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Resilience Informatics and Public Health

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Resilience

- The COVID-19 pandemic caused, and is still causing, immense harm worldwide
- It highlighted the importance of ***Resilience***
- Several definitions exist. We use the definition of the US National Academies of Science : "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to actual or potential adverse events." [1]
- Resilience Research is a growing discipline focusing on developing methodologies for enhancing multi-level resilience. [2,3]

Informatics

- Informatics underlies all of modern life
- Powerful capabilities including new ones from Large language models
- Predictive analytics
- Software intensive devices, eg smart phones are ubiquitous

Resilience Informatics

- *The Application of informatics techniques to materially improve and promote the ability of people, communities, and organizations, to effectively cope with natural and man-made stressors.*
- So the question is: How can we best apply the power of modern informatics to enhance resilience.
- Applications can span industry, economics, agriculture and so on
- We will focus on Public health
- Want to develop a framework for how Informatics can support Resilience among people, communities and systems

Types of Stressors

- Acute
  - Disease outbreaks, Tsunamis, Earthquakes, Terrorism attacks
- Chronic
  - Long-term "chronic" and persistent events
  - An acute stressor can transform into a chronic one
  - Climate Change is a Chronic stressor causing great concern
  - Apart from impact on agriculture, industry etc climate change has significant, highly concerning effects on public health.
    - Example: Coccidiomycosis (Valley Fever), a fungal disease originally detected in Arizona, has spread to California due to drier, hotter temperatures

Resilience Informatics and Stressor types

- Design and implementation of RI systems depends on type of stressor
- In both types of stressors need to reach large numbers of people
- **Acute Stressors**
  - Need to develop rapidly
  - Rapid dissemination and gathering of information
  - Loss of infrastructure
  - Language diversity and literacy
  - Social determinants of health in target population
  - Trauma (physical and mental)
  - **Behavior change (could be short-term)**

Resilience Informatics and Stressor types

- Chronic
  - Data Science and predictive analytics [4]
  - More sophisticated systems can be developed
  - Longer time window to develop and deploy
  - Can expect that good infrastructure will remain available
  - Language diversity and literacy
  - Social determinants of health in target population
  - Mental health of affected people
  - **Behavior change (may need to be long-term)**

RI functionalities

- Behavior change is often a part of enhancing Resilience
  - Example: Hand washing, mask-wearing
  - Workarounds to loss of infrastructure and facilities
- Alternatives and work-arounds to loss of health services and informatics facilities
  - Telehealth, mHealth
- Predictive analytics combining climatology, forecasting, disease modeling[4]

6-component framework for RI systems

Component 1	Team	Multi-disciplinary teams that represent all aspects/factors of resilience (subject matter experts about the public health emergency, culture of target population, environment, informatics technologies, and the specific resilience context).
Component 2	Requirements	Rapid development is often a requirement especially for Acute stressors. The system may need to reach large numbers of people as soon as possible.
Component 3	Information	System must provide evidence-based information pertinent to the stressor, battle misinformation, match cultural, linguistic, educational, and economic status of the target users.
Component 4	Design	The system must match the technological capabilities available in the target context and the education levels, language, cultural characteristics of target users. Concepts from Persuasive Technology could aid in designing these systems[5-7] when there is a need to change behaviors to
Component 5	Implementation	Systems must be implemented efficiently and rapidly using an adaptive management approach, while incorporating a feedback loop using, e.g. the Agile development model [8].
Component 6	Evaluation	Systems must integrate an evaluation strategy to regularly assess the impact of the system and make changes as needed..

AZCOVIDTXT: Case Study RI system

- Designed, developed, and deployed in 5 weeks April to May 2020
- In March 2020 as COVID-19
- The people of Arizona needed a trustworthy source of reliable information
- Give back to the people of Ariozna for their support of the Univ of Arizona
- Reassure people that someone cares

Framework components in AZCOVIDTXT

1. Identified the need for an epidemiologist specializing in Infectious disease (Ernst), a health promotions expert with a focus on persuasive messaging (Rains), and the informatics team consisting of informaticians (Iyengar, Merchant), systems architects, and programmers
2. Simplicity and ease-of-use primary requirements. Messaging in English and Spanish (at least 30% of the people of Arizona are Hispanic), rapid deployment, cell phones due to their very widespread use, minimal cognitive demand on user.

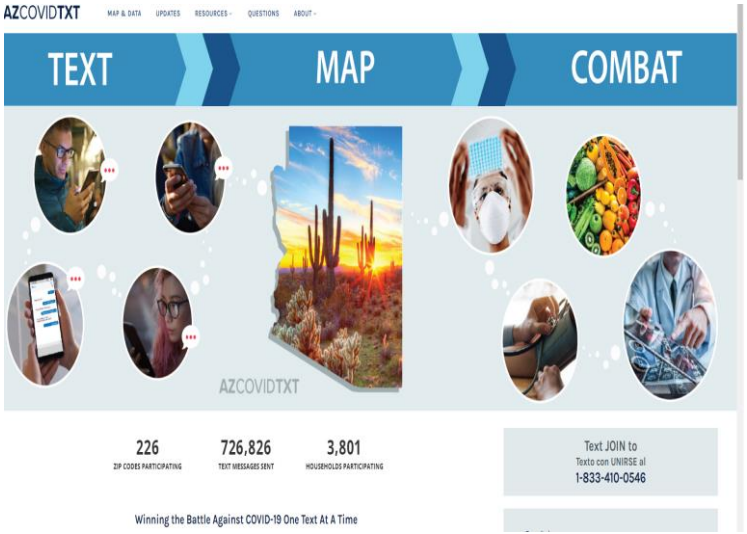
Framework components in AZCOVIDTXT

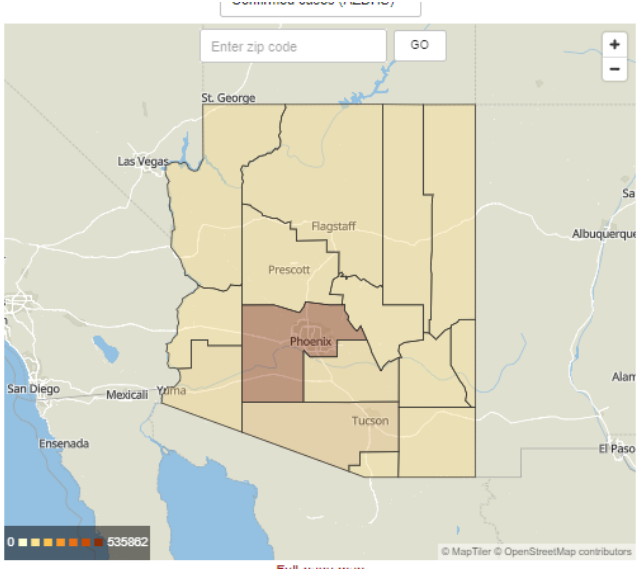
2. (Continued) Decided against apps
   - Time to develop, design user interface, need maintenance
   - SMS is simple, everyone knows how to use, everyone has it
3. Information disseminated from authoritative sources: Centers for Disease Control, World Health Organization, curated by in-house team of experts
4. Design: Messages crafted and edited by experts in Health Promotions

Framework components in AZCOVIDTXT

5. Implementation. Done with off-the-self and freely available components: Django, PostGres, REDCAP. Only paid service is Twilio, used for text messaging
6. Evaluation: User survey was conducted and usage metrics were measured.

AZCOVIDTXT was deployed in 4 weeks





Barriers to RI implementation and impact

- Loss of needed infrastructure.
  - However, note that billions of powerful information-processing devices, ie smart phones, could be available to execute RI systems
- Lack of needed expertise
  - Experts, programmers, system architects
- Misinformation and public distrust of information content especially regarding behavior change
- Refusal to download RI systems

Conclusion

- Informatics can play an important role in helping people, communities, and systems develop resilience
- Resilience Informatics

References

1. About Resilient America | National Academies. https://www.nationalacademies.org/resilient-america/about (accessed 12 Nov 2022).
2. 2 EE Werner. Resilience research. In: *Resilience in children, families, and communities*. 2005. 3–11.
3. 3 Purohit H, Peterson S. Social Media Mining for Disaster Management and Community Resilience. *Big Data in Emergency Management: Exploitation Techniques for Social and Mobile Data* 2020;:93–107. doi:10.1007/978-3-030-48099-8_5
4. Kamath S, Sirazitdinova E, Deserno T. Towards the Application of Machine Learning in Emergency Informatics. Medical Imaging 2018: Imaging Informatics for Healthcare, Research, and Applications 2018;10579:298–304. doi:10.3233/SHTI220003
5. Iyengar C, Pinzon MS, Campbell OE. Design and development of a mobile-based patient management and information system for infectious disease outbreaks in low resource environments. content.iospress.com 2020;28:697–709. doi:10.3233/thc-192100
6. Iyengar MS, Oinas-Kukkonen H, Win KT. Persuasive technology in biomedical informatics. J Biomed Inform 2018;85:136–7. doi:10.1016/J.JBI.2018.07.020
7. Oinas-Kukkonen H, Harjumaa M. Persuasive Systems Design. Routledge Handbook of Policy Design 2021;:87–105.
8. Isa WA, Lokman AM, Aris SR, et al. Engineering rural informatics using agile user centered design. 2014 2nd International Conference on Information and Communication Technology (ICoICT) 2014;:367–72.