PEDIATRICS AND NEONATAL NURSING

Openventio PUBLISHERS

ISSN 2377-1569 Open Journal http://dx.doi.org/10.17140/PNNOJ-2-113

Review

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Volume 2 : Issue 3
Article Ref. #: 1000PNNOJ2113

Article History
Received: September 10th, 2015
Accepted: October 16th, 2015
Published: October 19th, 2015

Citation
Veenema TG, Thornton CP. Enhancing child health and welfare following disasters and public health emergencies in schools and university health centers. *Pediatr Neonatal Nurs Open J.* 2015; 2(3): 75-84. doi: 10.17140/PNNOJ-2-113

Enhancing Child Health and Welfare Following Disasters and Public Health Emergencies in Schools and University Health Centers

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ABSTRACT

Our nation's families trust schools to protect the health and welfare of their children while in the educational setting. This task has become increasingly difficult to accomplish given the multitude of hazards that threaten our schools and the people in them on a daily basis. The frequency and intensity of natural disasters such as hurricanes, earthquakes, tornadoes and floods is increasing. Human-made disaster events such as active shooters, bomb threats, and other acts of terrorism are persistent challenges for preparedness and response and have been in the light of media attention with increasing frequency in the past several years. The role of the nurse working in a school or university health center as a member of the disaster response team is critical to the successful management of disasters.

KEYWORDS: Child health; Health emergencies in schools; School-based nurses.

ABBREVIATIONS: NCCD: National Commission on Children in Disasters; CDC: Centers for Disease Control and Prevention; NASN: National Association of School Nurses; FEMA: Federal Emergency Management Agency; EMSC: Emergency Medical Services for Children; NRC: National Resource Center; EMS: Emergency Medical Services; KI: Potassium iodide; FDA: Food and Drug Administration.

INTRODUCTION

Schools and universities across the United States are entrusted to provide a safe and healthy learning environment for students, faculty, and staff who live, work, and study on campus. More than 50 million children were enrolled in over 98,000 public elementary and secondary schools in 2014 and 21 million students were enrolled in a college or university.[1] Faced with emergencies ranging from active shooter situations to fires, tornadoes, floods, hurricanes, earthquakes, and pandemic influenza; school-based nurses must maintain a level of situational awareness and readiness to respond to situations that threaten our nation's children.[2] Many of these emergencies occur with little to no warning. Therefore, it is critical for educational institutions and the nurses who work with them to plan ahead in order to help ensure the safety and general welfare of all members of the campus community.

In 2010, the National Commission on Children in Disasters (NCCD) was established to evaluate the nation's level of disaster preparedness for children.[2] The commission found that many schools and school districts had disaster plans but few aligned with federal recommendations.[2] There was a general lack of plans for accommodating children with special needs and plans for continuing education if the school was closed for an extended period of

ISSN 2377-1569 Open Journal http://dx.doi.org/10.17140/PNNOJ-2-113

time.[2] Schools seem to be struggling with prevention programs; only 57.2% of superintendents surveyed said their school district had disaster or emergency prevention plans.[3] Recent studies echo these findings and indicate that improvement in comprehensive and all-inclusive disaster plans for schools are still needed.[4] Out of 1,997 school nurses surveyed from 26 states only 2.2% of respondents said their school had a mandatory influenza vaccination policy for students and staff.[5] The same study evaluated school districts on their level of preparedness for pandemic influenza on a scale of 0 to 10 and the average score was only 4.3.[5]

REVIEW OF SCHOOL HAZARDS AND IMPLICATIONS FOR STU DENT HEALTH SERVICES

Schools and universities (school systems) are subject to the same disasters as the local community but also additional hazardous situations unique to a school setting due to the congregation of children who have their own unique needs and vulnerabilities. School systems need to prepare for natural disasters that commonly affect their local and regional community (tornadoes, hurricanes, floods, etc.) but must focus preparedness efforts to address situations that have emerged as a threat to students and the educational campus as well.[6]

Natural/Weather-Related Disasters

When planning for natural disasters, schools need to prepare for those events that come with and without warning. For example, tornadoes and earthquakes often strike with no or very short warning systems whereas hurricanes, blizzards, and other inclement weather events may be known well in advance. In either case, the school system needs to have written emergency response plans for preparedness, response, and recovery from these events as they pose serious immediate risk of injury and death along with lasting damage and destruction to the community.[7] A review of recent natural disasters in the US indicates the need to not only strengthen plans for immediate disaster response, but also in providing care for students after these events.[8]

After the destruction brought on by hurricane Katrina and Rita in 2005 school/university nurses and mental health experts became instrumental in disaster response and recovery efforts.[9] Even with advanced warning systems in place, students still faced a wide array of physical and psychological injuries and damages. School based-nurses and mental health experts in surrounding areas served to coordinate care, provide mental health services, and facilitate a transition back to pre-disaster functioning.[9] In 2011, an EF-5 tornado struck Joplin, Missouri and severely damaged half of the area's schools. Luckily, it occurred on a Sunday afternoon and schools were not in session at the time, but administrators and school officials still had to plan to resume school services. School-based nurses were called upon to provide their expertise in integrating children back into schools while tending to the psychological and physical needs of the community's children.[10]

Fire, Explosion, and Building Collapse

Fires and other events that compromise the structural integrity of school buildings are rather frequent events. An average of nearly 5,700 fires in academic buildings and nearly 4,000 in collegiate housing have been reported to fire officials every year.[11,12] Advances in preparedness efforts have drastically reduced deaths from fires in schools to an average of only 1 per year in educational building and 2 per year in collegiate housing while also reducing the costs of damage from fires.[11,12] However, since these are high-frequency events with potential to affect any school building, school-based nurses must remain vigilant in preparedness for these events. Consider reviewing fire drill procedures and evacuation protocols for the school paying close attention to students with special needs or those who will need assistance with evacuation (see sections later in this publication for more information). In addition to assistance with evacuation planning, the school nurse may need to prepare to assist students who were injured during any fires including the potential management of smoke inhalation injuries, exacerbation of pulmonary disease (e.g. asthma attacks), and the provision of first aid until emergency responders arrive.[6]

Pandemic Influenza

According to the Centers for Disease Control and Prevention (CDC), only 44.6% of school aged children (5-12 years) and 31.8% of adolescents (13-17 years) received the flu vaccine in 2014.[13] Despite the heightened awareness of the severity of communicable diseases with the Ebola epidemic, immunization rates for influenza remain largely unchanged from the previous year.[13] Children in schools are particularly susceptible to influenza due to relatively low immunization rates and the high number of individuals who remain within the schools. Nurses need to be prepared for large numbers of sick children and to rapidly institute standard disease containment strategies. School and universities may be asked to become point of distribution clinics or mass immunization centers.[14] By applying their medical knowledge and leveraging the trust of the community, school-based nurses may become key players in slowing the spread of pandemic influenza.

Active Shooters

Shootings at the elementary, secondary, and university level have increased significantly. Deaths from gun-related violence within schools have been so high that communities now refer to some of the events as "massacres". The 2012 shooting at Sandy Hook Elementary that resulted in the death of 20 children and 6 adults sparked national debates on gun control and discussions on how children can be kept safe at schools. It was the second worst school-related shooting in history, second only to what is now known as the Virginia Tech massacre that took the lives of 32 only six years earlier.[15] Since 2010, there have been more than 106 gun-related shooting at schools or universities resulting in the death of more than 110 children.

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Nuclear Power Plant and Chemical Plant Failures

Schools located near industrial facilities, such as nuclear power plants or chemical and oil refineries, must prepare for incidents at these sites. While these events are extremely rare, they can have massive impact on schools and communities. The Fukushima Daiichi nuclear disaster of March 2011 serves as an example. An earthquake and resultant tsunami led to structural damage to the power plant; several reactors exploded and released colossal amounts of radiation into the surrounding environment. Massive evacuation, economic losses, widespread panic, and loss of life resulted from the nuclear meltdown[16] The incident was so devastating that it sparked international discussion on disaster prevention and preparedness efforts for nuclear events.

STUDENTS WITH SPECIAL NEEDS

Today's school/university nurse must be constantly aware and vigilant of children enrolled at the school who have chronic medical conditions (e.g. asthma, diabetes, seizure disorders, mental health disorders, etc), special healthcare needs, developmental disabilities, and those who are technology-dependent (e.g. ventilators, need for suction or tube feedings, wheelchair bound, etc). These students should be identified early as they will be more vulnerable to a disaster situation. When unforeseen events strike, these children, adolescents and young adults may have difficulty in independently seeking safety or protecting themselves; their lives can be heavily dependent on the actions of those around them. Plans for the evacuation or sheltering of these children must be discussed with their primary caretaker or teacher as well as with the child if appropriate.[17] Using developmentally-appropriate means to discuss their role during disasters with children allows them ease their tensions about disasters and discuss their own concerns.[17] The nurse should facilitate the discussion and planning for these children with school officials, special education teachers, school aids, and others involved in the day-to-day care of these children to ensure that their needs are not overlooked during a disaster.

ROLE OF THE SCHOOL/UNIVERSITY NURSE IN DISASTERS AND PUBLIC HEALTH EMERGENCIES

The daily functions of the school/university nurse center around health promotion, education, and ensuring safety. During an emergency or disaster, the nurse's focus must immediately shift to keeping the children, adolescents, and young adults under his or her care alive and safe. As such, the nurse must be a partner in planning for disasters and emergencies as recommended by National Association of School Nurses (NASN).[6] The role that the school nurse will play in disaster response and mitigation may vary based upon their individual state's scope of practice and other governing bodies. It is the responsibility of the school/university nurse to understand their role or advocate for their position to be heavily involved in planning and responding to disasters that affect the children and young adults under their care. Resources for the school/university nurse to use in disaster planning are included at the end of this article.

Communities trust school-based nurses and desire their participation in disaster preparedness and response activities. During the H1N1 outbreak, parents in Massachusetts became worried, even panicked, about allowing their children to attend school. Calls flooded the schools and community health departments with inquiries regarding safety but the community panic was controlled once the school-based nurses entered the discussion.[18] Parents trusted the expertise of the nursing staff and shortly thereafter calls on the topic ceased completely.[18]

The National Association of School Nurses (NASN) 2014 official position statement on the role of the school nurse in emergency and disaster preparedness states "as healthcare providers, nurses must be involved in all phases of disaster or emergency preparedness and response".[6] Nurses are trained experts in using and applying the nursing process of assessment, diagnosis, planning, implementation, and evaluation.[6] Their educational and clinical expertise is built upon the foundation of applying this system to a multitude of situations.

The nursing process closely aligns with Federal Emergency Management Agency (FEMA) disaster preparedness cycle. Nurses, as experts in applying the nursing process in multiple clinical situations, can approach disasters with a well-established and useful framework.[19] School-based nurses are often the first healthcare professional to respond to an emergency or disaster on school grounds and must be knowledgeable of their role and responsibilities to manage the disaster until support services arrive.[6] They must be involved in preparation of plans to handle events that may affect one person or the entire student body and faculty/staff at the school.

Preparedness

Nursing has long-stood as a field dedicated to making a difference in healthcare by collecting data and applying it to clinical situations. Surveillance, data collection, and assessment are crucial components to the nursing theory. Recent studies suggest that school-based nurses working in disaster and emergency preparedness save lives.[20] School-based nurses need to participate in ongoing assessments aimed to identify all hazards that may threaten the school.[6] For example, the nurse may identify that the school is threatened by the same inclement weather patterns that affect the community (tornado season, hurricane season, etc.) but also recognizes that the threat of infectious disease, violent persons, and acts of terrorism are unique threats to his or her school. Nurses, with their holistic approach to treating individuals, are well-equipped to recognize the unique threats to groups of children. They are well attuned to preparing for and responding to behavioral or mental health events[21] or in planning for the special needs of children with disabilities in disaster. Whatever the case, the school-based nurse must be involved in disaster preparedness and planning efforts and should also be a member of community-wide planning groups.[6] Part of maintaining a constant level of preparedness also means that the nurse

ISSN 2377-1569 Open Journal http://dx.doi.org/10.17140/PNNOJ-2-113

must remain attentive to local warning systems, maintain relationships with appropriate community organizations, and stay educated on their responsibilities as a school-based nurse.

Prevention and Mitigation

Planning for disasters and public health emergencies and strategies to mitigate the damaging effects of these events is dependent upon the strength of school and community partnerships. In turn, the establishment and nurturing of these partnerships will be dependent upon the degree of Collaboration, Coordination, and Ongoing communication (referred to as the "3 C's" of disaster management) that is established between the partners. Nurses can establish and conduct school safety programs that educate the students and community about disaster preparedness efforts and steps they can take to prevent disasters.[6,22] By participating in school safety assessments and environmental assessments, school-based nurses can identify potential hazards and risks and develop plans to reduce their potential for harm.[6,23]

Procurement of Emergency Equipment

As part of the school crisis team, school/university nurses must assess the medical equipment and supplies required to respond to a wide variety of emergencies and disasters for children and adolescents.[24] The Emergency Medical Services for Children (EMSC) National Resource Center (NRC) and the NASN have jointly compiled a list of medical supplies that are necessary for emergencies in all schools.[25] The NASN also maintains a list of emergency resources, equipment, and supplies as a guideline for emergency equipment recommendations for school-based nurses.[6] Nurses need to not only obtain enough supplies required to tend to the school population, but also ensure that the items are age appropriate and the necessary staff is knowledgeable on equipment usage. School-based nurses should recognize that the supplies required to handle day-to-day emergencies will not be sufficient in the case of a large-scale disaster.[24] The school may also become a shelter for the community in times of a disaster and will need to have a stockpile of supplies and equipment to appropriately handle such a situation.[24]

Collaboration & Communication with Parents

Communication remains a mainstay during preparedness, mitigation, response, and recovery efforts. Incorporating advanced warning systems into new technologies, such as text message alerts for students on college campuses, affords more time for preparation for disasters including the need to shelter in place or evacuate. Schools and universities must focus communication to include means by which they can contact emergency responders, local hospitals, and other key players in disaster response.[24] During times of disaster, communication should continue to be provided by whatever means the community uses most frequently; changing from one modality to another during a disaster is not recommended.[23] Disasters themselves may inhibit normal means of communication due to electrical outages or damaging cellular towers. School systems must therefore inform families and the community of their plans far before any disaster strikes. Breakdown in normal daily communication can be accounted for by letting families know where their children will be located in the case of an evacuation, protocols for school lockdowns, and who is approved to pick up their children and adolescents after such events.

Response

During a disaster or emergency the nurse will function as a key leader in in all response efforts.[6] The nurse will triage victims, direct first aid and emergency care, provide mental health care, and coordinate with first responders when they arrive. Nurses will play a role in the incident command system and establish treatment areas.[22] In order to effectively carry out this role, the school-based nurse must be intimately familiar with all disaster response plans and be comfortable as a leader. Mock exercises, drills, and tabletop exercises can help prepare responders and school-based nurses for their role.[23] Lives are saved when all members of the response team can carry out their tasks efficiently. Typical hazards and threats to safety along with their respected response strategies and the role of the school-based nurse in responding to these events are displayed in table 1 and further discussed in the next section of this paper.

Hazard	Current Guidelines for Response Strategy	Role of the School-Based Nurse	References
Fire	Evacuation	• Ensure evacuation plans are comprehensive and complete • Educate staff and students on their roles during evacuation • Conduct regular drills • Coordinate plans with school transportation officials and local emergency response agencies • Ensure children with disabilities are accounted for and staff can accommodate their needs • Evaluate plans annually or any time new students with disabilities are enrolled in the school	FEMA *Guide for Developing High-Quality School Emergency Operations Plans* http://www.dhs.gov/sites/default/files/publications/REMS%20K-12%20Guide%20508_0.pdf
Bomb Threat			
Structural Compromise			

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Tornado Tropical Storm Inclement Weather Earthquake Blizzard	Shelter-in-Place	• Listen to emergency television and radio broadcasts for instructions • Provide first aid as indicated • Ensure all students and staff can move to a pre-determined safe location inside the school • Initiate contact means to notify families that sheltering has begun • Ration and provide food, clean water, toilet, and bathroom facilities • Manage student medications as needed	CDC Emergency Preparedness and Response *Learn How to Shelter in Place* http://emergency.cdc.gov/preparedness/shelter/ Ready.gov *Shelter* http://www.ready.gov/shelter
Dangerous Person Active Shooter	Lockdown	• Draft plans for evacuation and lockdown procedures • Identify a means to communicate the need for a lockdown • Ensure staff and students know the signal for a lockdown and their associated responsibilities • Discuss responses with faculty including the potential to aggressively fight back • Assess environmental factors (door/window locks, items to use as weapons, etc.)	Readiness and Emergency Management for Schools *Active Shooter Situations: Responding to an Active Shooter Situation* http://rems.ed.gov/IHERespondToActiveShooter.aspx U.S. Department of Justice Federal Bureau of Investigation *Active Shooter Event: Quick Reference Guide* http://rems.ed.gov/docs/Active%20Shooter%20Event%20Quick%20Reference%20Guide.pdf
Hurricane Communicable Disease Inclement Weather	School Cancellation	• Provide input to school cancellation plans including means to communicate closures to families • Monitor for signs and symptoms of infectious disease outbreaks • Communicate urgency of closures to appropriate school officials • Monitor national infectious disease and immunization statistics • Educate staff and students on infectious disease principles	Centers for Disease Control and Prevention *Guide for School Administrators to Help Reduce the Spread of Seasonal Influenza in K-12 Schools* http://www.cdc.gov/flu/school/guidance.htm
Pandemic Influenza	Social Distancing Immunization	• Continuously monitor for national, state, and local communicable disease outbreaks and immunization rates • Communicate potential signs and symptoms of outbreak with local department of health • Advocate for immunization within the community and school • Facilitate and run immunization clinics when appropriate • Direct sanitation and disinfection of the school as needed • Implement quarantine of children who contract an illness while at school • Implement and direct social distancing protocols	Center for Disease Control and Prevention *Influenza School-Located Vaccination (SLV): Information for Planners* http://www.cdc.gov/flu/school/slv/index.htm U.S. Department of Health and Human Safety *School District (K-12) Pandemic Influenza Planning Checklist* *http://www.flu.gov/planning-preparedness/school/schoolchecklist.pdf* *Colleges and Universities Pandemic Influenza Planning Checklist* http://www.flu.gov/planning-preparedness/school/colleges_universities.pdf

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Chemical Exposure	Shelter or Evacuate	• Perform a risk assessment for the potential of mass chemical exposure • Network with local agencies to develop plans • Contact nearby chemical refineries or plants to discuss means of communicating the need to take action • Monitor for signs and symptoms of chemical exposure in children and staff on campus during and after critical events	Ready.gov *Shelter* http://www.ready.gov/shelter CDC Emergency Preparedness and Response *Chemical Agents: Facts About Evacuation* http://emergency.cdc.gov/planning/evacuation-facts.asp
Radiation Exposure		• Educate staff and students on their roles during a response to nuclear or radiation exposure • Direct sheltering in place or evacuation as indicated • Maintain communication with local response agencies and nearby nuclear plants • Perform decontamination of staff and students if indicated	Ready.gov *Nuclear Power Plants* http://www.ready.gov/nuclear-power-plants U.S. Food and Drug Administration *Frequently Asked Questions on Potassium Iodide (KI)* http://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm072265.ht

Table 1: Response strategies and roles of the school-based nurse during hazards.

Disaster/Mass Casualty Triage

Triage models change drastically during times of disasters. In mass casualty incidents, the goal of triage is to sort students and staff by the needs for immediate care while also considering and recognizing the needs of the greater group.[22] The nurse must realize that the needs of those affected greatly outweigh available resources. Triage is performed in 2 basic steps; first assess the scene and make basic observations and rapid decisions, and secondly to match the victim's needs with resources at hand while beginning treatment and setting priorities for transport.[22] The nurse can accomplish this secondary portion of triage by labeling individuals according to their condition. Traditionally, this correlates with color; black for those who are deceased or death is imminent, red for correctable but immediately life-threatening injuries, yellow for the serious but not life-threatening injuries, and green for anyone with non-emergent needs.[22]

Recovery

The goal after a disaster or emergency is to reunite families with their children and facilitates a transition back to normal daily activities. In the time immediately after a disaster, the nurse may be involved in maintenance of student health, building family partnerships, addressing staff wellness concerns, and providing mental health services for students.[22] In regards to long-term recovery efforts, the nurse will be involved in ongoing injury and illness care management, psychological responses to the disaster, and evaluation of the response capacity and activities to the disaster.[22] Mental health needs of all individuals involved in a disaster have emerged as a main focus of recovery efforts. School-based nurses may find themselves coordinating mental health services for the entire school, networking or collaborating with school counselors/psychologists and community mental health providers.[24] Nurses may be fulfilling these roles even if their school is not directly affected by the disaster or if the school is enrolling students who cannot return to their original campus.

CURRENT RESPONSE STRATEGIES

It is imperative that the school-based nurse be heavily involved in all aspects of disaster planning to be well aware of their roles and responsibilities during a disaster. It is the responsibility of the school-based nurse to be involved in networking with local emergency response teams, disaster preparedness agencies, the local Red Cross Chapter, school board, department of education, or other key players in preparedness to ensure that the school and its community are working synchronously to protect its children. During any disaster response the school-based nurse needs to make sure that the school's emergency plan is activated and that all steps are being carried out and followed by appropriate staff. The nurse will also be the go-to reference for any medical need and will become the leader in providing first aid, triage, mental health services, and any other medical intervention.

Evacuation

The need for evacuation arises when situations within the school are no longer safe because of terrorism, bomb threats, fires, or structural compromise (i.e. after an earthquake). During planning, the disaster preparedness team must consider several situations; how to safely move students, how to communicate the need for evacuation, secondary evacuation routes in case the primary route is compromised, safe sites for evacuation based on the hazard, evacuation of students without teachers or staff, to use a bus or walk, transport of students with disabilities, and how to account for students after evacuation.[26] Consultation with the fire department, Emergency Medical Services (EMS), and police departments is indicated to develop evacuation plans.[27]

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Conducting regular evacuation drills ensures that all students and staff know how to safely exit the building and allows the school-based nurse to evaluate the effectiveness of the plans.

Shelter-in-Place

Shelter-in-place is a situation where individuals seek shelter where they are, in this case the school, because the threat of leaving outweighs the benefit of staying. Situations requiring shelter include inclement weather, tornados, and tropical storms.[28] Earthquakes require a modified sheltering (hiding under desks) and sometimes mass radiological or chemical exposures may require shelter-in-place. These last two situations are discussed in their own section.

When the need to shelter arises, the responsible party activates the school's emergency plan including the notification to shelter *via* an alarm system or announcement. All students, staff, and visitors must report to pre-determined safe areas within the building.[29] These areas are typically rooms or hallways in the center of the school that are free of windows or doors to the outside. Sheltering plans must include a means to maintain communication (*via* telephone or cellular phone) or monitoring warning systems by television or battery operated radio.[29] The school-based nurse may be asked to be in charge of essential supplies including bottled water and food stores to sustain those in the school for an extended period of time. Even if not asked to be in charge of all supplies, the nurse should be in charge of all medical supplies including essential medications for students, first aid kit, and defibrillator. Once officials announce that the situation is safe and sheltering is no longer necessary, normal daily functions can begin. The nurse should then ensure that all medical needs of the children and staff are met and provide any interventions as needed.

Lockdown

In the situation that there is an unsafe person on campus, including an active shooter, schools must enter a lockdown mode to protect the lives of the students and staff on campus. Previous events with active shooters on school grounds, as discussed above, have shown us that the shooter's general goal is to take the lives of as many individuals as possible and then commit suicide. Therefore, the response plans are built upon the assumptions of these actions. Upon discovery of a dangerous person on campus, officials must immediately notify the school of the need for a lockdown and call 911.[30]

The role of the students and staff is to immediately respond with a *run-hide-fight* approach. The first response strategy is to run and get as many people out of harm's way as possible.[31] This requires a planned escape route, the need to leave all belongings behind, and helping others escape if possible.[31] If running is not an option, individuals should hide in an area out of the dangerous person's view, lock all classroom doors, turn off the lights, stay out of sight to make the classroom appear empty, and remain absolutely silent.[31] In the case where running and hiding are not viable options, responding with brute and aggressive force if confronted is indicated.[30] The choice to physically confront a dangerous person is up to the individual and cannot be included in their employment requirements but utilization of aggressive force and classroom items as weapons (fire extinguishers, chairs, etc.) has stopped attackers in past events.[30]

The role of the school-based nurse in these instances is to ensure that students and staff know the plans for responding to dangerous persons, facilitate drills and assessments of response, and pay careful attention to special education classrooms and children with disabilities when plans are being drafted. The school-based nurse may also play a role in prevention of some of these incidences as he or she may be tending to the psychological needs of children at the school and can help identify children who show aggressive or dangerous actions and may pose a threat to others on campus.

Social Distancing and Immunization

Nurses must also work to help inform the department of health of increasing signs and symptoms of influenza or infectious diseases.[32] The school-based nurse must leverage the trust the community has in them and act as an appropriate educator on the importance of immunization, hygiene, and treatment modalities for influenza. Holding immunization clinics in the school setting can combat influenza outbreaks in the community because it allows for the immunization of large numbers of children.[33] Schools can recruit the assistance of the health department to run immunization clinics. During times of pandemic influenza outbreaks the school may also serve as a Point of Distribution (POD) clinic and begin immunization of high risk individuals, of which children are included.[14] School-based nurses may also be asked for input regarding non-pharmacological means by which influenza can be controlled. Directing sanitation and disinfection throughout the school buildings may be one way the school-based nurse reduces future infections.[33] Social distancing may also be implemented in order to reduce the contact students have with each other and therefore restrict the ability for communicable diseases to spread throughout the community.[34] Social distancing includes cancellation of mass events, restricting individuals from entering areas with close contact of others, and possible school cancellations.

Chemical Exposure Responses

In the case of a mass chemical exposure, the school/university may need to either prepare to shelter-in-place with extra precautions or evacuate the children and staff immediately. Directions for which action to take will be provided by the local officials or the emergency operations manager from the chemical facility depending on the source of the offending agents. If sheltering-in-place is indicated, preparations follow aforementioned steps of sheltering with a few additional precautions.[35] In addition to moving all persons to a safe location, outside air must be sealed out of the building or area housing people.[35] By turning off all fans, closing windows and vents, and sealing windows or

ISSN 2377-1569 Open Journal http://dx.doi.org/10.17140/PNNOJ-2-113

doors to the room with plastic and heavy tape, contamination can be reduced.[35] This requires special preparations because unique supplies would be needed for all potential sheltering locations and instructions for faculty and staff. During this time the school nurse must attend to those students most at risk for negative outcomes from toxin inhalation (those with chronic respiratory diseases or special needs) and provide medical interventions to those who may have inhaled or been affected by chemical exposure. When the sheltering period ends, the nurse must assess children for signs and symptoms of toxin or chemical exposure including respiratory distress, neurological changes, or any other effects from chemical or biological toxin exposure.

The need for evacuation during chemical exposure will be communicated *via* local police, emergency coordinators, or government officials through television and/or radio broadcast systems.[36] Local officials will direct evacuees to pre-determined shelters appropriate for the hazard.[36] Otherwise, school evacuation should continue *via* standard evacuation procedures as described above.

Radiation Exposure Responses

Schools and universities located within 50 miles of nuclear plants may be subjected to radiation exposure in the event of a large release of nuclear or radioactive material.[37] Similar to chemical exposures, responses to radiation exposures fall into two categories; evacuate or shelter-in-place; the directions for which action to take will come from the emergency alert system.[37] In the case of evacuation, actions should be carried out in alignment with previously mentioned principles of evacuation. Keeping the windows and vents of school busses closed is important when evacuating due to radiation exposure to minimize contamination of the inside of the vehicle.[37] Sheltering principles are the same as previously discussed with some added concepts. Sealing all windows, doors, and outside vents in a similar fashion to chemical emergencies is indicated.[37] Students and staff should be sheltered in the basement of the school if available or in the center of the building.[37] Increasing the number of walls or objects between people and the outside environment will reduce radiation exposure. Ground water may be contaminated and should not be consumed until experts agree it is safe. The school-based nurse may find themselves faced with the need to decontaminate children or staff that may have been exposed to airborne radiation particles, i.e. if they were outside during the time of a nuclear blast. Removing clothing, storing them in a thick plastic bag away from all individuals, and showering/washing the hair and skin with mild soap while avoiding scrubbing or scraping the skin can remove up to 90% of contamination.[37] Transfer to the emergency department as soon as possible for further evaluation is indicated for these individuals. Potassium iodide (KI) is used to prevent the thyroid from taking up radioactive iodine by saturating the thyroid gland with iodine, any additional iodine substances will then be eliminated from the body. The US Food and Drug Administration recommend prophylactically treating children with KI in the event of radiation exposure as quickly as possible.[38] Schools should therefore stock KI in sufficient quantities to treat all students and staff and also understand the usage of KI in such an event. Table 2 outlines proper dosage of KI as provided by the Food and Drug Administration (FDA).[38]

CONCLUSION

Our world is not a safe place to live and yet each day school and university systems are charged with creating and maintaining safe environments for children to learn. During disaster events the responsibility for responding and protecting the health and well-being of children will fall to the nurse. Knowledge of the hazards schools and universities face allows the nurse to prepare for these events. Nurse participation in planning and preparedness efforts can influence the development of disaster response plans that will accommodate all students enrolled in the school or university setting. Finally, awareness of and the skills and abilities to implement appropriate disaster response strategies can improve student health outcomes and save lives.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

Resources and Tools

American Red Cross
Prepare your School
http://www.redcross.org/prepare/location/school
Preparedness Education
http://www.redcross.org/prepare/location/school/preparedness-education

CDC Emergency Preparedness and Response
Caring for Children in a Disaster

	KI Dose (mg)	Number of 130mg Tablets	Number of 65mg Tablets	Milliliters of Oral solution (65mg/mL)
Adolescent of Adult Size (>150 pounds)	130mg	1	2	2mL
Child or Adolescent (3 – 18 years)	65mg	½	1	1mL
Young Children (1month – 3 years)	32	Use Solution	½	0.5mL

Table 2: Dosage of potassium iodide (KI).

ISSN 2377-1569 Open Journal http://dx.doi.org/10.17140/PNNOJ-2-113

http://www.bt.cdc.gov/children/
Schools and Childcare Centers
http://emergency.cdc.gov/children/schools.asp

Federal Emergency Management Agency
Guide for Developing High-Quality School Emergency Operations Plans
http://www.dhs.gov/sites/default/files/publications/REMS%20K-12%20Guide%20508_0.pdf

International Finance Corporation
Disaster and Emergency Preparedness: Guidance for Schools
http://www.dhs.gov/sites/default/files/publications/REMS%20K-12%20Guide%20508_0.pdf

Readiness and Emergency Management for Schools (REMS) Technical Assistance Center
http://rems.ed.gov/

Ready.gov
School Emergency Plans
http://www.ready.gov/school-emergency-plans

Be A Hero! Training Program for Students
http://www.ready.gov/kids

U.S. Department of Education
Practical Information on Crisis Planning: A Guide for Schools and Communities
http://www2.ed.gov/admins/lead/safety/emergencyplan/crisisplanning.pdf
Readiness and Emergency Management for Schools
http://www2.ed.gov/programs/dvpemergencyresponse/index.html
Lead and Manage my School: Emergency Planning
http://www2.ed.gov/admins/lead/safety/emergencyplan/index.html
U. S. Department of Homeland Security
School Safety
http://www.dhs.gov/school-safety

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