Doctor of Nursing Practice Inquiry Project Report

Executive Summary

Impact of Surgery Department Mass Casualty Mini Drills on Improvement of Staff Knowledge in a Level 2 Trauma Center: A Pilot Study

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Problem Statement and Significance

The United States (US) is witnessing an epidemic in mass casualty incidents (MCIs) with mass shootings being the most common (Melmer, et al., 2019). An MCI is an event where the number, severity, and type of casualties require resources beyond what is available (Lowes & Cosgrove, 2016). Almost a third (31%) of the world's mass shootings have occurred in the US where there has been a mass shooting nearly every 12.5 days (Meindl & Ivy, 2017). With the rise in MCIs in the US, it is imperative that acute care hospitals and trauma centers be prepared for immediate MCI patient management.

Many US hospitals are operating at full capacity which complicates the ability to surge patients from an MCI which is further complicated by the recent pandemic, COVID-19. A mass incident may happen quickly and patients from an MCI may arrive at the hospital with no prior notice. A surge of injured patients requires knowledgeable staff, appropriate supplies, a structured plan, and a systematic response to respond efficiently and effectively. Many hospitals across the US feel that they are not prepared for no-notice MCIs (Hollister, 2019).

The outcome of an MCI depends upon hospital preparedness (Ben-Ishay, et al., 2016). Several studies described staff disaster training drills as being central to hospital emergency or MCI preparedness (Landman, et al., 2015; Grochtdreis, de Jong, Harenberg, Gorres, & Schroder-Back, 2016; Hang, Jianan, & Chunmao, 2016). Yet, less than forty-five percent of rural hospital nurses reported that they felt less than familiar with their disaster preparedness terms and processes; and 40% reported they would be less than effective during an actual disaster (Hodge, Miller, & Dilts Skaggs, 2017).

Often, the surgery department staff do not have the opportunity to participate in an MCI drill which may cause variation in how the surgery department responds or performs during a

real-life MCI. The standard for frequency of disaster drills in hospitals was established by The Centers for Medicare and Medicaid (CMS). The Emergency Preparedness Rule by CMS (2019) requires hospitals to complete two emergency preparedness training exercise drills a year that include one full community-based drill if possible, and one tabletop drill. However, not every staff member is mandated to participate in each drill, the drills may or may not focus on MCIs, and drills are not required to be specific to the surgery department. The frequency of the surgery department being involved in MCI disaster drills was limited. The surgery department had a full MCI drill in October of 2019 where it was determined that there were opportunities for improvement in MCI response knowledge. Based off that information, the hospital decided to implement routine MCI mini training drills in the surgery department to improve staff knowledge in MCI standard operating procedure. The MCI mini drills are quick and focused drills based upon specific details of a department's standard operating procedure or hospital policy; and are face-to-face interviews among the participant and the drill leader. Although disaster drills are required by CMS, the literature is scant on the benefits of MCI drills in hospitals on staff knowledge.

To enhance knowledge in mass casualty response, the question arose, would mass casualty mini drills in the surgery department impact institutional mass casualty knowledge of policy or procedure? The study aims were:

1. To determine if MCI mini drills have an impact on surgery department staff knowledge of institutional mass casualty policy or procedure over the course of the repeated MCI mini drills using Plan-Do-Study-Act (PDSA) cycles.
2. To correlate the relationship between demographic characteristics and the impact of MCI knowledge improvement.

Methodology

Study Design

This was a pre-intervention (pre-test) and post-intervention (post-test) design. This study was approved by the hospital and Purdue University Institutional Review Boards.

Study Procedure

Mass casualty incident mini training drills were implemented using PDSA iterative cycles for three months from February 3, 2020 to April 27, 2020, in four 3-week cycles, with surgery staff that were on-duty. A department manager recruited the participants and coordinated the day and time of each mini drill. Each participant for the mini drill was interviewed face-to-face by the same drill leader using an identical 12-item paper questionnaire or instrument which was developed by the author and validated for accuracy based upon the hospital and surgery department MCI policy or procedure.

Once the mini drill questionnaire was completed, the drill leader provided immediate feedback with the correct answers to the participant (PDSA action). The drill leader graded the responses. Each question was worth one point and percentage knowledge scores were determined. The interviewer documented the start and stop time of the mini drill, total time for mini drill, and noted whether day or night shift.

Study Setting and Population

The setting was a 440-bed hospital that was verified as a level 2 Trauma Center with Magnet Nursing Designation in the Midwest. The surgery department consisted of three areas that included the operating room (OR) area, the post-anesthesia care unit (PACU) area, and the pre-post-operative area. Inclusion criteria for the surgery department participants were a) on-duty hospital surgery staff who speak English, b) age greater than 17-years old, and c) staff in

non-leadership positions. Exclusion criteria were a) non-surgery department staff, b) staff less than 18 years old, c) staff that were not on-duty, d) non-English-speaking staff, and e) staff in leadership positions. The surgery department manager determined the participants based upon the inclusion and exclusion criteria and recruitment materials were not necessary. The participants were classified into two groups, non-previous mini drill (NPMD) participants and previous mini drill (PMD) participants, or participants that were mini drilled more than once.

Data Collection and Management

The data variables collected were a) demographic data, and b) MCI mini drill participant knowledge specific to hospital and surgery department MCI policy or procedure. Demographic data included age, gender, level of education, credentials, years of experience, total number of past disaster drill participation, number of real-life MCI experiences, part time versus full time work status, work area (location) within the surgery department; and whether they had participated in a previous surgery department MCI mini drill since February 2020. The mini-drill data variables collected were derived from the 12-item mass casualty questions (see Appendix).

Statistical Data Analysis

Data was collected in Excel and exported to SPSS (Version 25, IBM, Armonk, NY) for statistical analysis. Missing cases and/or variables were validated and corrected. The analysis included frequency distribution to reclassify data if necessary, cross-tabulation to characterize background information, and accuracy improvement. One-way analysis of variance (ANOVA) was used to show mean score differences across the cycles among NPMD (non-intervention group) and PMD (intervention group) participants. The assumptions of ANOVA were assessed for normal distribution of knowledge scores (histogram) and test for homogeneity of variances

(Levene statistic) among NPMD and PMD participants. The Games-Howell was employed and other tests for unequal variances, as well as, Welch t-test for unequal variances and unbalanced design (unequal sample sizes) in PMD participants to show mean knowledge score improvement in PMD cycles.

Results

Participant Characteristics

Eighty-four MCI mini drill interviews took place in the surgery department over the project period. Of those, 60 were NPMD and 24 were PMD participants. The participants within both groups were predominantly female, registered nurses, worked full time, day shift, less than a bachelor's degree, participated in a full MCI training drill none or once in the past, and never experienced working during a real-life MCI (see Table 1). The mean ages ± SD of NPMD and PMD participants were 40.0 ± 10.9 and 44.0 ± 10.7 years, respectively.

Question Response Correctness Among PMD Participants

Of the 12 MCI questions asked, questions two through five, seven through nine, and question 12 showed an increasing trend of percentage change in improvement of correct response from PDSA Cycle 1 through Cycle 4. Of these, question nine (elective procedures will be canceled during MCI disaster mobilization), question 12 (operating room space will not be used to care for patients that do not need surgery), and all 12 questions combined met valid statistical Chi-square tests (Figure 1).

Mini Drills Knowledge Improvement Status

Employing the one-way ANOVA analysis of variances, the difference between the mean MCI knowledge scores among NPMD participants across the four PDSA cycles were not significant, but significant in PMD participants $F(2, 21) = 12.96$, $p = .00$, and the effect size for

the association between the cycles and knowledge score improvement was large (see Table 2). Welch t-test on PMD participants revealed that there was a mean score difference of 36 (96.15 - 59.71) between Cycle 4 and Cycle 3, $p < .05$.

Correlation between Demographic Characteristics and Knowledge Score Improvement

Correlations were found among gender (13.33 difference between female versus male), work shift (24.92 difference between day versus night shift), and credentials (14.22 between registered nurses versus surgical tech/other) between PMD and NPMD participants (see Table 3).

Interview Time

The mean mini drill time ± SD between NPMD versus PMD was 5.55 ± 1.14 and 4.58 ± 1.47 minutes, respectively, and was statistically significant at $p < .05$ level.

Discussion

The mini drills were successful at improving knowledge with repeat mini drill participants. Data from the PDSA cycles on PMD participants showed a trend of improvement of correct answers from Cycle 2 through Cycle 4 in questions nine and 12, which were based on χ^2 test with valid $p < .05$ where 0 cells of the 2 x 2 table had expected count of less than five. After providing "action" at the end of first PDSA, the PMD participant scores improved, as shown in the Cycle 2 through Cycle 4 vs. Cycle 1, with repeated MCI mini drills. This indicated a positive impact on improving staff knowledge of institutional mass casualty policy or procedure in the surgery department. The PMD participants may be regarded as the test group in this study.

The NPMD participants represented the source population of the PRMC surgical department and not exposed to previous mini drill experiences during this study period. The

knowledge scores were normally distributed (normal histogram) and the Levene Statistic to test for homogeneity of variance was not violated ($p > .05$). These met the key ANOVA assumptions in NPMD but not in the PMD participants. More importantly, their mean knowledge scores did not demonstrate improvement across the cycles as indicated by F-test with $p > .05$. The NPMD participants could be regarded as the control in this study. Gender, work shift, and credentials could (small sample size) have influenced MCI knowledge score improvement.

The outcome of the results could have been impacted by contextual characteristics, such as, being a high reliability organization, an organization that utilizes Lean Six Sigma (LSS) or using the PDSA process. The hospital strives to be a high reliability organization with a just culture. Several hospital nursing leaders are trained in LSS principles. This PDSA quality improvement mini drill project had a hospital administrative sponsor, physician champion, lean leaders, and nursing staff support. These multidisciplinary principles supported and allowed the successful implementation of this project as suggested in the literature (Kringos, et al., 2015; McCormack, et al., 2001).

This study is generalizable to the remainder of hospital departments and other hospitals due to demographic similarity and contextual factors. Mass casualty mini drills should enhance knowledge in all departments. Augmenting the CMS requirement of two drills per year with regularly scheduled training drills for continual preparedness as recommended by Taskiran and Bakal (2019) could be achieved through MCI mini drills. Furthermore, disaster training should be specific to the hospital department and the role of the nurse or staff (Lynn, 2019; Sonneborn, Miller, Head, & Cross, 2018), such as, these surgery department MCI mini drills.

Limitations

The study had several limitations: (a) we could not identify the participants that did not receive the email PDSA actions for Cycle 2 through Cycle 4 PMD participants. A few of the Cycle 4 PMD participants could have received three actions at Cycle 1 through 3, (b) the initial mini drill data was reviewed after each PDSA cycle. Actions were taken following each cycle that included reminders to surgery staff via email of their standard operating procedure for MCI and providing leadership the answers to the top three most frequently missed questions to email their staff, and a combination of both. However, it was unknown if the email communication reached the staff or if they were read by the staff, (c) the COVID-19 pandemic impacted the hospital from March 2020 through the remainder of the study; elective surgeries were halted thus limiting staff that were available for participation in the mini drills; this may have led to staff confusion regarding COVID procedure versus MCI procedure, (d) there were time constraints of the study by using rapid fire improvement PDSA cycles, however, this is consistent with standard hospital performance improvement initiatives, (e) there may be inconsistency in how each department provides education to the staff. Some leaders provide weekly email education, didactic, simulation, or computer-aided education, (f) ANOVA analysis was done on restricted small sample size of each PDSA cycle.

Implications

Systems

Patient outcome improves when there is a system in place following an MCI since many hospitals function at full capacity. Staff from the scene of the event through rehabilitation need to be trained in the systematic process of MCI care and be ready at a moment's notice. With an organized hospital response, lives can be saved when staff are better prepared. Gaps in the system produce an increase in morbidity and mortality. Death and disability are preventable

with a quick and proper MCI response (World Health Organization, 2011). According to the Florida Department of Health (n.d.), the focus on mass casualty response is a "whole community approach" that includes all community resources to prepare, protect, respond, recover, and mitigate the disaster.

Hospitals need to leverage local, regional, state, and national plans to include prehospital, public health, other hospitals, long term care, rehabilitation centers, other health specialty services, department of defense, and homeland security. Planning a patient care system and surge process following MCI is daunting but necessary. Implementing small scale MCI changes will continuously improve the mass casualty victim care system. Mini drilling on the policy and procedure enhances the systematic process.

Policy

Encouraging US healthcare coalitions to adopt MCI mini drills as policy could enhance the system of care for MCI victims. Mass Casualty mini drills could be implemented in comparable hospital departments and hospitals since participant characteristics, culture, and leadership could be analogous. Despite the emergency preparedness requirement from CMS for hospitals to provide annual MCI training to staff, hospitals are still underprepared for MCIs. The US Department of Health and Human Service now requires hospital participation in regional planning via district healthcare coalitions through the Office of the Assistant Secretary for Preparedness and Response (ASPR). They require a collaboration of healthcare coalitions, trauma centers, hospitals, public and private healthcare, emergency medical services, nursing homes, rehabilitation centers, and various organizations (United States Department of Health and Human Services, 2020) in order to receive funding for emergency and disaster preparedness. Regional disaster response plans and policies are coordinated through the district healthcare

coalitions. Encouraging US healthcare coalitions to include MCI mini drills as policy is essential to improving hospital response throughout the US.

Economics

It takes an average of five minutes per participant and five minutes for the drill leader for a total of 10 minutes of staff time. There is minimal cost for MCI mini drills for staff participants due to the cost being absorbed through hospital staff emergency preparedness education that is required by The Joint Commission. The drill leader salary cost for MCI drills may be part of the job description for the emergency preparedness personnel and cost may be absorbed as part of the position. Additional staff or FTEs may not be necessary to conduct continuous MCI mini drills.

There are financial benefits that may be obtained from the Office of the Assistant Secretary for Preparedness and Response (ASPR) whose mission is to save lives and protect Americans from 21st century public health emergencies and disaster threats (United States Department of Health and Human Services, 2020). The ASPR budget for 2020 is $2.6 billion, of which, $258,000,000 is for hospital preparation to support cooperative agreements, improve surge capacity, and enhance healthcare readiness (United States Department of Health and Human Services, 2020). When funds are necessary for MCI hospital education in the district, it could be requested through the healthcare coalition whom has oversight of the disbursement of ASPR funds in each regional district. Ultimately, the benefit of MCI mini drills outweighs the cost of doing nothing.

Practice

A learning organization is skilled at creating, acquiring, transferring knowledge, and modifying behavior to reflect the new knowledge (Garvin, David, 1993). Mass casualty clinical

care and response should improve as knowledge improves. Focused departmental MCI mini drills provide the surgery department with the information necessary to care for patients effectively when an unexpected MCI occurs. The knowledge will lessen the chaos and confusion when the number of victims exceed hospital capacity and resources.

The study results could further change how the hospital routinely trains for MCI response**.** Based off the study demographics, MCI mini drills could be implemented in other hospital patient care departments with similar results along with yearly required drills or online education. Since staff usually prefer in-person training in comparison to computer-based training, this is an ideal format for future practice.

Conclusion

Mass casualty mini drills in the surgery department improve knowledge of institutional MCI policy and procedure in the surgery department of this level 2 trauma center. Mini drill repetition is a factor in success since PMD participants are shown to have knowledge improvement in comparison to NPMD participants. This study may contribute to hospitals seeking ways to improve mass casualty knowledge since many US hospitals are not or do not feel prepared for MCIs. Since mass casualty events have been on the rise, response education is critical to patient outcomes, and an efficient and effective response. Further studies should be undertaken to determine the benefit that MCI mini drills has on full-scale hospital MCI drill response. Recommendations for future implementation of MCI mini drills are: (a) in similar hospital departments, (b) in other hospitals (c) in other emergency preparedness activities to include bioterrorism, infectious disease, chemical, and natural disasters, (d) in prehospital, nursing home, rehabilitation centers, and other healthcare organizations.

Table 1

Participant Characteristics by Group: Continuous and Categorical Variables

Characteristic	NPMD (No Previous Mini Drill)	PMD (Previous Mini Drill)	*p* value
Gender: % (n)			
Male	5.0 (3)	20.8 (5)	<0.05
Female	95.0 (57)	79.2 (19)	
Age (yrs): Mean ± SD	40.0 ± 10.9	44.0 ± 10.7	>0.05
Age Group: % (n)			
< 40	46.7 (28)	33.3 (8)	>0.05
≥ 40	53.3 (32)	66.7 (16)	
Shift: % (n)			
Day	95.0 (57)	87.5 (22)	>0.05
Night	5.0 (3)	12.5 (2)	
Work Status			
Part Time	21.7 (13)	12.5 (3)	>0.05
Full Time	78.3 (47)	87.5 (21)	
Education: % (n)			
None/Diploma/Associate Degree	51.7 (31)	58.3 (14)	>0.05
Bachelor's degree	48.3 (29)	41.7 (10)	
Experience in Surgery Department			
0-5 Years	60.0 (36)	41.7 (10)	>0.05
>5 Years	40.0 (24)	58.3 (14)	
Credentials: % (n)			
Other/Surgical Tech	23.3 (14)	29.2 (7)	>0.05
RN	76.7 (46)	70.8 (17)	
Department			
Pre/Post-Operative Unit	35.0 (21)	29.2 (7)	>0.05
Operating Room	41.7 (25)	29.2 (7)	
Post Anesthesia Care	23.3 (14)	41.6 (10)	
Previous Full Drill			
0-1	75.0 (45)	66.7 (16)	>0.05
>1	25.0 (15)	33.3 (8)	
Real-Life MCI[a]			
No	90.0 (54)	75.0 (18)	>0.05
Yes	10.0 (6)	25.0 (6)	

Note. MCI = Mass Casualty Incident, n = number, RN = registered nurse, and yrs = years.

[a]History of working in a hospital during a real-life Mass Casualty Incident.

Table 2

One-Way ANOVA: Participants with NPMD and PMD

		n	Mean	SD	*F*	*p*	η^2
NPMD	Cycle 1	19	47.26	1180	1.17 (3, 56)	.32	[a]
	Cycle 2	21	52.33	16.99			
	Cycle 3	11	46.91	11.07			
	Cycle 4	9	57.44	20.84			
	Total	60	50.50	15.57			
PMD	Cycle 2	4	81.25	14.10	12.96 (2, 21)	.00[b]	.55 [c]
	Cycle 3	7	59.71	25.15			
	Cycle 4	13	96.15	6.54			
	Total	24	83.04	21.83			

Note. NPMD = Participants with No Previous Mini Drill. PMD = Participants with Previous Mini Drill. n = number. SD = Standard Deviation. η^2*=Eta-squared.*

[a]Not calculated because F test was not statistically significant. [b]There was a significant effect of mean score difference across cycles (Cycle 2 through Cycle 4) among PMD participants $F(2,21) = 12.964$, $p < .00$. Post Hoc comparisons using the Games-Howell test for unequal variances indicated that the mean score difference of 36.44 between Cycle 4 and Cycle 3 was significantly different, $p < .05$. [c]Large effect size.

Table 3

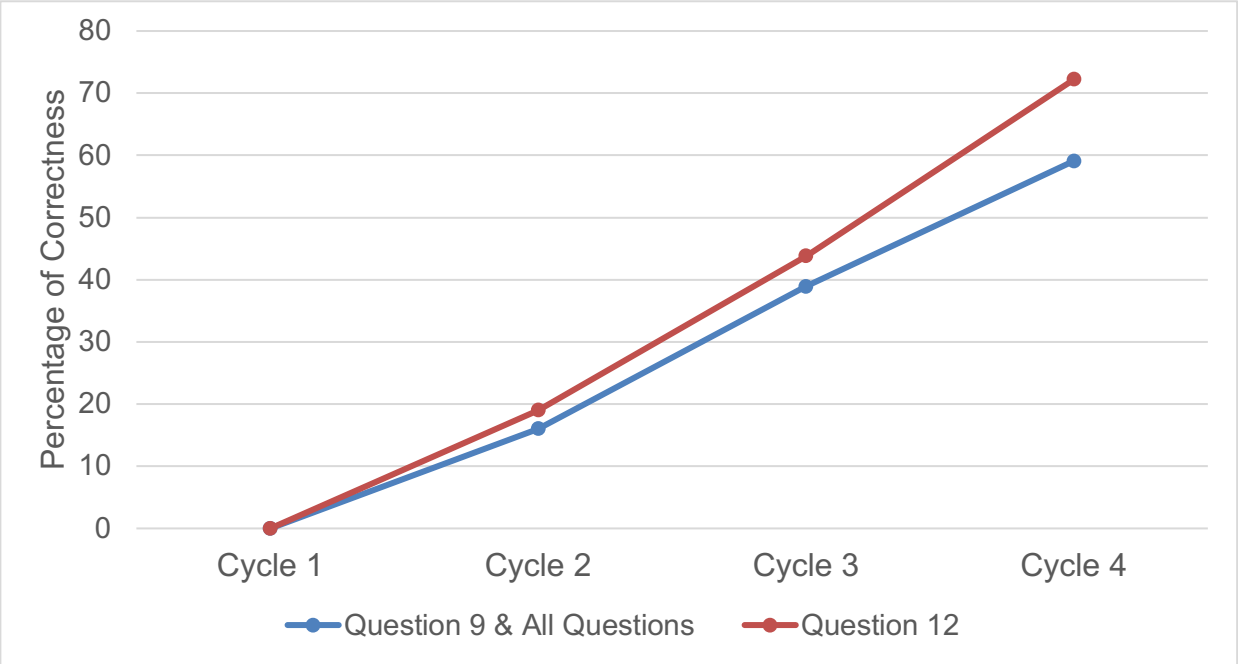
Influence of Some Covariates on Mean Knowledge Score Improvement (Subgroup Analysis)

Variable	Subgroup	Participant Status	n	Mean	SD	Mean Difference (within subgroup)	*p*	Mean Difference (between subgroup)
Gender	Female	PMD	19	86.00	16.138	35.46	< .00	13.33
		NPMD	57	50.50	15.019			
	Male	PMD	5	71.80	37.003	22.13	> .05	
		NPMD	3	49.67	28.868			
Shift	Day	PMD	21	87.71	14.796	36.59	< .00	24.92
		NPMD	57	51.12	15.391			
	Night	PMD	3	50.33	38.188	11.67	> .05	
		NPMD	3	38.67	17.214			
Credentials	RN	PMD	17	86.29	20.961	36.51	< .00	14.22
		NPMD	46	49.78	15.642			
	Surgical Tech/ Other	PMD	7	75.14	23.512	22.29	< .05	
		NPMD	14	52.86	15.664			

Note. Gender, work shift, and credentials could influence knowledge score improvement in PMD when compared with NPMD participants. NPMD = Participants with No Previous Mini Drill. PMD = Participants with Previous Mini Drill. n = number. SD = Standard Deviation.

Figure 1

Trend of change in improvement



Note. Correctness improved in question 9, 12, and the mean of all questions combined from cycle 1 where no previous mini drills had occurred to cycle 2, cycle 2 to cycle 3, and cycle 3 to cycle 4.

Appendix

Mass Casualty Mini Drill Questionnaire

Age:
Gender: (Circle) Male Female
Education: (Circle) Associates Bachelors Masters Doctorate
Credentials: (Circle) RN Surgical tech other, specify:
What area of the surgery department do you work? (Circle) Pre/post-operative Post-anesthesia care unit (PACU) Surgery
How many disaster drills have you participated in the past?
Do you have experience of working during a real-life MCI? (Circle) Yes No
Have you participated in a previous surgery department mini drill as of January 2020? (Circle) Yes No
Work Status: (Circle) Part time (less than 32 hours a week) Full time
How long have you been practicing in your current profession in the surgery department?
Q1: According to the emergency operations plan, which three people are responsible for declaring a "disaster mobilize?"
Q2: A patient arrives from a Mass Casualty Incident (MCI) with a gunshot wound to the chest, respirations are 4 per minute, and patient is not following commands, would this patient be categorized in the START triage system as? (Circle) Black Red Yellow Green
Q3: A patient arrives walking with a left hand amputation from an explosion, respirations are 16, cap refill is < 2 seconds, patient is alert and follows commands; what color is the patient triaged using the START triage system? (Circle) Black Red Yellow Green
Q4: Patients that arrive by private vehicle are triaged at which entrance ? (Circle) Ambulance bay Emergency Department patient entrance Entrance #1
Q5: During surge, when the surgical intensive care unit (STICU) is full, what surge location would open to accept critical patients?
Q6: During a disaster surge and inpatient units are full, name a surge location that opens for non-critical patients?
Q7: What color are the walking wounded triaged as according to the START triage system? (Circle) Black Red Yellow Green
Q8: Where is the personnel staging area?
Q9: When there is a disaster mobilize, will elective procedures be canceled? (Circle) Yes No
Q 10. Which surgery department operating room location may be used as back-up if the hospital OR is full? (Circle) Randallia North Premiere All three
Q 11. During a disaster mobilize, you may be reassigned to care for patients in other hospital departments (that are not surgery departments)? (Circle) Yes No
Q 12. Will operating rooms be used to care for patients that do not need surgery? (Circle) Yes No
Drill start time_____ Drill stop time_____ Total time to complete_____ Drill taking place during day or night shift_____ Month number in PDSA cycle (1,2,3,4) __

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