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Technology, Conflict Early Warning Systems, Public Health, and Human Rights

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Abstract

Public health and conflict early warning are evolving rapidly in response to technology changes for the gathering, management, analysis and communication of data. It is expected that these changes will provide an unprecedented ability to monitor, detect, and respond to crises. One of the potentially most profound and lasting expected change affects the roles of the various actors in providing and sharing information and in responding to early warning. Communities and civil society actors have the opportunity to be empowered as a source of information, analysis, and response, while the role of traditional actors shifts toward supporting those communities and building resilience. However, by creating new roles, relationships, and responsibilities, technology changes raise major concerns and ethical challenges for practitioners, pressing the need for practical guidelines and actionable recommendations in line with existing ethical principles.

Introduction

Wars and widespread or systematic abuses of human rights are public health disasters. Large numbers of civilians are often killed or inflicted with physical and psychological trauma and injuries, and survivors are left to cope with devastated health care and public health services, including water and sanitation.[1] Health facilities may come under attack, forcing health workers to flee.[2] At the same time, insecurity hampers individuals' ability to carry on their basic livelihood activities.[3]

In response to these crises, governments, UN agencies, and humanitarian and civil society actors are concerned with the implementation of preventive measures before conflicts and violence break out, echoing the public health aim to trigger early intervention in order to reduce the effect of impending epidemic or famine.[4,5] As a result, a wide range of conflict early warning systems have been proposed to monitor potential crisis situations and to inform the development of appropriate and necessary means to protect civilians.[6] These systems, like public health early warning and surveillance systems, rely on the gathering, management, analysis, and dissemination of large amounts of data from multiple sources.

Conflict early warning systems often operate beyond the parameters of public health, and differ in a number of ways.[7] First, in public health, while not always clear, major causal relationships are well understood. When it comes to estimating the magnitude and timing of relative risks of emerging conflicts, however, causal paths, conflict triggers, or thresholds in patterns of violence remain poorly understood, partly because of the complex and idiosyncratic nature of the onset of violence.[8]

Second, whereas response mechanisms and intervention in public health are supported by a rich body of evaluation research (including randomized control trials), such empirical evidence is less available when it comes to conflict intervention. A Google Scholar search on the terms "evaluation" and "public health intervention" yields over 100 times more results than a similar search for conflict intervention evaluation. Third, while public health early warning systems tend to involve local actors and authorities, conflict early warning systems tend to inform policy makers at the top level, with little or no information and attention given to the local level.[9] Finally, even though information itself is rarely the missing ingredient in conflict early warning, there is a general lack of empirical data to analyze and make evidence-based decisions for the protection of civilians.[10,11] Public health early warning systems, for example, can rely on surveys such as Demographic and Health Surveys (DHS) and mortality and morbidity surveillance systems to serve as a reference or baseline. Similar information on peace, conflict, and security is rarely available.

Technology fusion and early warning

Despite these challenges, both public health and conflict early warning are now evolving. Technology fusion is the integration of information network, mobile technology hardware and applications, and social media and mapping platforms into a readily available single mobile device such as a laptop, a mobile smartphone, or a tablet with access to unlimited amount of data from multiple sources and in multiple formats (big data). Such fusion is transforming the range of tools and data sources available to practitioners gathering data for public health and conflict early warning.

Technology fusion and its application to public health and conflict early warning is expected to provide practitioners with an unprecedented ability to monitor epidemics, as well as serious violations of individual and collective rights and liberties. It is expected to help scrutinize and identify factors leading to violence and disease outbreaks, including determinants of health outcomes, such as the provision of adequate education, housing, food, clean water and sanitation, and favorable working conditions.[12] It is also expected to offer accelerated ways to systematically, consistently, and accurately describe the nature, extent, and intensity of epidemics, civilian insecurity, or rights violations; in other words, to better define who needs care or protection, how, from whom, and from what. This information, in turn, is expected to assist the development of more appropriate and effective responses (civilian protection, humanitarian intervention, delivery of urgent medical care, preventive actions to avoid epidemics, and de-escalation of conflicts), and to foster community ownership and participation.

Whether or not technology can fulfill these expectations remains to be seen, and little progress to date has been made to rigorously evaluate efforts at transforming early warning systems. There is, however, an explosion of pilot projects and case studies. Search term surveillance, for example, has already proven valuable for disease surveillance, with the well-known case of Google Flu Trend, which monitors the use of flu-related search terms to estimate influenza activity.[13] Other attempts are currently being made to use Twitter data for disease surveillance and tracking public health trends. Similar web mining and data curation applications, which allow for the gathering of unstructured data from web sources including news feeds, Twitter, Facebook, or web searches to extract information about entities and events, are valuable for conflict early warning. Although specific events will likely remain unpredictable, retrospective analysis suggests that more widespread and effective use of web mining and new technologies would have helped detect the spread of the Arab Spring in early 2011, for example.[14]

Other technologies require crowdsourcing: the contribution of large groups of people to data gathering platforms. Frontline SMS, for example, is a tool that facilitates text messaging activities, including receiving and centralizing messages, sending announcements, conducting polls, and automatically replying to incoming SMS.[15] The Ushahidi crowdsourcing platform enables messages from multiple sources, including SMS, email, Twitter, and the web, containing geographic references to be mapped and serve as a source of information.[16] Using this information sharing and visualization platform, public health practitioners are developing participatory epidemiology. For example, individuals can harness user-generated data on asthma attacks to monitor their own health; such data can be aggregated to build risk maps and identify potential environmental triggers.[17] Applications for crisis early warning include sites known as crisis maps, which are set up to monitor violence and events of human rights violations

in conflict zones, including the Central African Republic, Libya, and Syria.

In addition, digital data collection and surveys using smartphones allow users to collect multiple data formats such as text, images, voices, or GPS coordinates in a unified way, and to transfer that information easily into an information management system. The applications make active data collection faster, more accurate, and safer, although new risks—for example in how data is transferred—also emerge.[18] Geospatial technologies offer yet another non-traditional source of data for human rights investigation and conflict early warning. Using satellite imagery, the American Association for the Advancement of Science, Amnesty International and the Satellite Sentinel Project have documented rights violations in Nigeria, Sudan, and elsewhere, and have generated early warning information demonstrating the concentration of troops in Sudan.[19]

At present, practitioners frequently focus on dynamic event reporting rather than on integration and detection of trends to inform prediction. One of the key assumptions underlying conflict early warning is that patterns and trends leading to violations of human rights and conflicts exist and can be detected. Yet our understanding of these patterns and trends remains limited—more so than in public health—due to the complex nature of conflicts and their varying characteristics. For this reason, the focus remains on reporting events and human rights violations indicating an increase of violence as a proxy for the breakout of a larger conflict.[20] Further empirical and theoretical research is needed to examine the capability of technologies and their associated data collection methods to make sense of big data and allow for the detection of a broader range of patterns and trends that may indicate the emergence of conflict.

Actors and response order

Conflict early warning differs from public health early warning and surveillance systems in how response mechanisms are integrated, involve local authorities, and rely on empirical evidence of their effectiveness. Technology itself does not guarantee a more efficient response by high level decision makers. However, changes in who generates information, how it is generated, and who accesses it are fundamentally shifting how various actors interact with and relate to each other, and respond to conflict situations, breaking hierarchies between affected communities, civil society, governmental or multilateral actors, and potentially perpetrators.

In traditional conflict early warning systems, the typical information flow involves large governmental and multilateral organizations setting up fairly complex data gathering processes that may extract information directly from affected communities through surveys, sentinel sites, news analyses, or other means. These systems may also communicate warnings to the affected communities, but the warnings are primarily aimed at concerned governments and policy makers, the UN and its Security Council, or international agencies. There is a growing international consensus that these actors have the duty to respond to early warnings of conflict: the emerging principle of Responsibility to Protect (R2P) provides a framework for preventive actions and diplomacy, humanitarian intervention, deployment of peacekeeping missions, and the use of force in national and international response to conflicts and large-scale atrocities.[21] Yet in practice, as former Human Rights Watch's Arms Division executive director Joost Hiltermann pointed out, "the international community, especially as embodied in the United Nations and its Security Council, has time and again failed to act decisively and effectively as crises have broken out in the post-Cold War world."[22] If and when action is taken, top-down, state-centric responses arrive too late and fail to recognize the role that civil society organizations and affected communities themselves play in preventing and mitigating the impact of conflicts.[23]

Recognizing these limitations, people-centered and community-based approaches to conflict early warning have emerged, mirroring a similar earlier paradigm shift in disaster early warning.[24] Together with the early adoption of new technologies, the new approaches to conflict early warning systems alter the traditional information and response order significantly. Affected communities are expected to increasingly become participants and partners in early warning and response, rather than bystanders or passive recipients of prevention and response actions designed by external actors. Concurrently, non-traditional responders and actors such as volunteer networks may emerge among a broader transnational civil society movement. Other actors, including the perpetrators of atrocities, may change their behavior

Table 1. Changing roles in technology-enabled conflict early warning systems

Actors	Traditional Conflict Early Warning Systems	Tech-enabled Community-Centered Conflict Early Warning Systems
Affected populations	Serve relatively small role or are passive as source of information Are seldom the recipients of warnings	Are actively involved in data gathering and submission Are actively involved in warning identification and communication Are actively involved in community preparedness, conflict prevention, and mitigation
Civil society	Serve small or passive role as source of information Develop contingency planning for top-down response	Serve as active source of information Provide innovative platform for data gathering, management, and dissemination Support local response and resilience Organize transnational information campaign (social media)
Public health/health practitioners	Rely on rapid surveys and sentinel sites to gather structured data to assess and monitor baseline health status, risks, and determinants of health, health services, security, changes in the population Hierarchical and linear information sharing (field to headquarter to field) and data sharing	Rely on multiple methods, including web mining and data curation, allowing the use of unstructured data from multiple sources in addition to traditionalforms
Governmental and multilateral organizations	Gather, aggregate, and analyze data Aim warning at policy makers Design and implement top-down response, starting with diplomatic action	Process, curate and analyze multiple sources of data, "sense making" and complexity Aim warning and recommendation at policy makers and communities Design and implement participatory responses, starting with building community resilience
Perpetrators	Hide or manipulate evidence Deny or redistribute blame for human rights violations	

in response to advances in technology to document and respond to human rights abuses.[25]

Affected communities

One of the key role changes expected as a result of technological innovation—and one of the most widely publicized—is the ability of individuals in affected communities and elsewhere to contribute information to public platforms such as the Ushahidi crowdsourcing platform. In addition to gathering information and communicating it to external actors, such systems have the potential to serve as a source of information for affected communities themselves, and ultimately as a means for dialogue within the communities, bypassing existing hierarchies. In this way, such platforms give individuals the ability to act upon warnings and work to build resilience within the community. They also allow for greater dialogue between external actors and affected communities, and provide a vehicle through which communities can express their views on potential responses or solutions to the conflict or specific issues affecting them.

As technology-enabled conflict early warning systems are expected to rely on much greater levels of community involvement, it becomes also necessary to rethink the conflict response model and develop more usable systems that adopt community involvement as a fundamental principle.[26] Greater community involvement would allow for building on existing assets; identifying, employing, and sharing adaptive strategies; and developing resilience in response to threats. Technology and platforms alone will not achieve this goal, but if designed appropriately they enable dialogue and information sharing within communities—and between communities and external actors—to achieve these broader objectives.

Civil society

Civil society organizations are expected to play a greater role within this new paradigm of technology-enabled conflict early warning systems and human rights reporting. Technological innovations are largely happening outside of large organizations with the traditional role of forecasting, warning of and reporting on violence. Ushahidi, for example, emerged from the Kenyan civil society response to the 2008 post-electoral violence.

As new applications of technologies are imagined, dozens of organizations or interest groups dedicated to documenting atrocities and preventing conflict are being created around specific applications. Ushahidi software has been used by local civil society groups to track events and serve as a conflict early warning and monitoring platform in the Central African Republic, Liberia, Libya, Syria, and many other locations. Tactical Technology Collective is a transnational non-profit organizations dedicated to enable the effective use of information for progressive social change. Digital Democracy was created to empower marginalized communities to use technology to fight for their human rights.

The emergence and professionalization of these new actors, however, raises urgent questions about the risks, responsibilities, and ethical challenges of working with highly vulnerable populations. At the same time, the multiplicity of actors calls into question the reach, duplication, credibility, and comprehensiveness that civil society actors can achieve. For example, more than 20 crisis maps were created to track reports related to Hurricane Sandy when it hit the United States in October 2012.

Public health/health practitioners

The traditional role of public health and health practitioners in conflict early warning systems consist in gathering data on health status, risks and determinants of health, health services, security, changes in the population, and the health impact of conflict. These data are collected using rapid surveys and surveillance systems generating information that flows linearly through a hierarchy of actors, from local to national, and reaches the public through periodic announcements and campaigns. In technology-enabled early warning systems, practitioners may increasingly use free, real-time, and broad-reaching data sources from the web in parallel to traditional

systems, possibly replacing such systems where active data collection and surveillance are impossible. At the same time, faster and better response, including community-led initiatives, may be informed by open data sharing platforms. These platforms also act as a direct outreach to communities at risk, enabling them to better prepare and mitigate risks.

Governmental and multilateral organizations

As non-traditional sources of data emerge, large governmental and multilateral organizations that have traditionally gathered, analyzed, and communicated data relating to early conflict and human rights violations are redefining their role as well. To a large extent, civil society actors gathering data are coalescing around a specific technology and/or data type. The result is a heterogeneous data landscape made of multiple data sources and platforms. In order for this information to contribute to effective response systems, it is increasingly necessary to make sense of the large amount of data available. Information from multiple sources must be processed and analyzed to facilitate understanding of the complex range of factors leading to violence, to map unfolding conflicts, and to design and implement participatory responses starting with building community resilience. Large governmental and multilateral organizations are best situated to play this role.

Perpetrators

Finally, it is important to note that not all changes in actors' role and behaviors are for the best. Perpetrators of atrocities are rapidly learning how to use technology to gain strategic and/or psychological advantages. In Syria, both sides of the conflict have reportedly waged a cyber-war, with news media sites being hacked to spread disinformation helpful to the Syrian government.[27] Undoubtedly, armed actors will attempt to manipulate any early warning technology for strategic gains. While some manipulations, as in the Syrian case, will be obvious, others may be more pervasive, for example the infiltration of crowd-sourced systems to create biased outcomes. This again calls for operating guidelines and ethical standards to dictate how information is gathered, managed, communicated, and ultimately shared in ways that adhere to the "do no harm" principle.

Key challenges: Quality, ethics, and response

Technology and its application in early warning approaches, as well as the changing roles of actors involved in the early warning system, are giving rise to a number of concerns about the quality and reliability of the information collected, and a possible tradeoff between speed and accuracy.[28] This raises ethical obligations about the responsibility of conflict early warning practitioners to provide reliable information to decision makers and affected communities, and to acknowledge the level of reliability and accuracy of the data shared.

Biases in data sources may hinder the accuracy and reliability of the warning and the responses, potentially resulting in harmful or discriminatory practices. For example, cell phones used in both active and passive data gathering systems may not be ubiquitous enough to avoid biases towards those who have access to the technology. Recent surveys by the authors show disparities based on gender and education. In eastern Central African Republic, for example, a survey conducted among 400 adults in the city of Obo shows that 33% of the respondents have no formal education.[29] Among them, just 7% own a cell phone and 2% use short text messages (SMS), on which most platforms rely. In comparison, 49% of the respondents have some or complete primary education, and among them, 22% own a cell phone and 7 percent use SMS. Finally, among the most educated, the 17% who have at least some secondary education, 46% own cell phones and 27% use SMS.

These results show that, by design, an SMS-based pilot system developed to engage communities affected by conflicts to report humanitarian needs, including public health and security concerns, was unable to reach the majority of the population. In this case, it is not known how the unequal distribution of cell phones and SMS use may have affected the project, but it may have resulted in biased information. Disparities in technology access may reinforce structural inequalities at the root of conflicts.[30]

In addition to potential biases introduced by unequal

access to technology, the question of the precision and accuracy of information remains unresolved. Limited studies in the field of health and environmental monitoring in the developed world suggest that while crowdsourcing has significant advantages in fostering public involvement, the accuracy of the monitoring is inferior to that of trained observers.[31] The issue of precision and accuracy is arguably one of the key barriers to the use of a number of technologies in conflict early warning. However, a number of approaches or "information forensics," are developed to address the issue and provide effective verification mechanisms.[32]

When conflict early warning systems rely on inaccurate, biased data to influence behaviors and decisions, the faulty information has the potential to increase risks and harm civilians. For example, six Italian scientists were found guilty of disseminating inaccurate early warning information about the seismic risks associated with the earthquake that hit L'Aquila in April 2009 and caused more than 300 deaths.[33] While such legal cases have not been raised about conflict early warning, the programmers and actors who generate such information have a clear legal and moral responsibility. The duty for actors to provide reliable, accurate, and updated information that is verifiable and at the level of precision and depth of detail for its intended use is outlined among key principles for protection work.[34]

An alternative to SMS-based reporting by affected populations is a seeded approach, where specific individuals are selected, trained, and equipped with cell phones to contribute information on a regular basis. Crowd-seeded program "Voix des Kivus" takes this approach, using an SMS platform to collect event-based data in eastern Democratic Republic of the Congo (DRC). Like surveys, a carefully designed crowd-seeding approach may offer a systematic, unbiased way to collect information from a large number of individuals; this may help identify needs and, potentially, broad patterns within a given population, such as prevailing opinions or the scope of exposure to violence. However, a candid evaluation of the project suggests little or no benefit to the population.[35] While there was interest among the humanitarian community, there were no known efforts to respond to or address incidents or issues raised by cell phone holders.[36] Furthermore, individuals who contributed messages expected that actions would be taken in response to their message; this incorrect assumption highlights the responsibility to manage expectations and assess the program's use for the population. When learning about the occurrence of serious violations, conflict early warning practitioners must ensure that action is taken, and alert others if they are unwilling or unable to take action.[37] Simply making the information available is insufficient to guarantee that action will be taken. Rather, specific response plans must be developed as part of the early warning system.

This responsibility to alert others may raise concerns about how and with whom to share sensitive information. Basic "do no harm" and data security principles should dictate information exchange. As a case in point, a program implemented in the DRC initially planned to collect information on human rights violations, which, under domestic law, must be reported to the police. However, reporting such information to the authorities would violate a confidentiality and anonymity agreement reached with the information provider as part of the data gathering. Reporting the information could give a corrupt police force an opening to pressure and intimidate the information provider; at the same time, not reporting the information would place the practitioner at odds with the domestic legal system. Regardless of the reporting requirements, the obligation of the practitioner to respond and possibly take corrective measures in response to violence is rarely taken into consideration within conflict early warning systems.

Other ethical challenges relate to the security of information gathered in the context of conflict early warning research. The ability to gather data locally and communicate information globally in near real-time has exposed new practitioners to data security threats more frequently than ever before, and has created new risks as much as new opportunities. For instance, repressive regimes in Syria, Myanmar, and elsewhere have monitored internet and cell phone traffic, as well as social networking sites, to identify and target activists who volunteer potentially sensi-

tive information. In addition, long-term information security is a challenge. For over a decade starting in the 1990s, about a dozen centers in northern Uganda collected identifying information on children and adults abducted by the Lord's Resistance Army (LRA), a notoriously violent rebel group now operating in the Democratic Republic of the Congo, Central African Republic, and Sudan. The information was collected with the goal of facilitating reinsertion of the LRA's thousands of abductees and other people forcibly displaced during the conflict. However, as the LRA withdrew its forces from northern Uganda and the centers ceased their activity, the confidentiality and privacy of the information, and the long-term management of the data, is uncertain.[38]

Ethical principles

Existing ethical principles must play an important role in guiding the responsible use of technology in conflict early warning. Ethical principles guiding human research are grounded in the same recognition of the dignity of the person as the Universal Declaration of Human Rights. However, research ethics and human rights have largely evolved separately. Internationally, three key documents frame research ethics. In 1949, the Nuremberg Code was drafted as a means to protect human research subjects; it includes expectations of informed consent, voluntary participation, subject safety, and recognition that the benefits of research participation should be proportional to the risks.[39] The 1964 Declaration of Helsinki and its revisions built on the Nuremberg Code to emphasize the well-being and security of participants, the expectation of freely given informed consent, the right to access research results, and the public dissemination of research results.[40] Finally, in 1985, the Universal Declaration on Bioethics and Human Rights further asserted the rights of participants and the general population to benefit from advances in science and technology, the duty to obtain informed consent, the need to balance scientific benefits with harm, and the application of the right to privacy.[41] In the U.S., the 1979 Belmont Report outlines ethical challenges and principles to protect human research subjects, including providing adequate information, obtaining consent, ensuring security of the person, and balancing risks and benefits.[42] The 1991 U.S. Department of Health and Human Services Rule 45CFR46, typically referred to as the "Common Rule," is more specifically focused on regulating review processes to ensure that research proposals are consistent with ethics.[43] Importantly, however, the common rule defines research more broadly than preceding instruments, as systematic investigation leading to generalizable knowledge.

It can be argued that conflict early warning is not research, and yet its practitioners share many key attributes of researchers: they gather information, often from individuals, in a systematic way and with the goal of generalizing findings. Whether or not it is considered research, the challenges are real and relate to the legal and moral obligations that result from engaging in monitoring human rights violations, including as part of a conflict early warning system. As Jonathan Mann wrote, "To have an ethic, a profession needs clarity about central issues, including its major role and responsibilities."[44] The rapid development of technology-enabled conflict early warning and human rights research and practice calls urgently for a better understanding of its stakeholders' major roles and responsibilities, as well as an outline of the key challenges and best practices.

The Department of Homeland Security recently released the Menlo Report, a landmark guideline for information and communication technology (ICT) research.[45] Based on the principles established in the 1979 Belmont Report, the Menlo Report proposes a similar framework to guide the identification and resolution of ethical issues involving ICT. It defines ICT as "a general umbrella term that encompasses networks, hardware and software technologies that involve information communications pertaining to or impacting individuals and organizations." The first three core principles (respect for persons, beneficence, and justice) are based directly on the Belmont Report but applied to the ICT research setting. However, the Menlo Report introduces an additional principle called Respect for Law and Public Interest because "it addresses the expansive and evolving, yet often varied discordant, legal controls relevant to communication privacy and information assurance (i.e., the confidentiality, availability, and integrity of information and information systems)." Given that the Menlo Report is a newly published guideline, it will take time for the community to interpret, translate, and apply the principles into practice. Furthermore, the report is aimed at academic and corporate researchers, professional societies, publication review committees, and funding agencies. Missing are the advocates, human rights activists, on-the-ground partners, and affected populations who all have interest in building systems that follow ethical guidelines. Yet new media and technologies are changing the roles assigned to affected populations in warning and responding to human rights violations.

The following table outlines key challenges based on the authors' discussions with practitioners and researchers. The list is far from exhaustive, but it serves as a pointer to the broader work needed to

Table 2. Changing roles in technology-enabled conflict early warning systems[46]

	Principles	Key Challenges for Technology-Assisted Conflict and Public Health Early Warning
Respect of persons	Participation is voluntary and follows from informed consent Treat individuals as autonomous agents and respect their right to determine their own best interests Respect individuals who are not targets of research but are impacted Individuals with diminished autonomy, who are incapable of deciding for themselves, are entitled to protection	Individuals must know what they are implicitly agreeing to when they volunteer information. They must understand the risks and benefits, including how individual and aggregated data will be communicated Individuals must retain control over the information submitted, retaining the right to withdraw any data Data ownership and sharing protocols must be outlined Community-level risks and benefits must be taken into consideration
Beneficence	Do no harm Maximize probable benefits and minimize probable harms Systematically assess both risk of harm and benefit	Only accurate and reliable systems will provide the type of benefits that justify the existence of the system, calling for data filtering, validation, and triangulation Potential reporting biases must be analyzed and acknowledged Data protection and encryption protocols and other minimum security requirements must adequately reflect the risks of breach of confidentiality and the type of data collected Individuals must be trained before getting access to confidential and potentially sensitive information Security must prevail over speedBenefits, including direct response to critical information, must be maximized, while managing expectations to avoid creating coercive processes
Justice	Equal consideration in treatment Benefits should be fairly distributed Selection of subjects should be fair, and burdens should be allocated equitably across impacted subjects	Everyone must have an opportunity to contribute and benefit even when unequal access to technology exists
Respect for law and public interest	Engage in legal due diligence Be transparent in methods and results Be accountable for actions	Volunteers, civil society organizations, and others who gather, process, and share information have moral and legal responsibilities, including respecting individuals' right to information, to privacy, and to benefit from the knowledge generated by the system In repressive environments, the practitioners' first responsibility is to protect the sources of information and to place sensitive data beyond the reach of authorities

identify key ethical challenges and development of ethical standards and guidelines in the application of technology fusion for public health and conflict early warning.

Conclusion

In conclusion, changes in early warning systems in response to technological progress and fusion are expected to do more than bring about a faster, easier, and better system for practitioners to gather information for the prevention of conflicts, epidemics, or famines. They are expected to fundamentally change what these practitioners do and how they do it.

Advances in technology and information networks enable practitioners to gather more information from more varied sources and to communicate it to a broader range of recipients. In this way, new technologies have the potential to bring about a fundamental shift in the information and response order in situations of epidemics, conflicts, or widespread human rights violations. They may open up doors to empower communities and civil society actors as sources of information, analysis, and response, while the role of traditional actors shifts toward supporting those communities and building resilience. Although there is a lack of empirical evidence and evaluation, it is expected that new applications of technologies to public health early warning (for example, monitoring Twitter data for disease surveillance and public health trends) and to conflict early warning (for example, crowdsourced protest monitoring) will be capable of improving the effectiveness and timeliness of prevention, mitigation, and responses to human rights violations and public health crises. Early pilot projects and case studies suggest that such changes are possible. These opportunities must be explored more fully, and imagination and willingness will be required to cautiously but deliberately embrace their role in the field.

The advent of new technologies brings with it a range of new concerns. Conflict early warning systems still lack the ability to accurately predict violent events, and the usability of "big data" for the purpose of detecting trends and forecasting conflicts demands further study.

The effectiveness of these technologies continues to be undermined by the lack of connection between warning and response, although the greater involvement of affected communities and civil society is promising. At the same time, there is little empirical evidence on what works and what does not in response to specific warning. The volume of information generated, and its wide variety of formats and sources, create problems for data management and analysis. Furthermore, as new roles and relationships emerge, actors are confronted with a host of unprecedented ethical challenges. The speed and openness of information flows makes those challenges even more critical, with high stakes for the affected populations. The Menlo Report and related challenges outlined in this paper represent significant progress toward conceptualizing ethical principles for the use of ICT in conflict early warning and human rights reporting. There is now a need for those principles to be fully translated into practical guidelines and actionable recommendations for practitioners.

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46. The principles are based on the Menlo Report (Ibid, p. 7) and key challenges are partially based on a list of questions first developed by the authors with Jennifer Ziemke following a self-organized session at the second International Conference on Crisis Mapping (ICCM 2010) on October 2nd, 2010.