offs to be made across different groups in the context of the overall social good of the system (Kuziemsky, 2015). Because of this past collaborative experience in other domains, we expected that the process of community driven information systems design would unfold naturally – we were quickly proven wrong. The first deliberate attempts to move toward a more formalized collaborative design framework began at the point that our team collectively accepted the failure of the alpha version and we decided to start fresh. We examine a few of the "critical moments" encountered in this process here.

METHOD – SMALL STORIES APPROACH

During weekly meetings with peer mentors and a series of veteran focus groups, we sought to extract information about the process of veteran-to-veteran peer mentorship and crisis events using the Small Stories method. The term small stories refers to under-represented and "a-typical" narrative activities, such as tellings of recent, ongoing, or still unfolding events, future or hypothetical events, shared (known) events, allusions to (previous) tellings, deferrals of tellings, and refusals to tell (De Fina & Georgakopoulou, 2011). These tellings are non-canonical in that they do not necessarily follow prototypical narrative inquiry, such as beginning–middle–end; they occur in small moments of conversation, and within everyday life situations (Georgakopoulou, 2007). A summary of data collection opportunities, methods, number of participants and military service periods are offered in FIGURE 1.

Method	Timeline	Focus Area	No. Of Veterans Participants	Military Service Period	Data Accumulation Process
Community collaborative design in technology lab	January 2014 – Present	System requirements	10 Veteran Peer-mentors	OEF/OIF, cold War	Weekly meeting and interviews over a 2 year period
First focus group in a Dryhootch center	July 2014	Gather views from veterans who could not participate in the design meetings	15 Veteran mentors and mentees	Vietnam, OEF/OIF, cold War	Close room audio and video recording, conversational session, simulation of mentoring session
One-to-One interview (Follow up first focus group)	July 2014	Importance of technology mediated peer-mentoring	1 Veteran mentor	Gulf war	Notes on conversation
Second focus group in a university veteran service center	October 2014	Gather views from younger tech-savvy veterans	7 Student veterans	OEF/OIF veterans only	Audio record conversations and notes on responses on usability

Figure 1. Data collection strategy for collaborative design effort

SMALL STORIES AS CRITICAL MOMENTS IN COLLABORATIVE DESIGN

Critical Moment 1: Acknowledgement of cultural barriers and cultural shock for both programmers and veterans

Trying to explain the ethos of military culture and jarring return from over-seas service to civilian life to a group of non-US CS students proved more difficult than anticipated. Fundamental things to the veterans and social science team, such as the existence of a national healthcare system for veterans (the VA) were not familiar to the CS students. When we tried to describe the transition from military to veteran life in technical or clinical terms,

none of this seemed to resonate with the CS students. Finally, one of the veterans asked where each student came from, and the responses were, "China…Vietnam…Bangladesh". The veteran then asked, "Have any of you experienced culture shock being a student here in the US?" The students discussed difficulties acclimating to food, language, and subtle cultural expectations. The veterans then turned the conversation to note that veterans also face culture shock moving from a deeply ingrained, pervasive military culture, to being a civilian again. From the perspective of the social science team, this appeared to be the tipping point where the students began paying much closer attention to the rich detail that veterans provided.

Critical Moment 2: Use of Video & Photos

With this first step closer to a truly transdisciplinary stance, where each group begins to enter into the life-world of the other (Hunt & Thornsbury, 2014), we started to use news and other video segments depicting how soldiers experience the transition back to civilian life and problem behaviors (e.g. high risk driving, social isolation). Particularly impactful was a brief video, called *Now After: PTSD From a Soldiers POV*, notably produced by a former US soldier who had deployed to Iraq. The video was evocative, at times disturbing, but ultimately hopeful (video available at: https://www.youtube.com/watch?v=NkWwZ9ZtPEI). The entire team watched it together, which we feel also helped solidify a common experience. CS students visually witnessed some of the traumatic war experiences that veterans often do not disclose out of honor and pride (Gutmann, 2010). Veteran peer mentors also gave mini-talks on their experiences in the military (see FIGURE 2).

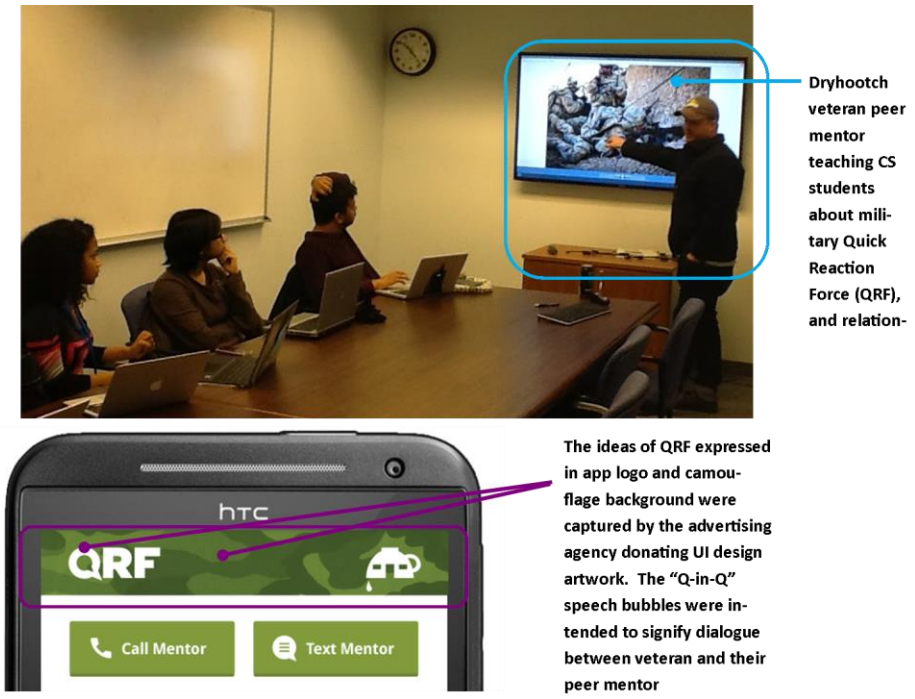

Figure 2. Collaborative cultural targeting for renaming of app from iPeer to QRF to reflect military culture

Critical Moment 3: Appreciative Inquiry about Code

While these steps were important in bringing the CS students closer to the lived experience of the veterans, there was similarly little appreciation from the veterans about the technical hurdles the CS team was encountering. Increasingly, the social science team encouraged the veterans and the lead developer to sit side-by-side and work through technical issues step-by-step. At one such moment, the anthropologist asked the lead developer, who had both the code and an app emulator up on his screen, "You need all that code to make this one little thing work properly?" pointing to the code-base. The veteran, seated next to the developer looked up from the app UI and at the code, and said, "Wow. I don't think I could keep all of that straight." This was an important transition where the veterans witnessed the effort required by the CS team build the QRF app.

Results: Deep Cultural Targeting

Perspectives on culture have become increasingly important in technology development (Rogers, 2012; Smith, 2013). While remaining aware of variations in veteran subgroups (e.g. differences arising from branch of service, military service period, deployment location, etc.), we focused on common characteristics (Kreuter & McClure, 2004). These included language (universal acronyms) and normative practices (following orders and collectivism), and exploring how veterans viewed early warning signs for psychological and reintegration crises.

Military Structure and Values

The military is necessarily structured as a hierarchical organization with a chain of command where members follow orders as a team, in order to succeed in complex and dangerous missions (Grossman, 2009). As a collectivist organization, members rarely make individual decisions. To ensure this trust in authority, an ethos of honor, duty and selfless service is instilled in recruits early in basic training (Holyfield 2011). The military also focuses on instrumental activity that is rapid and results in concrete outcomes.

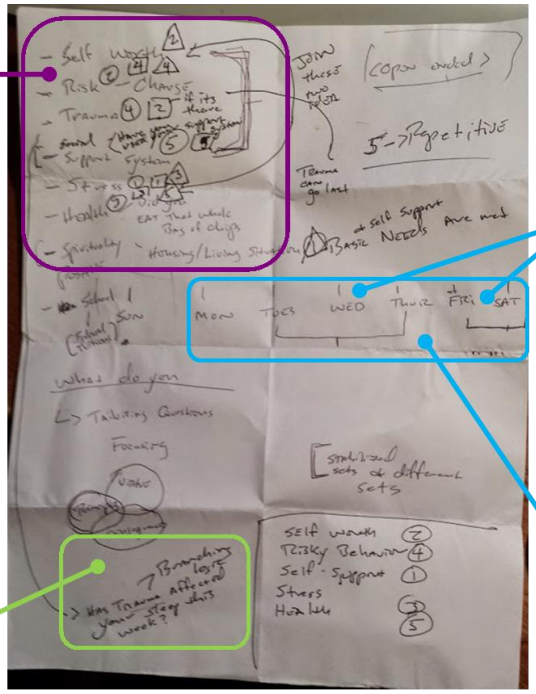

Figure 3. Consensus building document for reduced EMA survey items, optimal EMA data collection windows.

These cultural characteristics emerged in design discussions in a number of areas. First, the length of scientifically validated Ecological Momentary Analysis (EMA) survey instruments was seen as too lengthy (see FIGURE 3). Second, how to prompt veterans to take the EMA survey and how to visually graph if a survey was missed led to detailed discussions. Programmers designed an EMA "available" notification on the app homepage but the veterans felt this was not a strong "directive". A change was made to call this a "check-in" because "That way it is more of an order." Using "check-in" also reflected a military collectivist mentality letting the user know that their mentor is actively supporting and accountable to them.

Structure and routine are also key components of military culture. Upon reintegrating into civilian life, veterans often struggle with a lack of structure and routine. In discussions over when to have participants take the survey, veterans suggested that the beginning of the week and the end of the week were the most critical since the weekends were danger zones where participants were more likely to "go off-schedule" and engage in risky behavior (see FIGURES 3 & 4).

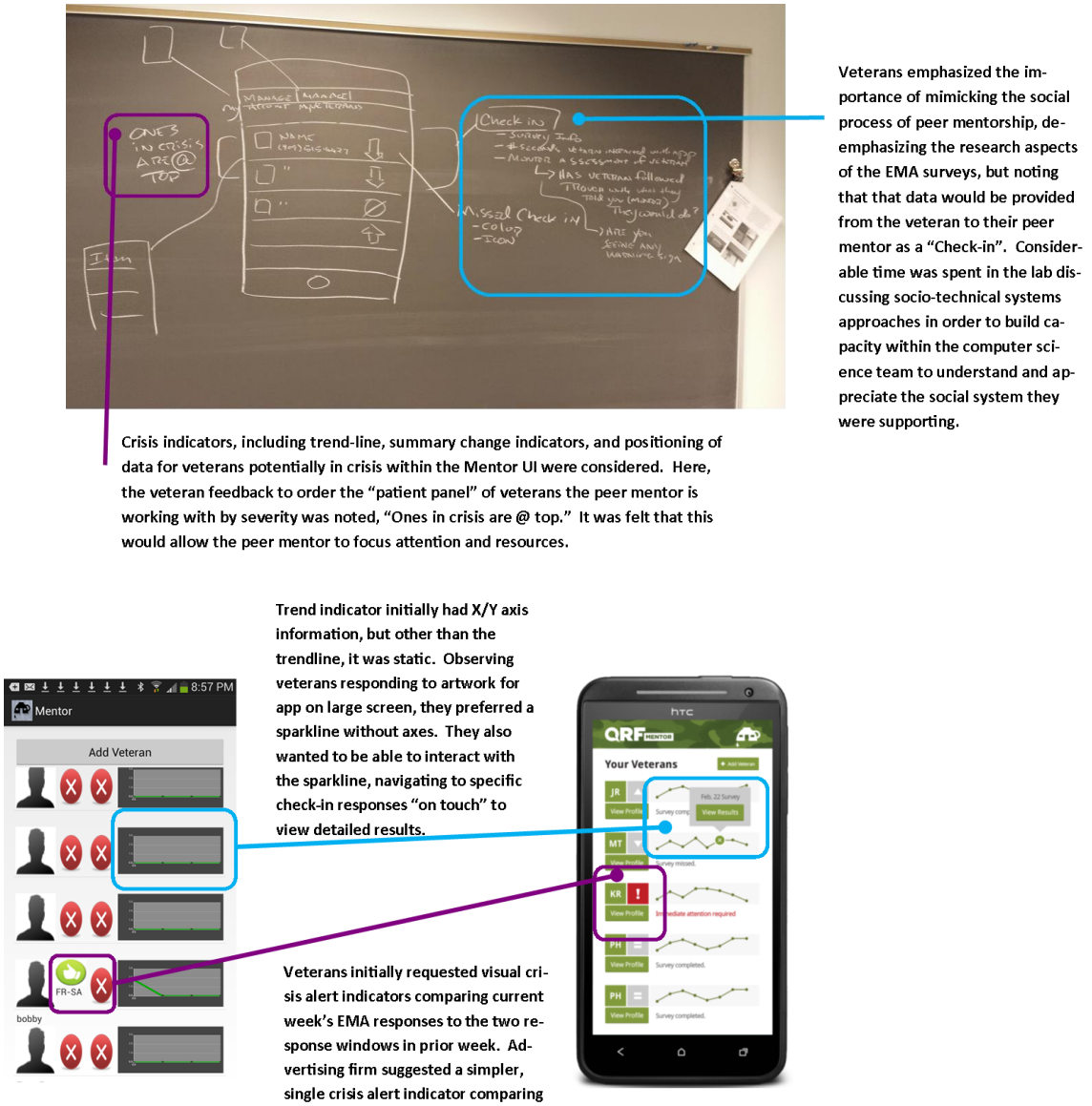

Figure 4. Multi-step design process to create mentor interface to aggregate data and provide visual indicators for impending psychosocial crisis.

Crisis Identification & Veteran's Views of Early Warning Signs

As part of this work, we attempted to carefully examine early warning signs for mental health crisis in veterans as a key component of information systems design. Beyond basic changes in EMA responses, four distinct areas of consideration for early warning signs were identified: 1) Notable differences in how failure to complete check-ins were viewed by military service age group. Older veterans felt that participants in the QRF program should perform check-ins using the app because "you were told to do so" and that failure to check-in was also an indication of lack of commitment – a warning sign in itself. Younger (OEF/OIF) veterans saw failure to check-in indicating countervailing short-term priorities, like having to take exams. 2) All veterans noted that creating individual baselines as important because some veterans may always appear to be in crisis based on survey response; 3) While averaged EMA survey responses were important, veteran peer mentors wanted to be able to view *individual* survey item responses over time as warning signs might be domain specific; And 4) modifiers to warning signs may be as important as the signal itself. For example, the veterans requested one item on overall health, noting that even minor illness can magnify psychological symptoms.

Conclusion

Cultural characteristics are critical in the consideration of crisis intervention design for military veterans who have transitioned between intensely different social contexts within a very short time. Such designs need to be collaboratively generated and targeted in ways that reflect the practices and beliefs of the user population. While cultural and contextual aspects are a key element of collaborative systems design (C. Kuziemsky, Nøhr, Aarts, Jaspers, & Beuscart-Zephir, 2013), understanding cultural and contextual user needs and then turning them into systems design requirements is a significant challenge (Kushniruk, Nohr, Jensen, & Borycki, 2012). The small stories approach presented in this paper is complementary to other user centered approaches from Human-Computer Interaction and Computer Supported Cooperative Work. The findings provide insights about early warning signs in mobile mental health applications with individuals. This discussion may also inform broader theoretical inquiry on the nature of weak signals in larger scale systems.

ACKNOWLEDGMENTS

This work was wholly supported by the Advancing a Healthier Wisconsin Endowment. Special thanks to Cramer-Krasselt Advertising for donating final UI artwork for the QRF app.

REFERENCES

1. Arnal, J. T. (2015). Financial Crisis and the Failure of Economic Theory: Routledge.
2. Berariu, R., Fikar, C., Gronalt, M., & Hirsch, P. (2015). Understanding the impact of cascade effects of natural disasters on disaster relief operations. International Journal of Disaster Risk Reduction, 12, 350-356.
3. Boettiger, C., & Hastings, A. (2012). Quantifying limits to detection of early warning for critical transitions. Journal of The Royal Society Interface, 9(75), 2527-2539.
4. Camara, S., & Abdelnour-Nocera, J. (2013). Revealing the Socio-Technical Context of Design Settings: Toward Participatory IS Design. International Journal of Human-Computer Interaction, 29(4), 289-307.
5. De Fina, A., & Georgakopoulou, A. (2011). Analyzing narrative: Discourse and sociolinguistic perspectives: Cambridge University Press.
6. Franco, Z., Flower, M., Whittle, J., & Sandy, M. (2015). Professional ethics and virtue ethics in community-engaged healthcare training. In D. Mitchell & R. Ream (Eds.), Professional responsibility - The fundamental issue in education and health care reform (pp. 211-229). Cham, Switzerland: Springer.
7. Georgakopoulou, A. (2007). Small stories, interaction and identities (Vol. 8): John Benjamins Publishing.
8. Grossman, D. (2009). On killing: The psychological cost of learning to kill in war and society: Little, Brown and Company.
9. Gutmann, M. C. (2010). Breaking ranks: Iraq veterans speak out against the war: Univ of California Press.
10. Hammarberg, M., & Silver, S. M. (1994). Outcome of treatment for post-traumatic stress disorder in a primary care unit serving Vietnam veterans. Journal of traumatic stress, 7(2), 195-216.
11. Hartl, T. L., Rosen, C., Drescher, K., Lee, T. T., & Gusman, F. (2005). Predicting high-risk behaviors in veterans with posttraumatic stress disorder. The Journal of nervous and mental disease, 193(7), 464-472.
12. Hunt, F., & Thornsbury, S. (2014). Facilitating transdisciplinary research in an evolving approach to science. Open Journal of Social Sciences, 2014.
13. Insel, T. R. (2008). Assessing the economic costs of serious mental illness. The American Journal of Psychiatry, 165(6), 663-665.
14. Kang, H. K., Bullman, T. A., Smolenski, D. J., Skopp, N. A., Gahm, G. A., & Reger, M. A. (2015). Suicide risk among 1.3 million veterans who were on active duty during the Iraq and Afghanistan wars. Annals of epidemiology, 25(2), 96-100.
15. Kaplan, M. S., McFarland, B. H., Huguet, N., & Valenstein, M. (2012). Suicide risk and precipitating circumstances among young, middle-aged, and older male veterans. American journal of public health, 102(S1), S131-S137.
16. Kreuter, M. W., & McClure, S. M. (2004). The role of culture in health communication. Annu. Rev. Public Health, 25, 439-455.

17. Kushniruk, A., Nohr, C., Jensen, S., & Borycki, E. (2012). From Usability Testing to Clinical Simulations: Bringing Context into the Design and Evaluation of Usable and Safe Health Information Technologies. Contribution of the IMIA Human Factors Engineering for Healthcare Informatics Working Group. Yearbook of medical informatics, 8, 78-85.
18. Kuziemsky, C., Nøhr, C., Aarts, J., Jaspers, M., & Beuscart-Zephir, M.-C. (2013). Context sensitive health informatics: concepts, methods and tools. Studies in health technology and informatics, 194, 1-7.
19. Kuziemsky, C. E. (2015). A Model of Tradeoffs for Understanding Health Information Technology Implementation. Stud Health Technol Inform, 215, 116-128. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/26249190
20. Lipscy, P. Y., Kushida, K. E., & Incerti, T. (2013). The Fukushima disaster and Japan's nuclear plant vulnerability in comparative perspective. Environmental science & technology, 47(12), 6082-6088.
21. Novaco, R. W., & Chemtob, C. M. (2015). Violence associated with combat-related posttraumatic stress disorder: The importance of anger. Psychological trauma: theory, research, practice, and policy, 7(5), 485.
22. O'Sullivan, T. L., Kuziemsky, C. E., Corneil, W., Lemyre, L., & Franco, Z. (2014). The EnRiCH community resilience framework for high-risk populations. PLoS currents, 6.
23. O'Sullivan, T. L., Kuziemsky, C. E., Toal-Sullivan, D., & Corneil, W. (2013). Unraveling the complexities of disaster management: A framework for critical social infrastructure to promote population health and resilience. Social Science & Medicine, 93, 238-246.
24. Quarantelli, E. L. (1985). What is disaster? The need for clarification in definition and conceptualization in research Disasters and Mental Health Selected Contemporary Perspectives.
25. Rizia, R., Johnson, N., Patwary, A., Ahsan, G., Ahamed, S., Franco, Z., . . . Flower, M. (2014). Mobile peer-mentoring: An approach to make veterans seek mental health-care support a normality. Paper presented at the Collaborative Computing: Networking, Applications and Worksharing (CollaborateCom), 2014 International Conference on.
26. Rogers, Y. (2012). HCI theory: classical, modern, and contemporary. Synthesis Lectures on Human-Centered Informatics, 5(2), 1-129.
27. Saleh, J. H., Saltmarsh, E. A., Favarò, F. M., & Brevault, L. (2013). Accident precursors, near misses, and warning signs: Critical review and formal definitions within the framework of Discrete Event Systems. Reliability Engineering & System Safety, 114, 148-154.
28. Semaan, B., Britton, L., & Dosono, B. (2016). Transition Resilience with ICTs: ŒIdentity Awareness[1] in Veteran Reintegration. . Paper presented at the ACM Human Factors In Computing Systems, San Jose, CA.
29. Smith, R. C. (2013). Designing Digital Cultural Futures: Design Anthropological Sites of Transformation. Aarhus UniversitetAarhus University, ArtsArts, Institut for Æstetik og KommunikationDepartment of Aesthetics and Communication, Institut for Æstetik og Kommunikation-InformationsvidenskabDepartment of Aesthetics and Communication-Information Science.
30. Sornette, D. (2002). Predictability of catastrophic events: Material rupture, earthquakes, turbulence, financial crashes, and human birth. Proceedings of the National Academy of Sciences, 99(suppl 1), 2522-2529.