Toward Effective Public Health Emergency Risk Communication: Modification of the Social Cubism Conflict Analysis Model for Assessing Risk Communications to Vulnerable Populations

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Abstract

Risk communication programs are vital for effective operational management in public health emergencies and disaster response. Failure to effectively communicate risk to the public can potentially increase unnecessary panic, over-run or exhaust resources, and cause unnecessary morbidity and mortality, only to exacerbate the crisis. Gaps in disaster risk communication programs have been identified, limiting the reach of public health authorities in providing risk communications to vulnerable or at-risk populations. It is a critical element to assess risk communication and conflict management effectiveness in historic incidents and in current public health preparedness plans. To effectively manage conflicts in preparedness programs, it is important to understand the social factors that lead to the conflict. The social cubism conflict analysis model was modified specifically to serve as a conflict analysis model in assessing risk communication preparedness and response effectiveness in public health emergencies for vulnerable and high-risk populations. The limiting social factors in risk communication were identified using literature, reviewed for inter-related and dynamic merit, and applied to the design of the modified risk communication social cube.

Keywords: public health preparedness, risk communication, social cubism, crisis, disaster response

Introduction

The past two decades have seen an increasing number of natural disasters with public health consequences, demonstrating a need for continuous reassessment and/or modification to disaster planning. As a result, the prevention, mitigation, and preparedness for disasters have evolved in many ways[1].Emergency management today is a daunting task and the ability to prepare for and respond to high-threat infectious disease epidemics, terrorism, and other public health emergencies rests largely in the hands of public health systems[2]. It is critical that sound public health preparedness and response plans exist for operations to be effective in public health emergencies. An effective public health preparedness program calls for effective biosurveillance services, community preparedness, medical countermeasures and materiel management, emergency medical information systems, mass care and surge management, and responder health and safety[3].

Nevertheless, it has been established that among the most critical services necessary during a public health emergency, communication is one of the most important, including public risk communication[4, 5, 6, 7]. Nonetheless, gaps in risk communications have been identified, limiting the reach of public health authorities in providing risk communications to vulnerable or at-risk populations[8, 9, 10, 11].

Literature Review

Although a significant amount of money has been spent worldwide on program development and research, disaster response and preparedness is still considered to be a science in the infancy stages[12].

Numerous organizations that handle some aspect of emergency preparedness, disaster response, and consequence management have designed plans, implemented policy, and published literature regarding preparation and response for disasters and public health emergencies. Nevertheless, even with new research and evidence being published almost daily, it is still challenging to define what it means to be fully prepared for disaster[12]. However, one of the agreed-upon requirements for preparedness programs is communication.

Communication Needs

Regardless of the type of emergency, one of the most critical immediate requirements is effectivecommunication using a model such as the C3 Comprehensive Disaster Communication Model, which incorporates intra-agency, inter-agency, and public risk communication (Figure 1).Effective communication, including advanced communication technologies are vital for organizations to stay connected during responses to public health emergencies. However, it is disaster risk communication that is the most important during disasters, because a failure to present trustworthiness and integrity can cause a significant rift between authorities and the public. The immediate implementation of an effective public risk communication method, such as the Crisis and Emergency Risk Communication (CERC) model, is critical for an effective operational response, including controlling a situation and preventing further spread of potential disease and panic[9,13, 14].

Risk Communication

The key factors in communication with the public regarding risk and crisis are trust and credibility[8, 14, 15]. It is nearly impossible to have one without the other. Both are essential in order for the public to listen to and heed the instructions and advice of authorities. It has been supported that the perceptions of trust and credibility are dependent mainly on perceptions of knowledge and expertise, perceptions of honesty, and perceptions of concern and care[15].

Communication with the public should use the STARCC model, ensuring that the information is simple, timely, accurate, relevant, credible, and consistent, and provided through media outlets via an informed professional risk communication or public affairs expert that is trained to deal with crisis and risk communication for public health emergencies[9, 14]. News reports regarding terrorism and natural disasters have sometimes been faulted with inaccuracy, incomplete information, and sensationalism that can contribute to misunderstanding by the public. This is sometimes a result of a need for journalists to report on stories rapidly and continuously, in an effort to outcompete other media outlets[6, 16]. This is also often due to limited, incomplete, or inaccurate information provided to journalists. Such complications have the potential to affect the credibility and trustworthiness of the message and the messenger, limiting effective communication[6].

Risk Communication Failures

A failure to communicate risk effectively with the public can increase unnecessary panic, and can potentially over-run or exhaust resources, only to exacerbate the crisis. Numerous failures in risk communications have resulted in devastating results to the public and in some cases to industry.

Thailand Avian Influenza Outbreak. In the 2005 Thai outbreak of H5N1 influenza, a lack of complete information and poor risk communication with the public and with farmers caused a loss of confidence in authorities and the poultry industry, resulting in severe economic losses to farmers, the government, and the further spread of avian influenza to humans[17].

Hurricane Katrina. Risk communication efforts in 2005 failed to prompt a large portion of the population in New Orleans to evacuate prior to landfall of Hurricane Katrina. For a diversity of reasons, much of the population remained in the area, and was immediately and chronically affected by the flooding disaster in the aftermath of the hurricane. The more vulnerable and at-risk population was disproportionately affected for a variety of reasons, including the failure of adequate provision of information on risk and instructions from community leaders[9, 18, 19].

Cleveland Babies.Following a significant 1994 flooding event in Cleveland, Ohio, CDC's investigation of a cluster of acute pulmonary hemosiderosis casesin infants suggested a causative association with a relatively obscure fungus, *Stachybotrys atra*[20, 21, 22]. Following the CDC announcement, *Stachybotrys* gained national notoriety spawning TV news shows, magazine articles, and congressional hearings[22]. As panic spread and the term "Toxic Mold" became common word, water damaged buildings were vacated, mold litigation intensified, and an entire mold industry was re-energized. However, the CDC findings were subsequently unfounded by an internal working group, and several failures in the original CDC investigation, including sampling bias, problems with selected control subjects, and no evidence of toxin production wereidentified,establishing that there was no well-substantiated evidence linking the mold with hemosiderosis[21].

Although the CDC later withdrew their 1994 study, failures in risk communication and the dissemination of misinformation resulted in widespread panic and reactive changes in the industry[21, 23]. The cascade of events following the release of the Cleveland infant study may have been avoided with better decision-making at the risk management and communication level.

Tokyo Sarin Attack. Probably the most well-known terrorist incident using weapons of mass effect was the 1995 Aum Shinrikyo cult's chemical attack on the public in three Tokyo subway lines, exposing passengers in more than 15 subways stations to sarin gas and sarin degradation products. The authorities had information that Aum Shinrikyo had chemical weapons and had used them previously. Nevertheless, neither the public nor emergency responders were appropriately notified of the threat. The attack resulted in 12 deaths, 17 sever exposures, 37 moderate exposures, and nearly a thousand mild exposures to the chemical nerve agent. Over 130 emergency responders required care for exposure. However, out of fear and panic, an approximate additional 4500people, some who were never near the subways, sought medical attention at 278 different medical facilities in and around Tokyo, overburdening the medical system and potentially exposing themselves to secondary contamination[24].

Risk Communication and Conflict

Conflict arises when incompatible goals develop between different parties, whether this is at interpersonal, intergroup or inter-agency levels[25]. These conflicts can develop and exist at all levels and activities, organizations, and

communities, including during public health emergencies and disasters. A failure of effective risk communication is a vulnerability in disaster and emergency management, and creates or perpetuates conflicts that may exist in preparedness and response. Conflict analysis is vital for effective organizational management and development. Public health experts have recognized the immediate need for environmental and public health practitioners to incorporate conflict analysis and resolution knowledge and methods into public health practice[26, 27]. It is vital to national, state, local, and corporate organizations to assess risk communication and conflict management in historic incidents and in public health preparedness plans and programs.

As the dynamics and complexity of conflict changes, so must the intervention methods in order to resolve those conflicts[28]. In order to effectively manage conflicts that arise in any environment, including public health preparedness, it is important to understand the factors that lead to the conflict. An effective conflict analysis model must be used in the process of resolving conflicts[28, 29, 30, 31]. There are multiple conflict analysis models used by experts across disciplines. The most dynamic of these analytical strategies is social cubism.

Risk Communication for At-Risk and Vulnerable Populations

Healthcare program requirements, public health response programs, and healthcare worker competencies have been recommended and published in the literature, and include risk communication as key necessities[4, 5]. One major gap identified in the risk communication framework is the issue of adequately communicating risk to the broadest population, including those that have the most need for services[11].In order to provide a comprehensive risk communication plan that takes into consideration the needs of vulnerable populations, and to ensure that the message communicated has the broadest reach, the STARCC model must be modified to address the two factors of inclusivity and comprehensive multimedia distribution. The multimedia factor confronts information release through all of the advancing communication technologies such as Facebook™, Twitter™, LinkedIn™, Instagram™, and other electronic and social media networks. The inclusivity factor addresses a major that has gap identified in the risk communication framework, which is the issue of adequately communicating risk to high-threat and high-vulnerability populations[11]. Practitioners in public health response should be proficient in addressing cultural, ethnic, religious, socioeconomic, and special needs in public health emergency response[7]. Those who will communicate with the public need to understand these issues and take them into account when planning preparedness and response programs. Failure to be inclusive and to integrate communication strategies that reflect the values and priorities of the affected population can increase the likelihood of social disruption and potential operational failure[32]. Risk communication vulnerabilities have been identified in after-action reviews of disaster response situations, demarking a problem with adequate responsiveness to emerging information priorities and needs of diverse groups in high-risk locations, including low-income, racially and ethnically diverse, immigrant, and special needs populations[8,10, 11, 33].

Addressing Social Factors in the Risk Communication Framework

Although crisis risk communication has been addressed in the medical and public health literature, and the literature indicates that significant progress has been made within this field, there is a continues need for in-depth assessments of event-specific effectiveness[9], including addressing the communication gap to vulnerable populations. An effective assessment and audit of the response system cannot simply take into account a checklist of whether the involved agencies notified people through press releases. An assessment has to consider social factors and whether these factors are addressed in the public health preparedness and response framework.

The social cubism conflict analysis model

Social cubism is a conflict analysis strategy initially developed for analyzing international *ethnopolitical* conflict, but has other potential applications. This model emphasizes the multi-factorial interaction of the main elements of conflict. Using a Rubik's Cube® as a visual representation of a potential conflict, each side represents one of the six main factors of conflict, and the mixture of colors in a turning cube represent the interaction of the factors causing conflict[34, 35]. Normally, the six interrelated forces in a conflict are history, religion, demographics, politics, economics, and psychocultural factors. However, a modified cube can potentially be applied in which some of the factors may be replaced with othersto address specific, relevant problems[36, 37]. Social cubism is a dynamic, interactive, and diagnostic model of conflict analysis that combines the study of six influencing factors simultaneously because the factors are not isolated from one another. It is the interaction of the six faces of the cube in particular that produce the trajectory of conflict[34]. By focusing on all of the involved factors, and not giving preferential attention to any individual side of the cube, thisconflict analysis and resolution (CAR)model can produce a complete analytical picture of the conflict, and can provide the ability to analyze a conflict as it changes. Analysis of these factors can provide feasible interventions and solutions[38].

*Background of the six sides of the social cube.*Conflict resolution theorists and practitioners have started to understand that they must carefully consider inter-related social forces that interact to create, escalate, and proliferate conflict[38]. Social cubism illustrates these interacting forces and their effect by focusing not on a single or a couple of potentially causative social forces, but rather on six interactive factors simultaneously and continually[35].

*Historical.*One of the critical challenges that conflict resolution experts face is to understand the historical depths within conflicts[35, 38]. Each party to a conflict has its own historical narrative. The history of any group in a conflict is important to understand any group dynamic and group perspective on the situation. These experiences can be based on exclusion, independence, ethnic differences, trans-generational factors, and previous conflicts[34]. Historical factors are vital in conflict resolution because the historical experience of groups legitimizes, at least for the groups themselves, their identitiesand actions[34].

*Demographics.*Demographic factors are critical elements of conflict because demographic differences lead to socio-psychological patterns visible during conflict as issues of identity between the conflicted parties. Demographics can include age, ethnicity, social status, rank status, and political geography, among other characteristics[34, 35, 39].

*Politics.*Politics plays a pivotal role in conflict. This factor includes political beliefs, political institutions, and political positional powers. These factors often carry with them the intentional actions of special interests of groups and individuals[35, 39]. Political forces also affect the distribution of power and decision-making capabilities within governments, communities, organizations, or groups involved in conflict, which can proliferate political divisions and the persistence of inter-group conflict[34].

*Economics.*Economics are no less important than any other side of the social cube and may include issues such as disproportionate earnings of individuals, availability of housing, availability of employment, competition between groups for resources,and institutional favoritism, among others[34, 39]. A thorough understanding of the economic challenges of the parties to conflict can assist in conflict analysis, intervention, and peace building processes[35].

*Psychocultural.*Psychocultural forces often define the root identity of people or groups and play a significant part in the escalation and de-escalation of conflict. Culture is central in the way that individuals, groups, or communities live

and perform their daily activities. It is a central element that determines the ways that people interact with their neighbors and communities[35]. Cultural and social factors and differences stemming from cultural, ethnic, national, and religious norms excite emotions and have the potential to increase tensions between groups. Identifying with a group assists individuals with defining their own identities[40]. These aspects can contribute to the evolution of conflict and have been known to do so historically[34, 35, 39]. In addition, psychocultural factors provide markers for determination of group identity. Based on psychocultural factors, groups are viewed as either *in-groups* or *out-groups*, which are usually at odds central to conflict[34].

*Balance of power.*Power is a significant element in conflict theory. Perceptions of power are at the heart of conflict, and conflict analysis[31]. The balance of power factor is critical in conflict. As dominant groups have power and jurisdiction, economic power can be harnessed in order to maintain loyalty of certain communities or groups, while other groups can be excluded[34]. Balance of power issues are relative to the way that power is distributed and used, and are closely related to political cues. The unequal distribution of power and the continual imbalance of power between or among groups involved in conflict can significantly contribute in conflict escalation[34].

*History of social cubism application.*Social cubism has been used to analyze ethnopolitical conflict in Northern Ireland and Quebec, between the Sinhalese and Tamils in Sri Lanka, and between the Palestinians and Israelis in the Middle East, among other conflicts[39, 41, 42]. It has also been applied to conflict in environmental health practice[37].

Methods

A literature review was performed on the topics of both risk communication and CAR in public health preparedness and disaster medicine, social disparities in public health risk communication, and risk communication and CAR strategies and methods. The review was conducted using Internet-based medical and legal literature search engines including PubMed, EBSCOHOST, Lexus Nexus, and Science Direct indices.Social cubism conflict analysis model was evaluated as a means of addressing risk communication conflicts in vulnerable population. A modified social cube was designed specifically to serve as a conflict analysis model in assessing risk communication preparedness and response effectiveness in public health emergency programs. The limiting social factors in risk communication were identified using literature, reviewed for inter-related and dynamic merit, and applied to design a modified risk communication social cube.

Results

Six social factors were identified in the literature that are believed to have significant impact on vulnerable populations, putting them at higher risk during public health emergencies and disasters as a result of ineffective risk communication. As a means of addressing these populations, the STARCC model was modified to include these populations. The modified STARCCMI model is recommended for incorporation into risk communication programs, calling for simplicity, timeliness, accuracy, relevance, credibility, consistency, multimedia release, and inclusivity. Additionally, the continuous advances in emerging technologies are addressed in this model in order for risk information, warning, and messages to have the broadest reach (Figure 2).

Six social factors that affect vulnerable populations were identifiedto include socioeconomic status, health literacy, spoken language, communicative disabilities, history, and cultural demographics. The cultural demographics factor includes ethnicity, nationality, and religion. Application of social cubism yielded a risk communication social cube (Figure 3)

including the six social factors that should be applied when analyzing risk communication programs for public health emergencies.

Discussion

Risk Communication Social Cube

Decision-making is multifactorial and socially embedded[19]. A modification of social cubism has been researched for application in health care and public health environments[36, 37]. A modified social cube design for risk communication can address the needs for an analytical model to assess risk communication programs in areas where gaps have been identified. This cube particularly points at risk communication for vulnerable populations that are often left out during public health emergencies and disasters. There are numerous social factors that particularly affect risk communication effectiveness to low-income, racially and ethnically diverse, immigrant, and disabled populations[8, 10, 11, 33].Like social cubism, the risk communication social cube can be considered a living and breathing framework that is constantly in motion, with the factors interacting as the situation changes (Figure 4).

Studies show that immigrant populations are vulnerable to serious health disparities, and result in higher morbidity and mortality than other segments of society[33]. Part of the reason for these statistics have been defined to result from risk communication challenges, including language barriers, health literacy difficulties, insurance and economic challenges, legal residence issues, and cultural barriers[8, 33]. Immigrants are only a sector of the vulnerable population that is faced with these challenges. Racially and ethnically diverse communities, low-income communities, and special-needs populations have also been identified as disproportionately at-risk with unique communication needs. These challenges include cultural, religious, and historic trust attitudes towards crisis events, recommended actions, and the organizations that affect risk communication[10, 11].

Six social factors were identified to pose significant challenges to effective risk communications to vulnerable populations. These social factors are socioeconomic status, health literacy, spoken and written language, communicative disabilities, history, and cultural demographics. The cultural demographics factor includes ethnicity, nationality, and religion.

*Socioeconomic Status.*Socioeconomic status plays an important role in the risk communication processes during public health emergencies[10]. Research shows that preparedness plans have not historically and effectively addressed readiness for low-income residents[10], and that minority groups, such as immigrant populations with economic challenges and lack of insurance, are less likely to respond to official communication and recommendations at the risk of being financially liable for treatment in cases of public health emergencies[18, 33]. Additionally, even in the time of advanced technology, disparities in access to cable or satellite television, Internet, and social media are a clear result of affordability. Other concernswithin this factor include economic stability. In the aftermath of Hurricane Katrina, for example, a percentage of the evacuees did not follow instructions out of fear of losing their jobs, communication of additional imposed work responsibilities by their employers, and the necessity to protect their property from looting[19]. Also, socioeconomic status has long been associated as a result of and a cause for inadequate education and literacy. Education and literacy, including health literacy, are vital to understanding and analysis of public health emergencies and other disasters, and the riskscommunicated to the affected communities[19, 33]. Likewise, individual misfortune has been shown to have an association with feelings of being discriminated against, and an overall resultant mistrust for official organizations[8]. It is

evident, from these examples, that the economic factor can interact with and affect other relevant social factors in risk communication.

*Health Literacy.*Literacy and health literacy are related, but are two separate categories. Health literacy is vital in understanding how emergencies and the environment can affect health. Additionally, health literacy often includes understanding the health care systems established in the community, insurance limitations, among other issues that affect health care. Vulnerable populations that fall within the impoverished and immigrant population often experience health literacy barriers, and therefore may not understand or respond to the threat and the recommendations made by public health and emergency management authorities[18, 19, 33].

*Spoken and Written Language.*This social factor should not come as a surprise. The United States is made up of an extremely diverse population, with people from different countries, religions, and cultures from all around the world. As such, there are language barriers in communities that extend to health disparities and public health risk communication[33]. The authorities are not able to communicate through every form of media in every language. The inability to understand the primary languages spoken in the United States can have an effect on understanding information reported, recommendations provided, and on health literacy. The inability to overcome language barriers presents a formidable challenge to officials' abilities to communicate relevant information about health risks[33].

*Communicative Disabilities.*People with disabilities, including those with hearing and other communicative disorders, are an underserved population when it comes to disaster planning[18], and their vulnerable characteristics can significantly influence trust in the public health system[8]. Large-scale disasters such as Hurricane Katrina have created awareness that these events affect disabled populations differently than the rest. Among them, the hearing-impaired are at higher risk. The 2010 U.S. Census showedthat approximately 19 percent of the population is disabled, and approximately 7.6 million people havehearing disabilities[43]. The inability of authorities to provide information and warning to people with communication disabilities is a failure in planning and operations, and the current warning and risk communication systems have been reviewed and received a failing rating from the hearing-impaired community[44]. Research is limited, but current results show that fewer than half of community-based organizations have emergency management plans that are accessible and understandable to their deaf and hard-of-hearing clients due to health literacy and media formats[45]. The substantive gap exists not only in the actual response capabilities but also in the emergency preparedness training on serving the hearing impaired populations. This has serious implications for responding to all-hazards emergencies[46]. Although some technology-based communication systems have been developed and field-tested, including a mobile device-based visual information delivery system that provides communication and warning regarding evacuation and shelter, the research and distribution of such products have a long way to go[47]. Understanding the behaviors of special-needs groups is key to developing informed risk-communications and interventions to bolster the preparedness of the most vulnerable populations[48]. However, this factor is closely interactive with the socioeconomic, demographic, and health literacy factors.

*Cultural Demographics.*Cultural demographics is a complex social factor that can consist of ethnicity, nationality, and religion, and interacts dynamically with all of the other social factors in the cube, and is particularly related to history in this case. Research performed in the aftermath of Hurricane Katrina, and other disasters, indicates that ethnic minority communities are less likely to evacuate are at higher risk during disasters[19]. Cultural ignorance, ethnic insensitivity, and racial bias contribute to lower rates of preparedness for and evacuation from disasters[19]. A study of public health disaster trust across communities revealed that racial or ethnic minorities exhibited lower trust scores when compared to white people[8]. This is likely due to perception of discrimination and experienced racism. With some demographics, such

as immigrants, it is often a result of fears of immigration problems and experience with immigration and citizenship services[8, 18, 33].

History. The history social factor involves the historical experience that the vulnerable or at-risk population has with emergencies and risk communication during public health and other disasters. This includes historical encounters with authoritative organizations, including the parties managing the response, risk communications, and recommendations. Decisions based on history also have a great deal to do with the type of disaster and the experiences the population has with similar emergencies, and the history of any of the illnesses or diseases being encountered. These histories are often clearly tied with cultural demographics, and particularly with ethnicity[8, 18, 19]. For example, the determinants of trust include the history of how groups have been marginalized or perceive having been discriminated against over history, and can even be passed from experience of ancestors or even unrelated people[8]. Public health systems have a history of discrimination on the basis of class and ethnicity. These discriminatory acts have included failure to treat for ethnic reasons and providing priority of health care services to Caucasian population. Specific acts include unnecessary quarantine of San Francisco's Chinatown at the turn of the 20th century, inequitable distribution of treatment during the 1918 influenza pandemic, and unethical scientific human experimentation during the Tuskegee Syphilis Experiment[8].

Conclusion

National health resilience and security in the face of natural and man-made disasters is significantly dependent on public health infrastructure. Although there is limited evidence in the medical literature regarding this topic, the evidence does suggest that public health emergency planning requires additional effort in addressing gaps in risk communication to high-risk and vulnerable populations. In order to improve programs and effectively manage disaster risk communication, a thorough assessment of the programs is necessary. The assessment of the risk communication systems should begin by identifying whether the core concepts of simplicity, timeliness, accuracy, relevance, credibility, and consistency, exist, in addition to the added fundamentals of multimedia distribution and inclusivity. Inclusivity refers to the need of public health emergency programs to address risk communication gaps to vulnerable or high-risk groups, including low-income, immigrant, and disabled populations, among others. There are prevalent social factors that affect program effectiveness and decision-making within the vulnerable groups, and these social forces can be assessed using a modified social cubism model re-designed specifically for analyzing public health emergency risk communication.

Interprofessional collaboration in health care and public health is crucial in today's environment. Risk communication assessments performed on public health preparedness programs should be interdisciplinary in nature. These assessments should be conducted by professionals within a diversity of fieldsincluding social and behavioral science, public health, disaster and consequence management, communications and public affairs,quality management, and urban planning. Together, professionals such as social workers, conflict resolution professionals, environmental and public health experts, public affairs officers, auditors, and community planners and organizers can potentially form a thorough group and use the necessary tools, including the risk communication social cube, to provide a robust evaluation with the deepest understanding of the priorities and needs of potentially affected populations, and the steps necessary to incorporate the findings into developing effective preparedness and response programs.

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Figure 1.The C3 Disaster Communications Model: Displaying Inter-Agency, Intra-Agency, and Public Risk Communication
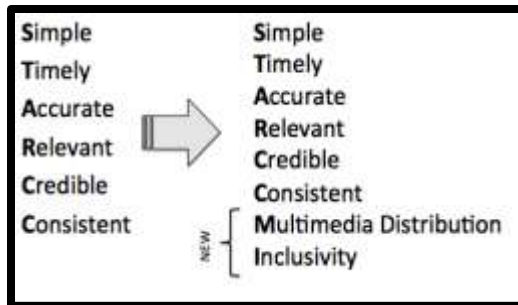

Figure 2. The STARCCMI Model: Displaying the Addition of Multimedia Distribution and Inclusivity to the Risk Communication Core Elements
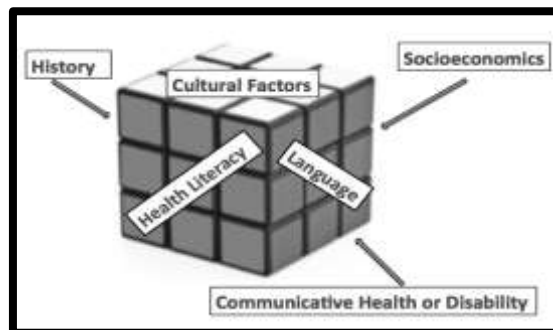

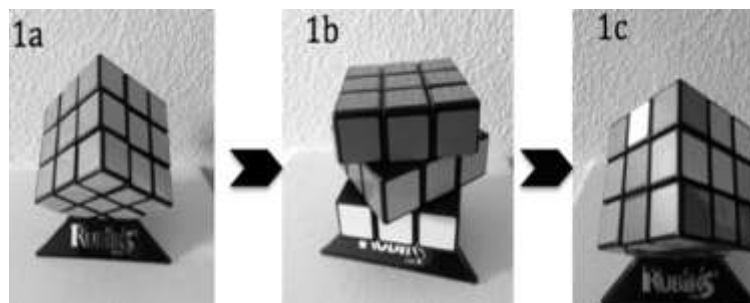Figure 3. The Risk Communication Social Cube

Figure 4. Photographic Display of the Risk Communication Social Cube: The Six Dynamic Factors

The Rubik's Cube® is used as a photographic model of the risk communication cube. **1a** represents the six inter-related factors (cultural demographics, spoken and written language, health literacy, communicative health or disability, socioeconomic status, and history) with each side and color representing an individual factor. **1b** represents the interaction of the six factors. **1c** represents the intertwined nature of the six dynamic factors that can lead to risk communication failure in public health emergency response, and can seriously affect response and consequence management.