Increasing Critical Care Access in Rural Communities: A Program Evaluation of An Advanced Practice Provider (APP) Led Service

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Introduction & Background

Access to critical care services is highly variable across the United States. This disparity is highlighted particularly in rural and low-income areas. Over 20% of the population, just over 60 million people, live in rural communities (Kanter, 2020). For this reason, residents of these communities are older, uninsured, live in poverty, and report lower health outcomes than their nonrural counterparts. Despite this well-known health care need, accessing health care and the availability of resources is still lacking in these communities. Over six million people are admitted to Intensive Care Units (ICU) every year (Lipsky, 2011). As this number continues to grow, it only exacerbates the challenges of meeting access to care needs. This also grows exponentially as this is coupled with shortages of intensive care providers where the demand for critical care services outpaces the supply of trained intensivists (Scherzer, 2017). One study showed that there would be a shortage of over 4,300 intensive care providers by the year 2020 (Deslich, 2014). Having an intensivist available to provide 24/7 coverage, especially in rural areas, continues to be a unique struggle that plagues overall access to critical care in these communities.

There have been numerous comparative studies showing no statistically significant differences between Advanced Practice Provider (APP) ICU groups and traditional ICU physician staffing models. Due to these studies showing no differences in patient critical care outcomes APPs have been suggested as a viable option in alleviating provider shortages (Edkins, 2014). A formal program evaluation comparing an APP led critical care program in a rural, critical access hospital could potentially provide some information necessary to convey a cost-effective way to decrease the disparity and lack of critical care services to communities that have never had this type of access before. Over the past few years several reviews were used to assess the added value that critical care APP groups provide and emphasized that they can increase a patients' access to emergency and critical care medicine (Kreeftenberg, 2019). APPs practicing at the top of their scope and bringing critical care services that are modeled after the newest evidence-based practice guidelines of the academic intensive care units, would be a monumental shift in balancing the availability of critical care access.

More research is necessary to truly understand the disparities associated with access to critical care services in rural communities. COVID-19 continued to showcase large gaps in ICU bed availability and were highly associated with income distribution. For instance, 49% of the lowest income communities had no ICU beds, in comparison to only 3% in the highest income-based communities (Kanter, 2020). If an APP led program in a rural community could be implemented and show similar outcomes regarding mortality, ICU Length of Stay (LOS), ventilator days, infection rates, and patient disposition data; in comparison to a physician led or urban critical care model; critical care services could be provided to communities with these disparities at an even lower cost. A program evaluation of a rural critical care APP led program could answer the clinical question of, Would an APP led critical care model provide safe and effective patient care outcomes in a rural community hospital?

Methods

Program Background

Based on rigorous review of the evidence, critical care APP provider groups provide safe and effective care in comparison to the traditional physician staffing models. This evidence paired with a shortage of critical care intensivists and lack of critical care resources in rural areas, suggests that utilization of critical care APPs could be a way to narrow these gaps in the critical care setting. A new critical care APP program was implemented in a rural community hospital and provided 24/7 critical care to a 6-bed mixed ICU for the first time in January 2020. Previously, the ICU was covered by a hospitalist physician with no specialty training in critical care. This led to frequent transfers to tertiary care centers and patients would have to be taken out of their home community to receive basic intensive care.

The high transfer rate of ICU patients (averaging almost 2 patients/day) from this rural community was recognized by the area's urban academic university hospital system which led to the training and implementation of its own APP group in April of 2019. The APPs went through a three-month training and orientation program at the university hospital's Medical Intensive Care Unit (MICU) which emphasized procedural skills, intensive rounding with attendings that would service as medical control for the rural ICU APP program, and complex care and diagnoses of all types of critical care patients. After the APP group was fully trained and all consultation services and interdisciplinary connections were made, 24/7 coverage was provided starting January of 2020.

After the height of the COVID pandemic, some basic mortality metrics were analyzed and revealed some similarities among outcomes between the academic university hospital MICU group and the APP rural ICU group. This led to the idea of completion of a program evaluation of the rural APP group as it highlights a few unique differences in comparison to other APP critical care programs. These differences are that the rural APP group received specialty ICU training by the attending physicians at its parent tertiary care hospital, the APPs provided 24/7 coverage without a physician onsite, and the program remains established at a rural critical access hospital.

Conceptual Framework

The Centers for Disease Control and Prevention (CDC) has outlined some effective program evaluation tools that center around public health. An appropriate framework allows for a tool that organizes each step of the program evaluation process and presents the program in a context that is understandable to all of those involved (CDC, 1999). The framework outlined by the CDC is a great choice to utilize for this program evaluation of a critical care APP group as it applies to the rural community and its disparity in critical care access. This framework outlined by the CDC consists of six steps: 1) Engage the stakeholders, 2) Describe the program, 3) Focus the evaluation design, 4) Gather credible evidence, 5) Justify the conclusions, 6) Ensure use and share lessons learned (CDC, 1999). These steps were utilized to structure overall program evaluation and determine key variables that would align with program evaluation goals and objectives.

Design

The CDC framework for program evaluation, described above, was utilized to formally evaluate the APP critical care program for the first time. The evaluation assessed the congruent variables seen across studies in the literature including ICU Length of Stay (LOS), Hospital (HOS) LOS, infection data, ventilator days, mortality, discharge disposition, and patient acuity outcomes. A retrospective analysis of the five-year data period was from August 2018 to August 2023. This period was chosen so that the data would include pre-APP comparison data, post-APP implementation, and various intervals of the COVID-19 pandemic. This design would evaluate critical care patient care outcomes and highlight principles of the program evaluation goals:

1. Bring critical care access to the rural community.
2. Provide safe patient outcomes.
3. Define potential areas for future improvement.

Setting

The APP critical care program was implemented in a 6-bed, mixed ICU, in a rural community hospital with a total bed capacity for 70 patients. The critical care APP program consisted of four to six full-time NPs. During the data period from January 2020 to August 2023, 24/7, coverage was provided by this APP group without an on-site physician, and this is still how the program functions today. Medical direction was provided by a critical care attending physician at the neighboring sister urban academic level I trauma center with total bed capacity of 696. Daily rounding would take place with an on-duty critical care attending via phone or telemedicine communications. These attendings would remain on call for admissions or other emergent changes in a patient’s condition.

Ethical Considerations

This program evaluation took place after the pilot program had already been implemented. The program evaluation proposal went through the university IRB for approval and the director of quality to take the proper steps in storing data properly and securely. All data of interest was de-identified, as there was no need for patient identifiers to be utilized for the variables and outcomes of interest. The investigator completed the human research training through the Collaborative Institutional Training Initiative.

Results

A total of 1,542 patients were admitted to the rural 6-bed ICU over the 5-year data period from August 2018 to August 2023. Of these, 1,054 patients were seen and cared for only by the APP critical care team that began 24/7 coverage January of 2020. Of this population 14.6% were COVID patients and during peak covid times, they accounted for 50% occupancy rates. Vent utilization rates nearly doubled after implementation of the APP team. Unfortunately, due to some limitations of the data set, which will be discussed later, acuity scoring could not be obtained, but this vent utilization increase does speak to the increase in overall patient acuity.

During this data period our lead APP implemented a unit nurse champions program to decrease Central Line Associated Blood Stream Infections (CLABSI). Post intervention there was only 1 CLABSI from August 2022 to August 2023. Prior to this the CLABSI rate was 5.37 per 1,000 catheter days. Implementation of the APP critical care team allowed for the first hospital wide ICU consult service averaging approximately 2 patients per day.

Mortality is a major indicator when discussing patient outcomes. Figure-1 summarizes the overall mortality rate broken down by quarter after the APP team went 24/7. There are major variations in quarter 4 of 2020 with peaks again in quarter 4 of 2021. These swings are during the COVID-19 pandemic and do correlate with increased occupancy rates for these patients. According to the data collected by the Society of Critical Care Medicine, the national average for ICU mortality in the US is 10-29% (Society of Critical Care Medicine, 2023), which you can see indicated by the orange dotted lines. This average is not adjusted for covid pandemic times where some data suggests average rates as high as 52%. Even during peak covid time intervals, the critical care APP group consistently maintained a mortality rate of less than the national average.

Figure-2 gives a detailed overview of the overall ICU discharge disposition data. In the first column, you can see the overall percentages of each discharge category of the 5-year data period. In the subsequent columns you will see both pre and post APP team implementation disposition findings. There was an overall decrease in discharges to extended recovery care and home with assistance, however, an increase in those patient's discharged home. Extended recovery care includes inpatient rehab, Long Term Care facilities, psych hospitals, skilled nursing facilities, and other intermediate care facilities. Home with assistance includes both home health and home hospice. There was also a decrease in transfers to other tertiary care hospitals, however, not as much of a decrease as anticipated. Some factors influencing this metric may include the covid pandemic, a need for increased bed capacity, or needs for specialty care services such as cardiac cath lab, complicated surgical procedures, or other need for specialty services that were unavailable at this rural critical access hospital. During this time there were no specialty GI, neuro, emergent heart attack or stroke intervention, or urology services. The overall mortality did increase however, as previously discussed, this was likely in the setting of the pandemic and overall increase in patient acuity.

Lastly, Figure-3 summarizes comparative results that show an overall increase in LOS data post APP implementation with ICU LOS remaining slightly below the national average. Although LOS is not directly linked to a causative relationship with morality, these overall trends when couples to all other data variables may paint a clearer picture when looking at all competing factors in the future.

Financial Considerations

The current needs of the critical care team include 6 full-time positions. When looking at the average cost analysis of the national average between an Intensivist and an APP critical care provider the salary cost savings alone is $1.39 million. Even if you consider a mixture of intensivist and APP providers, there is still a difference of $231,000 between the two provider groups.

Conclusions

In summary, these results do in fact replicate those being seen in the literature. This APP led critical care team did in fact provide safe care as reflected by the ICU patient outcomes data. The key positive variables that this program evaluation highlighted was the increase in overall patient acuity with vent utilization nearly doubling, a decrease in transfers to other tertiary care centers allowing more patients to stay in their home community, increased rate of discharge dispositions to home, 1 CLABSI over a one year period post implementation of a nurse champions infection prevention program, the ICU mortality being consistently below the national average, and the first ever hospital wide critical care consult service. These results further advocate that APPs in critical care could help close the intensivist shortage gaps and open discussions that a model like this could be replicated as a viable option to bridge the gap of critical care access in rural areas. Of course, not all data analyzed led to staggering improvements in all categories. Utilizing these outcomes will be just as important to ensure that its meaning is also analyzed. Incorporation of these outcomes for the final conclusions of the program evaluation will also highlight the ways that the program can be improved.

Project Limitations

The project limitations may help speak to some of the unexpected results and bring us into the final piece of the program evaluation that will help us look at the programs use and share its lessons. At the end of the 5-year data period, there was a switch of the Electronic Medical Records (EMR) system from Meditech to Epic. Unfortunately, it was quite difficult to obtain all data variables after this transition and some had to be pulled by hand. This opens the possibility of data being more prone to errors. To decrease this likelihood there was a 3-month overlap between systems and this period was checked against each other to ensure compatibility.
This 3-month overlap showed a noted error in ICU admissions and the data was queried again, tested for capability, and repeat analysis was performed.

When the EMRs merged some data could no longer be extracted. Patient acuity scores were one such item. Although, as previously discussed, ventilator utilization doubling is a major indicator of increased acuity, it is not the only factor that we should utilize for making this claim. The other category that was very limited given the EMR transition was also infection data. Central line infection data is the only one reported given this data was previously obtained during the nurse champions project, allowing this data to be reportable. The COVID-19 Pandemic also had some influence on a lot of the data points and after the APP group only being 24/7 for 3 months, the first covid patient was admitted to ICU that April. The pandemic could undoubtedly have influence over all key variables given the higher mortality rates, increased occupancy rates, and overall LOS data.

Lastly, some of the comparative data are not under similar circumstances. Pre and post APP implementation were both under very different conditions. Pre-APP implementation there was no pandemic, ICU admission and transfer criteria were quite different, and patients were not seen by a specialty provider trained in critical care.

Practice Impact

Improvements in overall data collection and appropriate documentation in the new EMR will allow for more streamlined and accurate data management. Future comparison data will help establish trends to highlight specific areas that the APP critical care team may improve upon in the future. Being able to track patient acuity data, disposition status with admission diagnosis, and infection data will only help further improve patient outcomes, pinpoint additional services and resources that may be needed, and contribute to providing a baseline comparison without influences from a pandemic.

If additional positive program outcomes can be replicated, it may help promote other critical care programs like it, and hopefully further break down the barriers of critical care access. This APP led critical care program also advances innovation of patient care team models, enhances interdisciplinary and professional team deliverables, provides access to critical care in a cost-effective manner, and allows advancement of nursing practice to allow APPs to perform at the highest level of their scope of practice. Overall, the final impact for the patients in this rural community may not really be summarized by data alone.

Figure-1

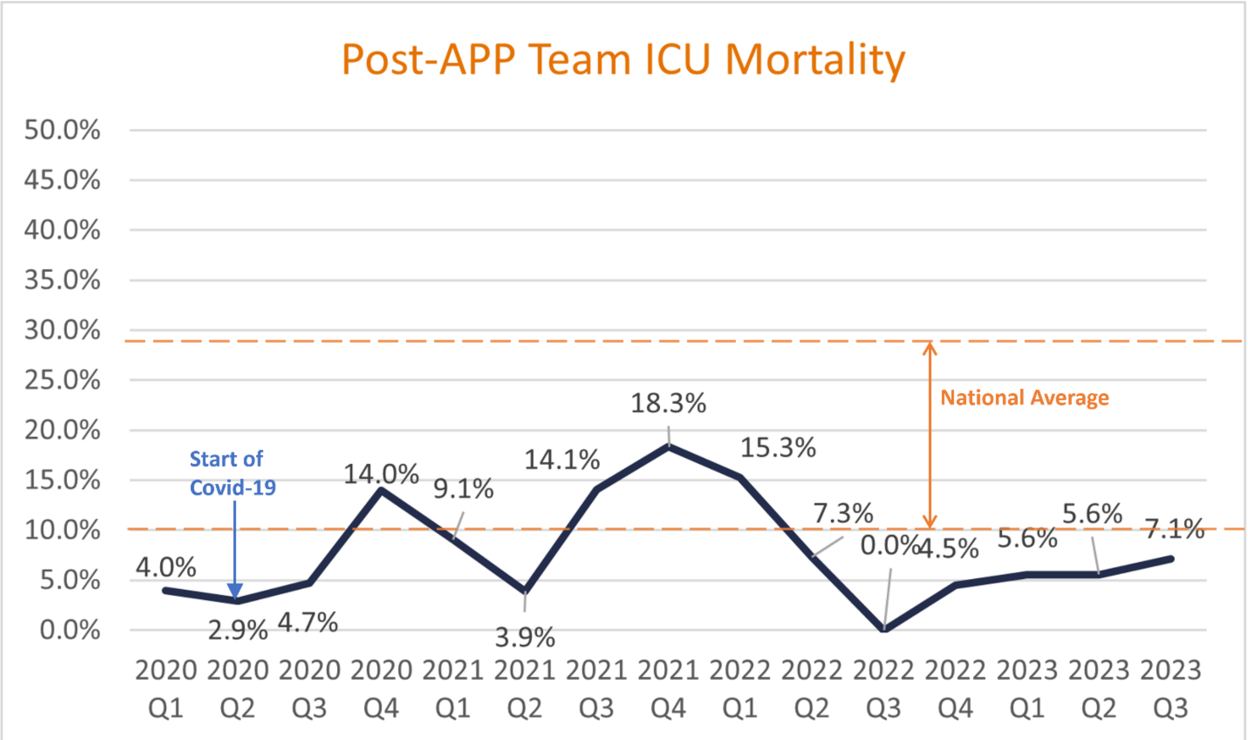
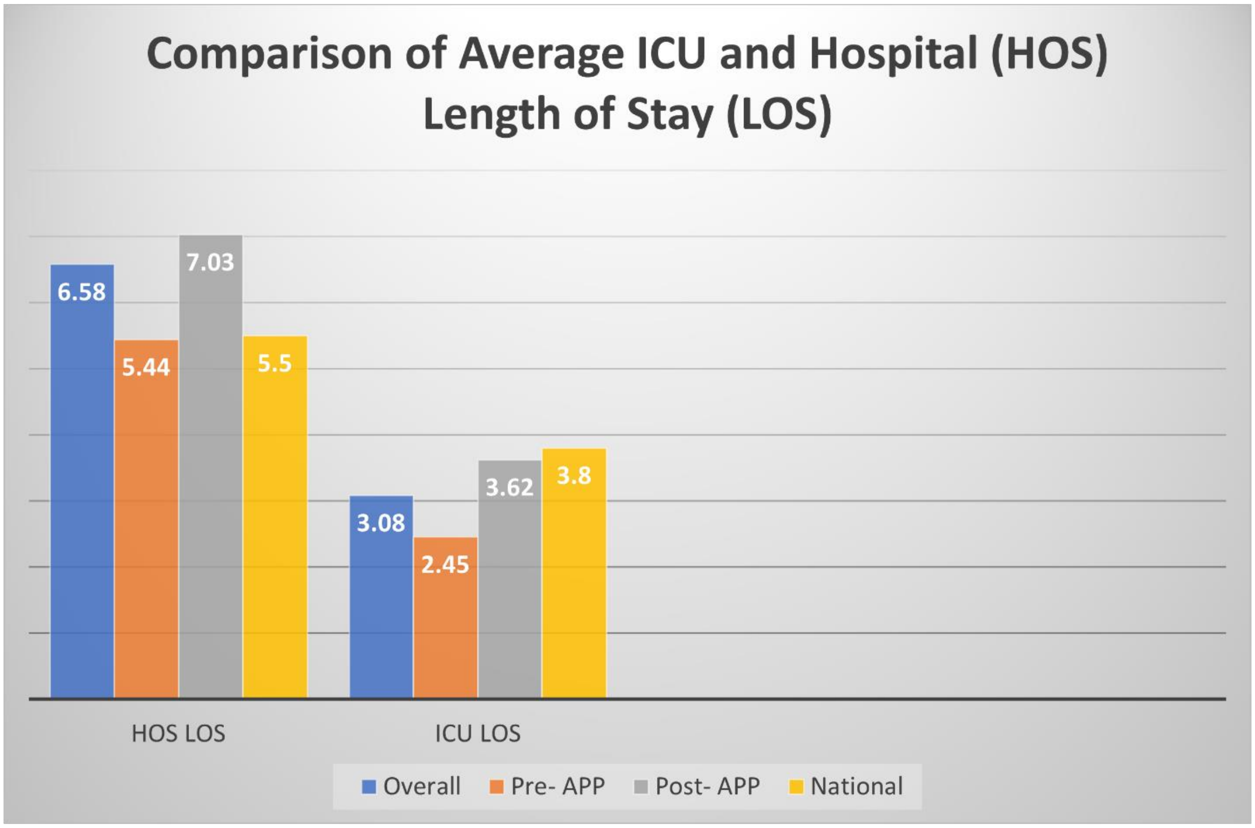

Post-APP Team ICU Mortality
50.0%
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Start of Covid-19
National Average
4.0%
2.9%
4.7%
14.0%
9.1%
3.9%
14.1%
18.3%
15.3%
7.3%
0.0%
4.5%
5.6%
5.6%
7.1%
2020 Q1
2020 Q2
2020 Q3
2020 Q4
2021 Q1
2021 Q2
2021 Q3
2021 Q4
2022 Q1
2022 Q2
2022 Q3
2022 Q4
2023 Q1
2023 Q2
2023 Q3

Figure-2

ICU Disposition Destination	ICU TOTAL (%) 2018- 2023	Pre-APP Service (%) 2018-2019	Post-APP Service (%) 2020-2023
Extended Recovery Care	23.4	26.8	21.8
Home w/ Assistance	16.2	16.6	15.9
Home	16.1	15.4	16.5
Tertiary Care Hospital	12.8	13.5	12.5
Expired	8.9	5.1	10.6* (NOTE: COVID19)

Figure-3


Comparison of Average ICU and Hospital (HOS) Length of Stay (LOS)
6.58
5.44
7.03
5.5
3.08
2.45
3.62
3.8
HOS LOS
ICU LOS
Overall
Pre- APP
Post- APP
National

References

Centers for Disease Control and Prevention. (1999). Framework for program evaluation in public health. Morbidity and Mortality Weekly Report, 48:11.

Deslich, S. & Coustasse, A. (2014). Expanding technology in the ICU: The care for the utilization of telemedicine. Telemedicine and E-Health. http://doi.org.proxy1.library.virginia.edu/10.1089/tmj.2013.0102

Edkins, R., Cairns, B., & Hultman, S. (2014). A systematic review of advance practice providers in acute care: options for a new model in a burn intensive care unit. Annals of Plastic Surgery, 72:3. Doi: 10.1097/SAP.0000000000000106

Gershengorn, H., et al. (2011). Impact of nonphysician staffing on outcomes in a medical ICU. CHEST, 139:6. Doi: 10.1378/chest.10-2648

Kanter, G., Segal, A., & Groeneveld, P. (2020). Access to critical care services. Health Affairs. https://doi.org/10.1377/hlthaff.2020.00581

Kleinpell, R., Ely, E., & Grabenkort, R. (2008). Nurse practitioners and physician assistants in the intensive care unit: An evidence-based review. Critical Care Medicine; 36:10.

Kleinpell, R., Grabenkort, W., Kapu, A., et al. (2019). Nurse pracitioners and physician assistants in acute and critical care: A concise review of the literature and data 2008-2018. Society of Critical Care Medicine. Doi: 10.1097/CCM.0000000000003925

Kreeftenberg, H., Pouwels, S., Bindels, A., et al. (2019). Impact of the advanced practice provider in adult critical care: A systematic review and meta-analysis. Society of Critical Care Medicine; 47:5. Doi: 10.1097/CCM.0000000000003667

Landsperger, J., Semler, M., Wang, L., et al. (2016). Outcomes of nurse practitioner-delivered critical care: A prospective cohort study. CHEST; 149:5. Doi: http://dx.doi.org/10.1016/j.chest.2015.12.015

Lipsky, M.S. & Glasser, M. (2011). Critical access hospitals and the challenges to quality care. JAMA. doi:10.1001/jama.2011.928

Matsushima, K., et al. (2016). A high-volume trauma intensive care unit can be successfully staffed by advanced practitioners at night. Journal of Critical Care, 33(2016): 4-7. Doi: http://dx.doi.org/10.1016/j.jcrc.2016.01.024

Mostrag, Katherine. (2022). Unit nurse champions to decrease central-line associated bloodstream infections.

Page M.J., McKenzie J.E., Bossuyt P.M., et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

Scherzer, R., Dennis, M., Swan, B., et al. (2017). A comparison of usage and outcomes between nurse practitioner and resident-staffed medical ICUs. College of Nursing Faculty Papers & Presentations. Paper 84. Doi: 10/1097/CCM.0000000000002055

Society of Critical Care Medicine. (2023). Critical care statistics. Retrieved from https://www.sccm.org/Communications/Critical-Care-Statistics