



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

USING PROBLEM-BASED LEARNING FOR PANDEMIC PREPAREDNESS

Carrie S. Marshall,¹ Seiji Yamada,¹ and Megan K. Inada²

¹University of Hawaii John A. Burns School of Medicine, and ²Kokua Kalihi Valley Comprehensive Family Services, Honolulu, Hawaii, USA.

To test the hypothesis that PBL is an effective method for preparing multidisciplinary learner groups at community health centers (CHCs) for pandemics, quantitative and qualitative methods were utilized to evaluate the conduct of a PBL case of a hypothetical outbreak of severe acute respiratory syndrome (SARS) at two CHCs in Hawaii, with multidisciplinary health professional and student participants. It was found that: (1) there was an overall increase in knowledge of bioevent preparedness; (2) participants gave high ratings for the effectiveness of the PBL process; (3) participants found value in the multidisciplinary group process; and (4) participants strongly agreed that they preferred the PBL process to the traditional lecture format for learning about bioevent preparedness. The PBL approach is useful in educating community-based health professionals from different disciplines about issues related to pandemic preparedness.

Key Words: bioterrorism, disease outbreaks, interprofessional relations, problem-based learning

(*Kaohsiung J Med Sci* 2008;24(3 Suppl):S39–45)

During the International PBL Workshop at Kaohsiung Medical University in July 2007, one of the cases used portrayed a hypothetical outbreak of pandemic influenza—a case used in the curriculum of the University of Hawaii John A. Burns School of Medicine. This case, developed as one of a set of PBL cases on preparedness, generated much discussion as well as formal learning issues, as students and faculty from Taiwan, Hong Kong and Singapore reflected on their experiences of the severe acute respiratory syndrome (SARS) outbreak of 2003.

While participants in the International PBL Workshop in KMU focused on the international cooperation during future public health emergencies being fostered by such gatherings, the response to a pandemic

is also a local phenomenon that can involve the entire health workforce and many sectors of society besides the health care system, as our colleagues found with the SARS epidemic. However, little literature exists regarding training for a coordinated and culturally appropriate response to public health emergencies [1]. Finding the best approach to train health professionals to respond to public health emergencies in a multidisciplinary collaborative manner has been called a “largely unaddressed need” [2].

In the US, community health centers (CHCs) serve many ethnically diverse and vulnerable populations. Different cultural groups present unique issues including varying languages, cultural interpretations, expressions of grief, help-seeking behaviors, and inherent cultural resources [3]. Charged with meeting their primary health care needs, CHCs may become the point of initial care for victims in the event of epidemics of emerging infectious diseases, the intentional release of bio-terrorist agents, natural disasters, or industrial accidents. In the event of community public health emergencies, the entire workforce of CHCs may be called upon to respond.



Address correspondence and reprint requests to:
Dr Seiji Yamada, University of Hawaii John A.
Burns School of Medicine, 651 Ilalo Street, MEB
401G, Honolulu, HI 96813, USA.
E-mail: seiji@hawaii.edu

ELSEVIER

Multidisciplinary teamwork requires participants to be adaptable and flexible, able to communicate effectively with one another, and collaborate to achieve common end goals [4]. The World Health Organization (WHO) recommends an approach to multidisciplinary education [5] in which health professionals learn to work together by learning the material together. Such interaction promotes understanding of and respect for the roles and skills of other practitioners [6], as well as provides an opportunity for the development of democratic leadership and functioning, adaptation to different cultural and social groups, and enhancement of teamwork skills [5–7].

Although problem-based learning (PBL) has been recognized by the World Health Organization as the most appropriate vehicle for teaching multidisciplinary teamwork [5], a report published by an expert panel of the Association of American Medical Colleges on the “broad spectrum of teaching strategies” [8] for training future clinicians to respond to large-scale health emergencies makes no mention of a PBL-based approach to learning about and training for preparedness. This absence is unfortunate, as PBL is a process whereby participants learn through scenarios to determine what information they need to understand and address the problems presented. By a process of self-directed learning, participants identify and research learning issues relevant for their particular disciplines. Conducting multiprofessional PBL groups within the community [9] is an approach to training for coordinated and culturally-competent responses to public health disasters.

HYPOTHESIS

PBL is an effective method for preparing multidisciplinary learner groups at community health centers (CHCs) for pandemics.

We report here on the evaluation of a program to conduct a pandemic PBL case study with multidisciplinary learner groups in a CHC setting.

METHODS

The conduct of a PBL case of patients infected with SARS was evaluated at two CHCs in Hawaii, with multidisciplinary health professional and student

participants. The case focused on common public health preparedness issues, including recognition, information gathering, communication, dissemination, and ethics, as well as teamwork and functioning within a multidisciplinary group.

The participants were members of a community-based interdisciplinary training curriculum conducted at the CHCs. They included six first-year medical students, three second-year nursing students, a nurse practitioner, three social workers, two social work students, one health education specialist and one public health student.

The groups met twice over 2 weeks, for 3 hours each session. The sessions opened with a summary of the PBL process. The first 3-hour session consisted of reviewing and discussing the case and identifying learning issues, while the second session 1 week later had students return with their researched learning issues and present them to the group. Sessions were facilitated by experienced PBL tutors.

An educational specialist observed both sessions and administered a short pretest questionnaire of participant’s familiarity with bioterrorism issues, as well as a longer, more in-depth evaluation follow-up, administered online through anonymous survey software. Nine participants (3 medical students, 2 nursing students, 1 social work student, 2 social workers [grouped together for evaluation purposes under *Social Workers*], and 1 public health student) participated in the self-reported evaluation.

RESULTS

The results have been divided into five categories: (1) effect of the module on knowledge of bioevent preparedness; (2) PBL case content and process; (3) multidisciplinary group process; (4) overall review of the PBL case; and (5) qualitative data.

Effectiveness of the module to increase knowledge of bioevent preparedness

Comparing the pre- and posttest scores, there was an overall increase in all testing components (Table 1).

PBL case content and process

As shown in Table 2, participants were asked to rate the PBL case content and process. The results indicated that participants felt that the case proposed

Table 1. Effect of the module on knowledge of bioterrorism preparedness. Mean participant scores on pre- and posttests self-assessing subject knowledge (change); pretest score – posttest score (**change in score**); (0=no knowledge on subject, 5=maximum knowledge)

	Social work (n=3)	Nursing (n=2)	Medical (n=3)	Public health (n=1)	Overall mean change by question
Awareness of potential bioterrorist agents	1.0–3.5 (+2.5)	4.0–5.0 (+1)	3.3–3.7 (+0.4)	3.0–4.0 (+1)	2.7–4.0 (+1.3)
Ability to recognize signs and symptoms of potential bioterrorist agents	1.7–3.5 (+1.8)	2.5–4.5 (+2)	2.7–3.3 (+0.6)	4.0–4.0 (0)	2.1–3.7 (+1.6)
Knowledge of on-the-scene treatment/isolation procedures to protect myself and other health personnel	0.7–4.0 (+3.3)	4.0–5.0 (+1)	3.0–3.7 (+0.7)	2.0–4.0 (+2)	2.3–4.1 (+1.8)
Knowledge of containment/quarantine procedures to protect the public from cases of potential bioterrorist agents	0.3–3.0 (+2.7)	3.0–4.5 (+1.5)	2.3–3.3 (+1)	3.0–4.0 (+1)	1.9–3.6 (+1.7)
Knowledge of delayed treatment needs, including psychological	3.7–3.7 (0)	2.5–4.5 (+2)	2.0–3.0 (+1)	4.0–4.0 (0)	2.9–3.6 (+0.7)
Skills in communicating an infectious outbreak to patient, family and community	1.0–3.5 (+2.5)	2.5–4.5 (+2)	2.0–3.0 (+1)	3.0–3.0 (0)	1.9–3.5 (+1.6)
Knowledge of how to report potential bioterrorist agents to appropriate health authorities	0.3–4.0 (+3.7)	2.5–4.5 (+2)	3.0–3.7 (+0.7)	3.0–4.0 (+1)	2.0–4.0 (+2.0)
Confidence in identifying and appropriately responding to potential bioterrorist agents	0.3–4.0 (+3.7)	3.0–4.5 (+1.5)	3.0–3.7 (+0.7)	4.0–4.0 (0)	2.2–4.0 (+1.8)
Skills in communicating effectively in interdisciplinary groups	3.7–3.7 (0)	4.0–5.0 (+1)	3.7–3.7 (0)	3.0–3.0 (0)	3.6–4.0 (+0.4)
Overall mean change by discipline	1.4–3.6 (+2.2)	3.1–4.7 (+1.6)	2.8–3.5 (+0.7)	3.2–3.8 (+0.6)	2.4–3.8 (+1.4)

a realistic scenario (mean=4.1 on a scale from 1 to 5, with 5 meaning “strongly agree”) and was written in a way that fostered group discussion (mean=4.4). Participants also felt that all health perspectives were adequately addressed in the case (mean=3.8). Overall, participants gave high ratings for the effectiveness of the PBL process. They felt they were able to research learning issues on their own, in a manner that was conducive to their learning the information (mean=4.1), and that they could access a variety of sources to research their learning assignments (3.9). In relation

to group functioning, the group agreed overall that the learning issues were equitably divided amongst disciplines (mean=4.0) and that the group was able to govern itself with minimal intervention from tutors (mean=4.1).

Multidisciplinary group process

In data addressing the multidisciplinary aspect of the PBL process (Table 3), participants from all disciplines felt that they had actively participated (mean=4.6), that they had provided ideas that contributed to the

Table 2. PBL case content and process. Mean ratings (1 = strongly disagree, 5 = strongly agree)

	Health professional students				Overall
	Social work (n=3)	Nursing (n=2)	Medical (n=3)	Public health (n=1)	
Proposed a realistic context similar to something I may encounter in my practice	3.3	4.5	3.7	5.0	4.1
Written in a way that aroused suspense/fueled group discussion	4.0	5.0	3.7	5.0	4.4
All health perspectives were adequately addressed in the case	2.7	4.5	4.0	4.0	3.8
I was able to access a variety of resources to research my learning issues	3.7	4.5	3.3	4.0	3.9
I could research information on my own which allowed me to understand my learning issues	4.0	4.5	4.0	4.0	4.1
Learning issues were divided equitably	3.7	4.5	4.0	4.0	4.0
The group was able to govern itself with minimal intervention from tutors	4.0	4.5	4.0	4.0	4.1

Table 3. Multidisciplinary group process. Mean ratings (1 = strongly disagree, 5 = strongly agree)

	Health professional students				Overall
	Social work (n=3)	Nursing (n=2)	Medical (n=3)	Public health (n=1)	
All viewpoints from across the represented disciplines were accepted equally	3.3	4.5	4.0	5.0	4.2
I actively participated	4.7	4.5	4.0	5.0	4.6
All others actively participated	3.7	4.5	4.0	5.0	4.3
I provided ideas which contributed to the success of the case	4.3	4.0	4.0	4.0	4.1
I felt I could express my ideas without judgment	3.7	4.5	4.0	4.0	4.1
All group members participated equally in decision making	3.7	4.5	3.7	5.0	4.2
The group worked cooperatively rather than competitively	4.0	5.0	4.3	5.0	4.6
All participants had the necessary medical capacity/knowledge to contribute productively	2.7	3.5	3.3	5.0	3.6

success of the case (mean=4.1), and that they could express their ideas without judgment (mean=4.1). Students also agreed that the group had worked cooperatively rather than competitively (mean=4.6).

Overall review of the PBL case

Participants were asked to rate their overall experience of this multidisciplinary PBL process (Table 4). Overall, participants strongly agreed (mean=4.5) that they

Table 4. Overall review of the PBL case. Mean ratings (1 = strongly disagree, 5 = strongly agree)

	Health professional students				Overall
	Social work (n=3)	Nursing (n=2)	Medical (n=3)	Public health (n=1)	
The process benefited from the contributions of professionals from multiple health disciplines	3.3	4.5	4.0	5.0	4.2
I would prefer this process over traditional lecture format for learning about bioterrorism preparedness	4.3	4.5	4.3	5.0	4.5
Through participation in this case, I feel better prepared to deal with something similar in my practice or profession	3.7	4.5	3.7	5.0	4.2
This process was successful in encouraging a holistic analysis of potential bioterrorist agents	3.3	4.5	4.0	4.0	4.0
This experience stimulated an interest for me in bioterrorist issues	3.3	4.0	4.0	4.0	3.8
Overall mark (1=poor, 10=excellent)	7.0	9.5	8.3	9.0	8.5

preferred the PBL process to the traditional lecture format for learning about bioevent preparedness, and that through participation in this case, they felt better prepared to deal with a similar event (mean=4.2). Participants also agreed that the PBL process benefited from the multidisciplinary environment (mean=4.2).

Qualitative data

Participants were also provided the opportunity to comment anonymously on their experiences of this process and to make recommendations to address these issues. The qualitative data has been integrated into the discussion below.

DISCUSSION

Overall, participants from all disciplines gave high ratings to the PBL approach, indicating they preferred the PBL process to the traditional lecture format for learning about bioevent preparedness. The PBL method also proved to be of educational benefit, with pre- and posttest scores indicating self-reported knowledge increases in several categories. The greatest increases in scores were in participants' knowledge of how to report unusual bioevents to appropriate health authorities, their confidence in being able to identify and

appropriately respond to potential biologic agents, and their knowledge of on-the-scene treatment/isolation procedures to protect health personnel. As one nursing student put it, "PBL increases critical thinking and the chance to practice critical thinking before you get into the field." Social work students had the lowest baseline knowledge and recorded the greatest increase in scores between the pre- and posttests; at the conclusion of the pilot testing, the social work, public health and medical disciplines all reported similar levels of knowledge, while the nursing students reported the greatest absolute knowledge.

Participants also agreed that the PBL process benefited from the multidisciplinary environment. Multidisciplinary education has been called "the best vehicle to prepare professionals to increase collaboration" [9]. As has been found with other multidisciplinary groups [7,9], the members almost unanimously valued their experience of participating in this diverse group exercise. Participants from the multiple disciplines felt that they had provided ideas that contributed to the success of the case, that they could express their ideas without judgment, agreed that the group had worked cooperatively rather than competitively, and that all viewpoints from the represented disciplines were equally accepted. These results support other research that has found the benefits of

multidisciplinary training include harmonious group functioning and an increased understanding and respect for other professional's contributions [4]. One medical student noted, "[the case] gave me a different perspective on learning medical issues"; another commented that for them, the case "brought to light public health and psychosocial issues" related to bioevents. One participant wanted to see even more of his/her field represented within the context of the case "so that the medical students could gain a better knowledge of how an assessment is done". This exposure to a wide range of health workers and the anticipated outcome of an enhanced understanding of others' roles and responsibilities can potentially improve relationships, increase trust, and dispel stereotypes across disciplines, in turn strengthening a coordinated response to emergencies.

There are also difficulties and constraints associated with conducting multidisciplinary PBL groups that have been identified elsewhere and were partially identified here. Most notable was the effect of an inherent "interprofessional hierarchy" [9] guiding the interactive process and a deference to medical students, who are often the only group exposed to a PBL curriculum in their schooling [10]. As one social work participant noted, "it seems like there is a natural inclination by the group to focus on the medical aspects because the medical students are most accustomed to this format". Although these issues were not evaluated directly, several results and comments are worth noting, particularly with views expressed by the social workers. For example, although on average participants felt all viewpoints from across the represented disciplines were equally accepted, social workers were the most likely to disagree and also rated the benefits of the multidisciplinary setting lower than all other groups. One social work student had these comments:

"I don't know if we truly 'benefited' from multidisciplinary participation when, clearly, not all disciplines participated equally, or were equally represented. The inherent bias towards medicine in the PBL format, including tutors/instructors who are enmeshed in this bias, does not effectively integrate or take advantage of all the talents of varying disciplines involved. Although there is great opportunity for learning under the PBL format, ending that bias will be extremely challenging but beneficial in the long run."

The PBL format has also been criticized for inadequately addressing psychosocial and population content [10]. The case did elicit more psychosocial and populational/public health issues than either biological or clinical learning issues. However, participants from all disciplines commented on the need for the case to address broader health perspectives. The social work participants gave the lowest marks for the realistic context of the PBL case and its sufficiency in addressing these issues. Comments by social work participants included the following:

- "There was too little focus on outcomes and activities that would involve non-medical health care providers. Our role in the aftermath of a SARS exposure in the community would be very important, particularly in communicating with community residents in a way they can understand."
- "Include more background information to address psychosocial issues of patient to more conducive to social work aspects."
- "Need to incorporate more information about the patient's family support system and living conditions."
- "The patient had no voice; don't hear anything from her point of view. Difficult to pick up psychosocial cues the way the case was written; the case didn't say how these events affected the patient psychologically."

Non-social work participants also commented on the need to address more psychosocial and populational aspects:

- (public health student): "Need more information about the patient and her community. Also, more public health issues; for example little more detail about isolation and quarantine procedures and little more about the steps related to management of the patient."
- (medical student): "Need more surrounding ecological issues esp. family issues, how to process with keeping family members safe after diagnosis."
- (medical student) "A quarantine could have [been] put into effect, thereby allowing more social work involvement (i.e. patients' family can't see patient, so social worker tries to help out)."

Another issue raised was the importance of determining the correct use of medical terminology that is appropriate and encompassing of all educational levels within the group. In this group, the two disciplines presumably at opposite ends of the medical

knowledge continuum—the social workers and medical students—were the least likely to agree that all participants had the necessary medical capacity/knowledge to contribute productively. None of the medical students commented on the terminology used in the case. However, future recommendations for the case by a social worker and nursing student, respectively, highlight this issue:

- “The language used in the scenario was too technical, and somewhat intimidating—use more lay terms when discussing symptoms and conditions so that non-medical people would feel comfortable while participating in the discussion.”
- “Use of terms was too complicated [and] a summary of the labs would have been sufficient (instead of exact lab values).”

This evaluation had several limitations, including the small number of participants and the fact that only nine of the 17 participants completed the evaluation questionnaire. Lastly, the high ratings given to the multidisciplinary setting may have been due to a self-selection process of participants that were perhaps already interested in multidisciplinary environments. However, as the development of a surge capacity will depend on volunteers, this group may indeed be a representative sample of our local response pool. Despite these limitations, this pilot-testing has highlighted many considerations and recommendations for improvements by both the participants and evaluation for conducting future PBL-based multidisciplinary bioevent response training events within community settings, a topic with little research precedent to date.

Future implementation of PBL training for responses should enhance the facilitator’s role in facilitating multidisciplinary communication skill building, specifically, to encourage the individual, non-medical disciplines, such as social workers, to bring their perspectives to the case. Facilitators should also stress the importance of a discussion of population/social issues and encourage discussion of these issues with the presentation of the learning issues. Cases should include the patient’s perspective—adding more of the patient’s “voice”—including interactions with her community and more of her interactions with the physician, or possibly a social worker. They should also expand information on communication strategies for bioevent cases, including communication with family members of suspected cases.

CONCLUSION

To our knowledge, our evaluation of the use of the PBL method to address the issues surrounding a pandemic response and preparedness in multidisciplinary, community-based settings is the first of its kind. We found that the PBL approach is useful in educating community-based health professionals from different disciplines about issues related to pandemic preparedness. Conducting PBL with students from various disciplines brought issues of multidisciplinary communication and collaboration to the fore. We suggest that PBL be further utilized in such training.

REFERENCES

1. Catlett C, Perl T, Jenckes M, et al. *Training of Clinicians for Public Health Events Relevant to Bio-terrorism Preparedness*. (Evidence Report/Technology Assessment No. 51 (Prepared by Johns Hopkins Evidence-based Practice Center under Contract No. 290–97–006). AHRQ Pub. No. 02–E011. Rockville, MD: Agency for Healthcare Research and Quality, January 2002.
2. Markenson D, DiMaggio C, Redlener I. Preparing health professions students for terrorism, disaster, and public health emergencies: core competencies. *Acad Med* 2005; 80:517–25.
3. Ng AT. Cultural diversity in the integration of disaster mental health and public health: a case study in response to bio-terrorism. *Int J Emerg Mental Health* 2005;7:23–31.
4. Parsel G, Spalding R, Bligh J. Shared goals, shared learning: evaluation of a multiprofessional course for undergraduate students. *Med Educ* 1998;32:304–11.
5. World Health Organization. *Learning Together to Work Together for Health: Report of a WHO Study Group on Multiprofessional Education of Health Personnel—The Team Approach*. Technical Report Series Number 769. Geneva: WHO Publications, 1988.
6. Hall P, Weaver L. Interdisciplinary education and teamwork: a long and winding road. *Med Educ* 2001;35:867–75.
7. Horsburgh M, Lamdin R, Williamson E. Multiprofessional learning: the attitudes of medical, nursing and pharmacy students to shared learning. *Med Educ* 2001;35:876–83.
8. Association of American Medical Colleges. *Training Future Physicians About Weapons of Mass Destruction: Report of the Expert Panel on Bio-terrorism Education for Medical Students*. AAMC: Washington DC, 2003.
9. Reeves S. Community-based interprofessional education for medical, nursing and dental students. *Health Soc Care Community* 2000;8:269–76.
10. Pham K, Blumberg P. Case design to emphasize population health concepts in problem-based learning. *Educ Health* 2000;13:77–86.