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Physician Assistant Impact on Trauma Patient Care at Level I Centers

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Abstract
Background: Trauma centers have historically been staffed by attending surgeons and varying levels of surgery and emergency residents. With the imposition of resident work hour restrictions there was a need for staffing solutions. One of the options that has been utilized is the addition or replacement of residents by physician assistants (PAs). What is the impact of PAs on the outcomes of trauma patients at level I centers when compared with resident only teams?

Methods: An exhaustive search of available medical literature was conducted using Medline-OVID, CINAHL, and Web of Science. The keywords used for each search were: physician assistant, trauma center, length of stay, patient readmission, and hospital mortality. Additional inclusion and exclusion criteria were used to focus the search.

Results: Three retrospective studies met criteria and were included and assessed for this systematic review. One study compared a resident based team with a team that added PAs and found no change in mortality rates and a reduction in length of stay (LOS). Another study compared three groups: a resident based team, an attending surgeon only team, and a PA based team. This study showed a reduction in mortality and LOS. A third study compared a PA based team with the National Trauma Data Bank. That study showed a reduction in mortality and LOS when normalizing for injury severity.

Conclusion: When PAs were added to or replaced residents on trauma teams there was either no change or a reduction in patient mortality and length of stay. PAs can be a helpful and productive addition or replacement on resident based teams without negatively impacting patient outcomes.

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The student author attests that this work is completely his/her original authorship and that no material in this work has been plagiarized, fabricated or incorrectly attributed.
Physician Assistant Impact on Trauma Patient Care at Level I Centers

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A Clinical Graduate Project Submitted to the Faculty of the
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Biography

[Redacted for privacy]
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**Background:** Trauma centers have historically been staffed by attending surgeons and varying levels of surgery and emergency residents. With the imposition of resident work hour restrictions there was a need for staffing solutions. One of the options that has been utilized is the addition or replacement of residents by physician assistants (PAs). What is the impact of PAs on the outcomes of trauma patients at level I centers when compared with resident only teams?

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**Keywords:** Physician Assistants, Residents, Trauma Centers, Level I, Mortality, Hospital Mortality, Hospital Length of Stay, ICU Length of Stay
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Table I: Characteristics of Reviewed Studies

List of Abbreviations

ACGME………………………….Accreditation Counsel for Graduate Medical Education
AMA………………………………………………………American Medical Association
APCs…………………………………………...……………Advanced Practice Clinicians
DVT………………………………………………………..………Deep Vein Thrombosis
ED………………………………………………………....………Emergency Department
HIA……………………………………………………………..Health Impact Assessment
ICU…………………………………………………………………Intensive Care Unit
ISS……………………………………………………………………Injury Severity Score
LDSH…………………………………………………………………LDS Hospital
LOS…………………………………………………………………………Length of Stay
MA……………………………………………………………………Major Arrhythmia
MLPs..................................................................................................Midlevel Practitioners
MOI…………………………………………………………...…Mechanism of Injury
NPs……………………………………………………………………..Nurse Practitioners
NTDB………………………………………………………...National Trauma Data Bank
PAs………………………………………………………………........Physician Assistants
UTI…………………………………………………………………Urinary Tract Infection
Physician Assistant Impact on Trauma Patient Care at Level I Centers

BACKGROUND

There are many studies\(^1\)\(^-\)\(^8\) showing that for trauma patients the advent of specifically designated trauma centers have improved outcomes overall. Some of the specific outcomes that impact these trauma patients include mortality, length of stay (LOS) in the hospital or ICU, readmission, and quality of care.

Trauma centers have historically been staffed by attending surgeons and varying levels of surgery and emergency residents. These teams took many different forms including full time versus part time attending coverage, attending surgeons only, and attending surgeons plus residents. In 2003, the Accreditation Council for Graduate Medical Education (ACGME) initiated a work-hour restriction on medical residents.\(^9\) This restriction created some staffing dilemmas for trauma centers.\(^10\) One solution to this restriction was the option of incorporating midlevel providers (MLPs), also known as advanced practice clinicians (APCs). These APCs were added as dedicated trauma providers and were either physician assistants (PAs) or nurse practitioners (NPs). The addition of APCs changed the makeup of trauma teams in one of two ways. The APCs were either an addition or a replacement for the residents. The roles of the APCs on the trauma teams varied by location, but in general the responsibilities were very similar to those held by residents. Gillard et al\(^10\) outlined the roles and responsibilities of the APCs to cover all of the daily patient care and management in both the general care unit and
ICU. The roles also included taking part in the trauma resuscitation and performing minor surgical procedures.10

Data has been collected on trauma patients both by individual centers and as part of the National Trauma Data Bank (NTDB). These registries give information on demographics, preexisting conditions, and injury severity score (ISS).10-13 The hospital specific registries contain information that is gathered solely at each facility. The NTDB is a collection of trauma registry data that has been created by the American College of Surgeons.12,14 The NTDB is a very broad database and encompasses trauma information from all levels of trauma centers with many different team configurations.12,14 The ISS is a system which allows comparison of patients based on severity of trauma. It provides a single number to rate patients with multiple injuries. The higher the ISS number, the more severe the trauma.12,13

The goal of this systematic review of literature is to compare the outcomes of mortality and LOS for trauma patients in level I centers when utilizing PAs versus resident only teams.

METHODS

An exhaustive search of available medical literature was conducted using Medline-OVID, CINAHL, and Web of Science. The keywords used for each search were: physician assistant, trauma center, length of stay, patient readmission, and hospital mortality. The bibliographies of the original articles were then searched for additional sources. English language and human studies were additional inclusion criteria used. Additional exclusion criteria were used to focus the search. These criteria were: studies
that utilized NPs as the only APCs without use of PAs, studies done at non level I facilities, and studies that utilized PAs but not as direct members of the trauma team.

RESULTS

Using the previously discussed methods, the initial search resulted in a total of 27 articles. Using the references included in those articles added an additional nine articles for a total of 36 articles to be reviewed. After reviewing the articles and assessing them using the inclusion and exclusion criteria and eliminating duplicate articles, four relevant studies\textsuperscript{10-12,15} were further appraised. On further review the study done by Oswanski et al\textsuperscript{15} was eliminated. Although the title lists the hospital as a level I center the study was actually performed while it was a level II center.\textsuperscript{15} The three included articles in this review are all retrospective studies utilizing trauma registries and/or the NTDB as the source of data.\textsuperscript{10-12}

**Gillard et al**

This retrospective study\textsuperscript{10} was performed at a level I trauma center that admits more than 2200 patients annually. The trauma team was originally made up of fellowship-trained attending trauma surgeons as well as rotating residents from general surgery and emergency services. The original team also included a limited use of two MLPs. The updated trauma team as of 2005 included four more MLPs (total of six) in addition to the original team. The hours and schedules of both the attending surgeons and residents did not change from group to group. These two groups are referred to as PRE-MLP and POST-MLP.\textsuperscript{10}

This study\textsuperscript{10} compares these two groups over separate 13 month timeframes. Those timeframes were intentionally separated with five months in between to help
account for the transitional period. The PRE-MLP period was assessed from November 1, 2003 through November 30, 2004. This team used two MLPs for inpatient care and the outpatient clinic from 8am to 5pm on weekdays only. The POST-MLP group was assessed from May 1, 2005 through May 31, 2006. This group utilized six MLPs for inpatient care and the outpatient clinic and added responsibilities of trauma evaluation and admission, trauma resuscitation, and minor surgical procedures. These MLPs worked 8am to 5pm seven days a week.10

During these two timeframes data was collected in the trauma registry of the hospital. Data collected included demographics, pre-existing conditions, and ISS. The outcomes that were included in this study were hospital LOS, ICU LOS, mortality, deep vein thrombosis (DVT), major arrhythmias (MA), and urinary tract infections (UTI).10

There were 1216 patients included in the PRE-MLP period and 1585 patients from the POST-MLP timeframe. The two groups of patients were assessed and found to be similar with respect to age, gender, ISS, and admission type. The outcomes are included in Table I. There were no significant differences in mortality, DVT, or MA. UTIs were reduced during the POST-MLP period from 2.6% to 0.9% (p=.0001). LOS was also reduced in the POST-MLP group. The hospital LOS was reduced by 0.25 days (p=0.092) and ICU LOS was reduced by 0.8 days (p=0.019).10

**Mains et al**

This retrospective study11 was conducted at a level I trauma center. This study was broken into three distinct groups with different trauma team members. The Group 1 consisted of fourth year surgery residents in house with attending surgeons on call at
home. The Group 2 was made up of attending surgeons who were full time in house without residents or PAs. The Group 3 added PAs to the full time surgeons of Group 2.\textsuperscript{11}

Group 1 covered the timeframe July 1, 1999 through June 30, 2002. Group 2 was assessed from July 1, 2002 through June 30, 2005. Group 3 went from July 1, 2005 through June 30, 2006. The patients included over this total timeframe of July 1, 1999 through June 30, 2006 were consecutively admitted patients who were at least 18 years old. There was a total of 15,297 patients admitted over that timeframe; 6365 patients in Group 1, 6599 in Group 2, and 2333 in Group 3. Statistically significant differences were found across the three groups in regards to the patient demographics.\textsuperscript{11}

The outcomes measured over the three groups were overall mortality, mortality with ISS >15, hospital LOS, and ICU LOS. Results were presented both unadjusted and adjusted for age, ISS, mechanism of injury, severe head injury, and transfers.\textsuperscript{11}

Overall mortality rates unadjusted showed no statistically significant changes among any of the groups. The adjusted values did show significant changes for all groups. Overall mortality incidence was decreased for Group 2 compared to Group 1 (3.12\% vs. 3.82\%; \textit{p}=0.05), Group 3 compared to Group 1 (2.32\% vs. 3.82\%; \textit{p}=0.003), and Group 3 compared to Group 2 (2.80\% vs. 3.76\%; \textit{p}=0.05).\textsuperscript{11}

Mortality for patients with ISS >15 showed significant changes for all of the unadjusted groups. There was a decrease for Group 2 compared to Group 1 (12.21\% vs. 14.83\%; \textit{p}=0.04), Group 3 compared to Group 1 (9.73\% vs. 14.83\%; \textit{p}=0.006), and Group 3 compared to Group 2 (9.73\% vs. 12.21\%; \textit{p}=0.02). When assessed in the adjusted format, there were still significant differences. There was a decrease for Group 2 compared to Group 1 (11.41\% vs. 14.83\%; \textit{p}=0.02), and Group 3 compared to Group 1
(9.03% vs. 14.83%; p=0.003). The change between Groups 2 and 3 was not found to be statistically significant (9.67% vs. 12.21%; p=0.13).\textsuperscript{11}

Mean unadjusted hospital length of stay was significantly different for the groups. It was longer for Group 2 compared to Group 1 (5.28 days vs. 4.66 days; p=0.003), and Group 3 compared to Group 1 (5.10 days vs. 4.66 days; p=0.02). There was not a significant change in Group 3 compared with Group 2. When looking at the adjusted mean hospital LOS there was no significant difference comparing Group 2 to Group 1 but it was reduced for Group 3 compared to Group 2 (4.32 days vs. 4.69 days; p=0.05), and Group 3 compared to Group 1 (4.32 days vs. 4.62 days; p=0.05).\textsuperscript{11}

Mean ICU LOS was not significantly changed among any of the groups both adjusted and unadjusted.\textsuperscript{11}

**Sherwood et al**

This retrospective study\textsuperscript{12} is a comparison between trauma data gathered at LDS Hospital (LDSH) and the National Trauma Data Bank (NTDB). The trauma team at LDSH used to be staffed by attending trauma surgeons and residents. Their residency program was removed and their team was changed to an attending surgeon and APC model without use of residents.\textsuperscript{12}

At the start of 2006, the APC model had already been in place at LDSH for 17 months. They chose to use that year of data as their comparison point. The data was gathered from the LDSH trauma registry and compared with the 2006 data from the NTDB. The teams that are represented in the NTDB are varied in their makeup and the level of trauma center. Demographic data was obtained about mechanism of injury (MOI) and ISS. Any category of patients that was included in the NTDB data set that was
not treated at LDSH, such as burns, was excluded from the study. The outcomes that were assessed were the included patients’ mortality and hospital LOS.12

During 2006 LDSH admitted 967 patients and the NTDB contained 1 055 450 patients that were included in this study. The patients were organized by MOI and ISS and that information was used to help categorize the two outcomes.12

For LOS based on MOI there was not a significant difference for the categories of fall, firearm, transport, cut/pierce, machinery, cyclist, and other. LDSH had significantly greater LOS than NTDB for categories of motor vehicle collision (7.5 days vs. 6.1 days; p=0.018), struck (6.3 days vs. 3.6 days; p=0.011), and pedestrian (10.0 days vs. 6.2 days; p=0.012).12

LOS based on ISS showed LDSH had a significantly shorter LOS for the ISS categories from 1-9 (2.5 days vs. 3.5 days; 95% CI 2.21-2.80), 10-15 (4.7 days vs. 5.8 days; 95% CI 4.15-5.28), and 16-24 (7.6 days vs. 8.5 days; 95% CI 6.46-8.71). ISS >24 was not shown to be significantly different.12

Mortality rate was not significantly different for the two groups based on MOI. Using ISS score the overall mortality rate was significantly lower for LDSH (p<0.034) which was mainly driven by the ISS 16-24 category (0.9% vs. 5.8%; 95% CI 0.2-3.5).12

DISCUSSION

The dedicated trauma team is changing. Part of this change has been driven by the resident work hour restrictions imposed in 2003.9 This change has caused a number of different trauma team configurations. Even for the three studies10-12 included in this review, all had different staffing and staff responsibilities. No matter the reason for the
change or the specific iteration, it is important to understand how a change in staffing affects patient outcomes.

The specific outcomes that were originally searched for in this review were hospital mortality, LOS, and patient readmission. Patient readmission is an important outcome because if LOS is getting progressively shorter and patient readmission is increasing this would indicate that the team is not improving as much as LOS alone would suggest. Unfortunately there were no studies found that specifically assessed patient readmission rates and therefore that outcome was removed as part of this assessment.

Based on the outcomes of the three articles\textsuperscript{10-12} reviewed the overall assessment is that APCs are doing as well as and in some cases better than the resident only teams. Hospital mortality has either been unchanged or reduced over certain demographics. LOS has been reduced in almost all cases.\textsuperscript{10-12} Even in the cases where the outcomes are a minimal change or not statistically significant, the inference is that the APC based teams are not affecting patient outcomes negatively.

Another important marker of the efficacy of APC based trauma teams is that they are not only effective in level I trauma centers. While not included in this review, there have been a number of studies\textsuperscript{7,15,16} done which show similar results in level II trauma centers.

An outcome that was not specifically part of this review but should be considered a valuable marker of trauma team care is the quality of care provided as perceived by the patient. This data is very subjective but should be used as a secondary type of outcome which highlights how the team is doing in a more well-rounded sense of patient care. One
study\textsuperscript{17} conducted at the level I Wesley Medical Center specifically assessed the quality of care of an APC based team. This study performed surveys of not only patients but physicians, nurses, and ancillary providers as well. The survey results showed that patients overall felt they received high quality and compassionate care from the APCs.\textsuperscript{17} In addition to patient satisfaction, 86\% of the staff agreed that the APCs were more available for patients and 80\% of doctors and nurses believed trauma care was more efficient.\textsuperscript{17} All these results point to the effectiveness of APCs beyond just the outcomes reviewed here.

**Limitations**

There are various limitations to the studies presented here. In order to review these limitations a set of grading criteria was adapted from studies that addressed health impact assessments.\textsuperscript{18,19} A risk of bias assessment was conducted for each article using the following criteria: conflict of interest, financial bias, timeframe limitations, quality of the assessment team, and the specificity of the question.\textsuperscript{18,19} Each of the articles was rated as having either a high, moderate, or low risk of bias for each criteria. The results are included for each article in Table I.

Conflict of interest and financial bias both assess bias of the authors of the article related to the published results. In all three of the articles reviewed the authors are working for the hospital systems which are being studied.\textsuperscript{10-12} Because some of the authors are PAs or NPs and work for the hospital trauma teams, it is a possible source of conflict of interest. This conflict is related to the authors promoting their jobs over previous team configurations. This bias is balanced by having multiple authors who do not all have the same roles. All three of the articles\textsuperscript{10-12} have a moderate risk of bias for
conflict of interest. This same conflict can tie directly into financial bias as well. There is no mention made of any financial impact these studies would have for the authors of the articles and therefore this criteria is not able to be fully assessed. It is worth mentioning, however, none of the articles addressed cost implications in their studies, so a financial bias is less likely.

One of the major timeframe limitations of all three studies\textsuperscript{10-12} is that they are retrospective studies. This study design is a limitation; not all variables could be controlled or accounted for after the fact. The authors have to use whatever data was previously collected and they are not able to go back and gather what might later be considered relevant. Another timeframe based limitation is the differences in timeframe or year in which the different phases of the study took place. This allows for other changes to take place within the trauma setting that could be confounding factors when trying to only compare staffing changes. These changes for example may include updates in evidence based medicine practices or hospital policies. The only study of the three reviewed that had an identical time period for both groups was Sherwood et al.\textsuperscript{12} Gillard et al\textsuperscript{10} used the same length of time for both groups but the data is from separate years. Mains et al\textsuperscript{11} was not able to use the same timeframe for all three groups which may have had an impact on overall results; the amount of time separating the end of Group 1 from the start of Group 3 is three years. For the above reasons Gillard et al\textsuperscript{10} and Mains et al\textsuperscript{11} were rated as having a high risk of bias with respect to timeline and Sherwood et al\textsuperscript{12} was rated with a moderate risk of bias.

The quality of the assessment team was very good for all of the articles\textsuperscript{10-12}. The authors are of various professions, most of whom have firsthand knowledge of trauma
teams. For this reason all three articles\textsuperscript{10-12} were rated with a low risk of bias with respect to quality of the team.

The specificity of the question is a measure of how well the study was able to isolate one specific question for comparison. In the case of this review, that goal was accomplished by attempting to remove as many confounding factors as possible. As was previously mentioned this was difficult due to the retrospective nature of the studies and the differences in timeframes when data was collected. However, as these factors have been included in previous grading criteria they do not have to be accounted for again. The specific goal was to isolate the differences between PA based trauma teams and resident based teams. This question was not able to be fully isolated in Gillard et al\textsuperscript{10} because the team with PAs added personnel to the resident team. This does not allow for a direct comparison because it is just the addition of staff. This article\textsuperscript{10} was rated as having a moderate risk of bias in relation to specificity of the question. Mains et al\textsuperscript{11} was rated with a low risk of bias based on its specificity because it did an excellent job of analyzing each of the three separate groups. Sherwood et al\textsuperscript{12} did not do well in making the question very specific and was rated as having a high risk of bias. Utilizing the NTDB was a very non-specific comparison both in terms of team makeup and level of the trauma centers.\textsuperscript{12,14}

**Recommendations**

Recommendations for further study include utilizing different study methodologies and assessing additional outcomes. An important aspect of any different study methodology would be to prospectively setup the outcomes and type of data to be collected for the group of patients. Ideally there would be an opportunity to use a resident
based team and an APC team side by side in the same facility with randomly assigned patients. This would afford a more randomized approach over the same timeframe which would help eliminate some of the potential confounders. Some of the additional outcomes that might be included are patient readmission in conjunction with the LOS and a cost analysis of the different teams.

**CONCLUSION**

Trauma teams, much like the rest of medicine, are constantly changing. PAs have been able to step into some of the new roles and make a positive impact. When PAs were added to or replaced residents on trauma teams there was either no change or a reduction in both mortality and length of stay. PAs provide good quality care and have the opportunity to provide more continuity of care than residents, who rotate short term through a trauma service. PAs can be a helpful and productive addition or replacement on resident based teams without negatively impacting patient outcomes.
REFERENCES


### Table I. Characteristics of Reviewed Studies

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<sup>a</sup>P values variable due to multiple comparison points, see results section