Staffing Needs and Associated Costs in Times of Disaster: An Integrative Review

Joanne C. Langan
Mary M. Krieger

Strategies to complement nursing staff during response to disasters or public health emergencies are identified in this integrative review. Academic and community volunteers and government-vetted providers augment staff by expanding the labor pool and contribute to the effort at substantial savings.

Healthcare institutions consider nurse staffing with the key goals of excellent patient outcomes and quality of care within the context of cost containment. Nurses are the largest group of healthcare providers in hospitals and the largest single budget item in the overall operating budget. Attempts at cost containment that reduce professional nurse labor hours threaten the achievement of positive patient outcomes and quality of care (American Nurses Association [ANA] & Avalere Health LLC, 2015).

Nurse leaders must consider a number of variables when determining optimal nurse-to-patient staffing ratios. Among these considerations are patient acuity, skill mix of nurses and ancillary personnel, geographical layout of unit, admissions, discharges and transfer of patients, and availability and proximity of resources. Accurate and appropriate nurse staffing will lead to greater patient satisfaction, less errors, and, ultimately, cost savings due to improved patient health and decreased readmissions (ANA & Avalere Health LLC, 2015).

While appropriate nurse-to-patient staffing ratios continue to be debated among healthcare institutions and lawmakers in some states, the issue of appropriate nurse staffing and associated costs during disasters and public health emergencies is uncertain. If appropriate nurse staffing is often difficult to determine on a daily basis, it becomes even more problematic during times of disaster when the number of patients who will present to the healthcare institution is unknown. When mass casualty events occur, a surge of patients follows.

Surge Capacity Defined

A mass casualty event is a disaster or public health emergency that overwhelms the baseline capacity of a healthcare institution. Surge capacity is the ability of a given healthcare facility to deliver the required resources to handle a significant increase in demand over that baseline (Kelen & McCarthy,
2006). The author of a seminal surge preparedness model, the Bioterrorism and Epidemic Response Model, lists the components of surge capacity as staffing, supplies and equipment, beds, and the management system (Hupert, 2004). In general, staffing needs are determined by the number of persons who need care, their condition upon arrival, diagnostic tools and resources for appropriate care, and number of healthcare providers needed to deliver that care. Because nurses deliver care 24/7, the correct number of nurses must be anticipated with scheduled staff and others who can be called in to stretch their capacity to receive unanticipated casualties. Additional shifts, personnel, and resources have accompanying financial implications in providing emergency care.

**Purpose**

The purpose of this integrative review was to determine the extent to which healthcare providers or systems anticipate staffing needs and their associated costs in times of disaster or public health emergencies.

The specific questions were: (a) How do healthcare providers calculate the number of nurses who will be needed to staff the healthcare entity based on an estimate of disaster survivors? (b) How do healthcare providers calculate the anticipated costs of employing their staff nurses and/or additional agency nurses for extra shifts during disaster response?

**Search Methods**

Systematic searches were conducted in the Scopus, Ovid MEDLINE, and CINAHL Plus with Full Text bibliographic databases using a combination of keywords and database-specific subject headings for the concepts of nurses AND disasters AND (costs OR finance OR economics OR staffing OR workforce OR manpower). The searches were limited to English-language articles, peer-reviewed journals, and to publication dates between January 2009 to May 28, 2019. A total of 811 citations were downloaded into the EndNote X8 software program from which 262 duplicates were removed. The remaining 549 unique title/abstracts were reviewed by two nurse researchers using the inclusion criteria: article discussed involvement of the nursing workforce in a disaster, and the disaster was based in the United States. One hundred and fifteen citations were deemed potentially relevant and the full-text articles were obtained for further review. Inclusion criteria for the full-text review were that the article contained data addressing nurse staffing in a
Results

Staffing Plan Defined

Sixteen (14%) of the 115 full-text articles assessed for eligibility in this review addressed disasters and/or public health emergencies and staffing issues related to these events (see Table 1). The research team identified those with a “Staffing Plan in Place” and labeled articles that expressed a specific means of staffing for unanticipated events or described a successful model to achieve adequate staffing during uncertain times. Of the 16 reviewed articles, 7 (44%) had no staffing specifics while 9 (56%) discussed specific staffing models or plans.

No Staffing Specifics

Among the seven articles that expressed no specific staffing plans, four were in public health or community-based sites (Apostle, O’Connell, & Vezeau, 2011; Liong & Liong, 2010; Malone & Bergren, 2010; Savage & Kub, 2009). Frasca (2010) described the work of...
Table 1. (continued)
Nurse Staffing and Finance Plan for Disaster/Emergency Surge Review Articles

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<thead>
<tr>
<th>Author</th>
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<tr>
<td>Bowen et al. (2014)</td>
<td>Point of dispensing (POD) center/epidemic disease outbreak or bioterrorist attack</td>
<td>Integer programming technique: mathematical formulation to predict number of PODs and optimal staffing</td>
<td>Attempt to meet federal guidelines regarding effective and efficient use of scarce resources with declining fiscal sustainability of U.S. state and local governments (no specific costs/finances)</td>
<td>Centers for Disease Control and Prevention planning guidelines to assist public health and emergency management officials requires calculation of numbers of PODs, population size served by each POD, and staffing requirements for each POD. The integer programming technique is based on throughputs.</td>
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<td>Campion et al. (2016)</td>
<td>Urban level 1 trauma center/airline crash</td>
<td>Additional overtime nursing work hours through timelcard system</td>
<td>370 nursing overtime (OT) hours required on the day of the airline crash; 5.9 OT hours per patient; Incident Command Center fully staffed for 12 hours after disaster (no specific costs/finances)</td>
<td>Disaster preparedness requires attention to needs of survivors including imaging, blood products, operating room availability, nursing resources, and management of hospital beds.</td>
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<td>Charney et al. (2012)</td>
<td>Pediatric ED/H1N1 influenza pandemic</td>
<td>Tiered surge response plan related to number of patients presenting to ED during flu pandemic</td>
<td>Physician wages were $17,416 and professional collections during that period totaled $43,494. Nursing and secretarial wages were $16,258 and collections totaled $155,566. A total net profit for the influenza-like illness surge event was $165,386.</td>
<td>Tiered response plan was successful in managing patient surge of low-acuity patients during the H1N1 influenza pandemic in 2009 in delivery of efficient, cost-effective care.</td>
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<td>Frasca (2010)</td>
<td>Medical Reserve Corps (MRC)/hurricanes</td>
<td>Medical and public health professionals including MDs, nurses, pharmacists, dentists, veterinarians, epidemiologists, and nonclinical volunteers (no staffing specifics)</td>
<td>Volunteers are self-sustaining for 72 hours of operation and deployed for 2 weeks. As of 2009, there were 190,000 MRC volunteers nationwide, including 50,000 nurses and 4,000 nurse practitioners who were trained and passed a background “vetting” process, credential verification. (no specific costs/finances)</td>
<td>The MRC network expands the labor pool or “force-multiplier” at a substantial savings. This provides the Department of Health and Human Services with a pool of volunteers who can augment federal public health and medical response teams.</td>
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<td>Gabriel &amp; Webb (2013)</td>
<td>Intensive care units (ICUs)/influenza pandemic</td>
<td>Increased demand requires anticipation of staffing equipment and consumables; cancellation of leave, more full-time hours, changes in nurse-to-patient ratios, mandatory OT to meet demand; ICU-prepared nurses may be reassigned from external to internal patient care areas</td>
<td>No specific costs/finances</td>
<td>Optimal response to future pandemics requires prior planning for clinical care/staffing.</td>
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<td>Koehler et al. (2014)</td>
<td>ED/following theater shootings</td>
<td>ED was short-staffed with two sick calls; charge nurse texted ED nurses to request additional help; goal was two nurses with every critical patient; ICU nurses worked alongside ED nurses; units doubled their nurse-to-patient ratios</td>
<td>No specific costs/finances</td>
<td>The disaster/safety coordinator should develop a surge plan/algorithm for the hospital to use in determining activation of a departmental emergency plan versus a hospital-wide disaster plan.</td>
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<td>Langan et al. (2017)</td>
<td>Nursing service and academic settings/disasters/mass casualty events</td>
<td>Learning options to strengthen readiness of healthcare workforce for disaster response; direct support or shift coverage for deployed nurses (no staffing specifics)</td>
<td>Cost considerations for disaster programming include essential content and practices at each level of nursing education and how faculty and nurse leaders make allocation decisions regarding education with available funding. (no specific costs/financing)</td>
<td>Academic and workplace partnerships can strengthen nurse workforce knowledge and readiness to serve our communities in disaster response and recovery.</td>
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<td>Liong &amp; Liong (2010)</td>
<td>Community-based emergency response providers/disasters/mass casualty events</td>
<td>Nurse leaders need to be aware of information regarding staff needs during disasters including work assignments. (no staffing specifics)</td>
<td>In 2010 the Federal Emergency Management Agency was awarded over $1.8 billion for preparedness grants funding planning, exercises, training, and equipment such as communication devices; Disaster Medical Assistance Teams are paid while serving as part-time federal employees.</td>
<td>The establishment of standards and guidelines, financial support for planning exercises and communication systems, and integrating best practices to respond to disasters are essential. Nurse leaders experienced in disaster management should share knowledge and information to other nurse leaders, legislators, and policymakers.</td>
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<td>Malone &amp; Bergren (2010)</td>
<td>Schools/surveillance for life-threatening emergencies</td>
<td>School nurses are often the only healthcare professionals in their educational institutions. (no staffing specifics)</td>
<td>School nurses are a reasonable and cost-effective investment for schools and communities to keep children safe in school. (no specific costs/finances)</td>
<td>Defining failure to rescue in school nursing may provide valuable direction in setting guidelines for credentialing, staffing requirements, and care delivery models for improved outcomes.</td>
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<td>McHugh (2010)</td>
<td>Hospitals/public health emergencies</td>
<td>Emergency response plans overestimate the sources and numbers of nurses available for staffing during hospital surge events. There is little flexibility for unanticipated fluctuations in patient acuity and demand for large-scale emergencies/surge; no standby capacity.</td>
<td>Public health emergencies require a response above and beyond what existing resources can handle, including mutual aid agreements, temporary nurses, volunteer nurses, and other relief agency nurses. (no specific costs/finance)</td>
<td>To tackle the nursing workforce shortage and inability to be adequately prepared for emergencies, a national investment in nursing education and workforce infrastructure will require financial investment and significant political interest.</td>
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<td>Murray (2012)</td>
<td>National Disaster Medical System (NDMS)/large scale disasters</td>
<td>A unit must be capable of treating as many as 250 patients per day.</td>
<td>Members’ employers grant them time off for training and disaster response missions; NDMS does not reimburse employers for team members’ time away from work.</td>
<td>Hospitals who are part of the NDMS commit a specific number of acute care beds for the victims of catastrophic events. They are reimbursed for care provided to NDMS disaster victims at 110% of Medicare rates.</td>
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the Medical Reserve Corps in great detail. This entity offers great support to communities in general. Bell, Dake, Price, Jordan, and Rega (2014) described staff willingness to report to work at an emergency department following an Avian influenza outbreak. Langan, Lavin, Wolgast, and Veenema (2017) described the need for both nursing service and academics to prepare nursing students and licensed nurses for staffing needs during disasters and public health emergencies.

**Staffing Specifics or Models Employed**

Six of the nine articles (66%) that described staffing models or practices such as a tiered surge response plan were in the hospital or acute care setting (Campion et al., 2016; Charney, Ambrecht, Kennedy, & Flood, 2012; Gabriel & Webb, 2013; Koehler, Scott, & Davis, 2014; McHugh, 2010; Murray, 2012). Two articles describing practices in community-based sites (Berry et al., 2011; Bowen, Chen, & Tukel, 2014) illustrate unique considerations for staffing pre- and post-disasters. Berry and colleagues (2011) explained the specific number and hours/month that a nurse would provide to coordinate care for children with special healthcare needs. Bowen and associates (2014) detailed the use of the integer programming technique in determining the number of nurses required to staff each point-of-dispensing (POD) center to deliver prophylactic medications in the event of an epidemic disease outbreak or bioterrorist attack.

**Finance/Budgeting**

Regardless of the type of disaster or public health emergency, extra nurse staffing will be required and the associated costs must be considered. Interestingly, of the 16 reviewed articles, only 5 (31%) presented financial or budgeting information. The exact cost of care for an individual child with special healthcare needs/year was offered by Berry and co-authors (2011). Breaking down the cost of providing this level of care helps nurse leaders understand what would be required to sustain this level of effort. Charney and colleagues (2012) shared the total cost of wages

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<td>Savage &amp; Kub (2009)</td>
<td>Public health/disaster management/ emergency preparedness</td>
<td>Public health nurses provide key services including disaster management and emergency preparedness. (no staffing specifics)</td>
<td>Reimbursement for prevention services is limited, which reduces the incentive for nurses to engage in preventive care. (no explicit costs/funding)</td>
<td>Preventive healthcare services and disaster preparedness teaching are threatened by the growing nursing workforce shortage in acute care settings and less public monies invested in preventive health care.</td>
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<td>Verni (2012)</td>
<td>Integrated health network/hurricanes</td>
<td>Surge Capacity Model: hospital would know in advance types of patients to anticipate and appropriate staffing; hospitals received patients based on expertise of hospital staff.</td>
<td>Overall system costs from Hurricane Irene were $13 million; $4 million attributed to labor and supplies.</td>
<td>Low absenteeism was attributed to an employee advisory, preparing employees and their families; healthcare workers were &quot;physically and mentally present.&quot;</td>
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for physicians, nurses, and secretarial staff during an H1N1 influenza pandemic. A 2010 Federal Emergency Management Agency grant for disaster training and equipment for volunteer support staff, Disaster Medical Assistance Teams, was described by Liong and Liong (2010). These teams of healthcare professionals are paid while serving as part-time federal employees. Murray (2012) also described a federal-level entity, the National Disaster Medical System (NDMS), as one that provides disaster care as an augment to the local disaster response capability in mass casualty disasters. Members of this system are granted time off for training and disaster response missions but NDMS does not reimburse employers for the team members’ time away from their work site.

Verni (2012) discussed overall costs from Hurricane Irene with the greatest expense attributed to labor and supplies.

**Anticipating Staffing Needs**

Even in the best of times, there is no single approach to staffing that can be applied to all institutions. Nurse leaders will consider organizational goals and nurse input as team members when developing staffing plans. Incentivizing extra shifts to cover unplanned scheduling issues may help institutions reach the appropriate staffing levels (Bowie & Baker, 2019).

The integer programming technique is a mathematical formulation to predict numbers of PODs and operational staffing needed to immunize populations prophylactically (Bowen et al., 2014). The tiered surge response plan offers providers an algorithm to address the anticipated surge of patients with H1N1 that is updated weekly, based on recommendations from the Centers for Disease Control and Prevention. Various methods of retaining nurse staff during times of increased demand were offered by Gabriel and Webb (2013), including cancellation of leave, more full-time hours, modifying nurse-to-patient ratios, mandatory overtime, and reassigning intensive care unit-prepared nurses from external facilities to internal patient care areas.

**Anticipating Costs Associated with Disaster Response**

Researchers who shared details of the costs of providing care during emergency situations help us to understand the importance of financing and budgeting for unanticipated staffing and resource needs. While it is impossible to anticipate the magnitude of unexpected events, it is possible to have a plan in place to meet these demands. Bowen and associates (2014) emphasized the need to meet federal guidelines regarding effective and efficient use of scarce resources. This is in the context of declining fiscal sustainability on federal, state, and local levels. Federal, state, and local volunteers (e.g., nursing students) augment available nursing staff at a substantial cost savings. While personnel and supplies compose the largest expenditures during a disaster response, a total net profit was achieved during the influenza-like illness surge (Charney et al., 2012).

**Discussion**

**Education and Drills**

Preparing for disasters and public health emergencies demands a wide-scale approach including the establishment of optimal numbers of providers, and training and communication among those who respond. While the desired number of healthcare providers may not be immediately available at the onset of the disaster and response, simulated drills and training will help prepare those who are present to respond in an organized, competent, and safe manner (Girard, 2010). When nursing students and nurses take advantage of disaster preparedness, and response and recovery education opportunities, they strengthen the healthcare workforce for disaster response or shift coverage for deployed nurses (Langan et al., 2017).

**Limitations**

These findings are limited by the narrow time frame of restricting the publication dates to studies published from 2009 to 2019. The limited number of articles that met the inclusion criteria resulted in a small sample size.
Conclusion

The financial toll of disasters and public health emergencies can be mitigated through the use of academic and community volunteers. Federal and state resources are also invaluable in augmenting available staff by expanding the labor pool as “force multipliers” (Frasca, 2010) and contribute to the effort at substantial savings. Interprofessional education is emphasized as it becomes “all hands-on deck” in disaster response and all must learn to work together with clear communication among staff, institution’s leadership, and Incident Command Center (Campion et al., 2016; Koehler et al., 2014). Education must be translated and communicated to family members and other dependents so staff members are comfortable reporting to work, knowing their loved ones are safe and prepared (Verni, 2012). Strategic partnerships, staffing models, and financial support for planning exercises and communication systems will aid in effective and efficient response to unanticipated disasters and public health emergencies.

References


Girard, N.J. (2010). The complexities of determining safe staffing levels. AORN Journal, 91(8), 794-752. doi:10.1016/a.aorn.2010.03.010


