

Critical Medicine in Low Resource Setting. Retrospective Analysis after 2 Years of Working at Piedras Negras, Coahuila

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Abstract

Introduction: The availability of resources and the access of critical medicine is a challenge for all health services around the world. Specially, when it's required in places where the facilities and staff are not enough. All hospitals have critically ill patients and the procedures applied at the intensive care unit do not necessarily depend on current technology, usually with very high costs. Piedras Negras is a city with a population of approximately 150,172 people. Second-level medical facilities are located from 2 to 4 hours road trip. The experience gained in implementing ICU units at Clinica Mexico and the HGZ 11 (Hospital General Zona 11) with low resources due to the lack of specialized staff; provides important information to evaluate the results and needs of the work in this facilities.

Methods: Retrospective study from November 2016 to September 2018.

Results: In this period of time 134 patients were assisted, 52.9 % were males, Average age 47.5 years with SD \pm 19.5, days at ICU 3.8 days SD \pm 4.7, Mortality in ICU 11.19% (at hospital 17.9% with 20.1% of patients transferred, hospital mortality registered, removing patients transferred (n = 99) was 24.2% and the average mortality calculated by SAPS3 was 40.8% with $p < 0.0001$. A standard mortality rate analysis was done (SMR) with Mid-P test with value 0.44 IC 95% 0.29 - 0.65 $p < 0.001$. The study presents important limitations regarding methodology and application of the indicators and population however it provided of very important and preliminary information of the ICU attention of both low resources medical facilities.

Keywords: *Low-Resource Setting; Critical Care Medicine; Mexico*

Introduction

The availability of resources and the access of critical medicine is a challenge for all health services around the world. Specially when it's required in places where the facilities and staff are not enough [1]. All hospitals have critically ill patients and the procedures applied at the intensive care unit do not necessarily depend on current technology, usually with very high costs [1]. Some of the most important critical interventions like infusion of intravenous fluids, early administration of antibiotics and monitoring have a low cost [1]. There is a tendency to think that the need of the attention required by critically ill patients in a low resources situation is not cost-effective, however it is proven that the population getting assistance in this facilities is younger and healthier if we compare them with those attending third-level medical facilities [1]. Piedras Negras is a city with a population of approximately 150,172 people. Second-level medical facilities are located from 2 to 4 hours away at Monterrey, Saltillo, and Monclova cities [2]. The General Area Hospital #11 at Piedras Negras from the Mexican Social Security Institute has 99 beds, 2 operating rooms, obstetric area and provides medical care to 600 a 700 patients every

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month; the ICU has 2 beds with mechanical ventilation with invasive and non-invasive models, invasive and non-invasive monitoring, 1 Specialists Nurse at the morning, afternoon and sometimes evening shifts and 1 intensivist Physician in the morning shift from Monday to Friday. Internist Physicians take care of the other shifts, but they are not at the Hospital all the time. The Clinica Mexico is a private medical facility with 20 beds, 4 operating rooms, and 2,600 admissions per year. The ICU is closed, the medical and administrative work is provided by the only Intensivist Physician in charge. The Nursing staff has a general nurse degree and received training during 6 months; they are permanently in training in order to acquire the intellectual and practical capabilities needed to assist the critical ill patients. The unit has 2 beds, mechanical ventilation with invasive and non-invasive mode, invasive and non-invasive monitoring, besides having pulmonary cardiac monitoring equipment with ultrasound guidance for Vascular access. The cost-benefit analysis of the assistance provided to the critical ill patients has been subject of few reports: Cubro H., *et al.* analyzed the cost-benefit of 148 ICU patients at Sarajevo, Bosnia: they reported: survivors (47.2%) a median of years of life gained by survivor of 30 years, adjusted by QALY: 18. The cost per survivor was from \$1,820 USD up to \$20,109 USD and between \$100 to \$2,514usd for QALY. The experience gained in implementing ICU units at Clinica Mexico and the HGZ 11 (Hospital General Zona 11) with low resources due to the lack of specialized staff; provides important information to evaluate the results and needs of the work in this facilities.

Objectives of the Study

1. Describe demographic characteristics, most common diseases, illness intensity and mortality of the patients admitted at the ICU from November 2016 to September 2018.
2. Describe the quality of the assistance provided at the ICU facilities.

Materials and Methods

Retrospective study from November 16th to September 18th of consecutive patients admitted at the IMSS HGZ #11 (for its acronyms in Spanish) and “Mexico” Clinic (Private Facility) ICU, using the registered information at the BASUTI (Intensive Care Unit Data Base) (for its acronym in Spanish).

Each BASUTI from each ICU is updated with each admission done, at the ICU facilities of the Clinica Mexico and at the HGZ 11 all patients who were cared for by the only Intensivist Physician in charge. The data collected in the BASUTI were: general demographic characteristics, admission diagnoses, service of origin, priority, medical factors of admission, days in the intensive care unit (ICU) and hospital, mortality at ICU and hospital, procedures done, healthcare indicators, complications related to the assistance provided at the ICU, severity, organic failure and prognosis predicted by SAPS 3 and SOFA. As result of the data, the calculation of attention indicators was done, for example; Digestive Tract Bleeding prophylaxis, Deep Vein Thrombosis, Central venous catheter-associated bacteremia, Pneumonia associated with mechanical ventilation, catheter-associated Urinary Tract Infection, medications errors, Reperfusion in Acute ST-Segment Elevation Myocardial Infraction, reintubation, mortality in severe BTI, acquired weakness in the ICU and adequate glucose levels.

Qualitative variables will be described as mean and standard deviations; quantitative as percentage and frequency; the quality indicator will be calculated as specified in the SEMICYUC (for its acronym in Spanish) (Spanish Society of Critical, Intensive Medicine and Coronary Units). The statistical analysis will be done using StatCal software, version 1500.1.3 (c) AcaStat software 2018.

Results

The study period spanned from November 26th, 2016 to October 9th, 2018. In this period of time 134 patients were assisted, 60 of them at the Clinica Mexico (private hospital). 52.9% were males, 67.9% had a functional activity status; the three main services of origin were: Emergency Room (ER) (47.7%), Ward (20.9%) and Operating Room (OR) (17.1%). Average age 47.5 years with SD \pm 19.5, days at ICU 3.8 days SD \pm 4.7 (See table 1, Graph 1 and 2).

Male n (%)	71 (52.9%)	p < 0.45
Median age years (SD)	47.5 (±19.6)	p < 0.0001
Median days at ICU (SD)	3.8 (±4.7)	p < 0.0001
Median days at Hospital (SD)	7.9 (±7.9)	p < 0.0001
Median VMI hours (SD)	55.1 (±95.6%)	p < 0.0001
Median SOFA (SD)	6.6 (6.0)	p < 0.0001
Median SAPS 3 (SD)	57.9 (20.0)	p < 0.0001
Median Mortality SAPS 3 (SD)	40.8% (±9.4)	p < 0.0001
Administrative Category		
Private n (%)	38 (28.4%)	p < 0.0001
Medical Insurance n (%)	22 (16.4%)	p < 0.0001
Public n (%)	74 (55.2%)	p < 0.0001
State, activity and health before admission		
Functional n (%)	91 (67.9%)	p < 0.0001
Symptomatic n (%)	37 (27.6%)	p < 0.0001
Out of bed < 50% n (%)	3 (2.2%)	p < 0.0001
In bed n (%)	3 (2.2%)	p < 0.0001
Procedence place		
Emergency n (%)	64 (47.8%)	p < 0.0001
Inpatient n (%)	28 (20.9%)	p < 0.0001
Operating room n (%)	23 (17.2%)	p < 0.0001
Other hospitals n (%)	17 (12.7%)	p < 0.0001
Typical admission mode		
Threat of organic failure n (%)	58 (43.3%)	p < 0.0001
Mechanical ventilation n (%)	32 (23.9%)	p < 0.0001
Shock n(%)	25 (18.7%)	p < 0.0001
Hydrometabolic n (%)	8 (6%)	p < 0.0001
CPR n (%)	7 (5.2%)	p < 0.0001
Post-operated n (%)	3 (2.2%)	p < 0.0001
Vasoactive n (%)	1 (0.8%)	p < 0.0001
Admission conditions		
Unstable n (%)	41 (30.6%)	p < 0.0001
Stable n (%)	93 (69.4%)	p < 0.0001
Advanced resuscitation directive		
Yes n (%)	8 (6%)	p < 0.0001
Cardiopulmonary resuscitation level		
CPR 1 n (%)	126 (94%)	p < 0.0001
CPR 2 n (%)	5 (3.73%)	p < 0.0001
CPR 3 n (%)	3 (2.2%)	p < 0.0001
ER operating room		
Yes n (%)	22 (16.4%)	p < 0.0001
Coronary		
Yes n (%)	19 (14.2%)	p < 0.0001
Principal admission diagnosis		
Sepsis n (%)	37 (27.6%)	p < 0.0001
STEMI n (%)	11 (8.21%)	p < 0.0001
DKA n (%)	9 (6.7%)	p < 0.0001
Preeclampsia n (%)	8 (6%)	p < 0.0001
Others n (%)	69 (51.5%)	p < 0.0001

Table 1: Main characteristics of the critical ill patients Piedras Negras Coahuila 2016-2018.

Abbreviations: ICU: Intensive Care Unit; ER: Emergency Room; OR: Operating Room; SAPS 3: Simplified Acute Physiology Score 3; qSOFA: quickSOFA; SOFA: Sequential Organ Failure Assessment; SD: Standard Deviation; STEMI: ST-elevation Myocardial Infarction; DKA: Diabetic Ketoacidosis.

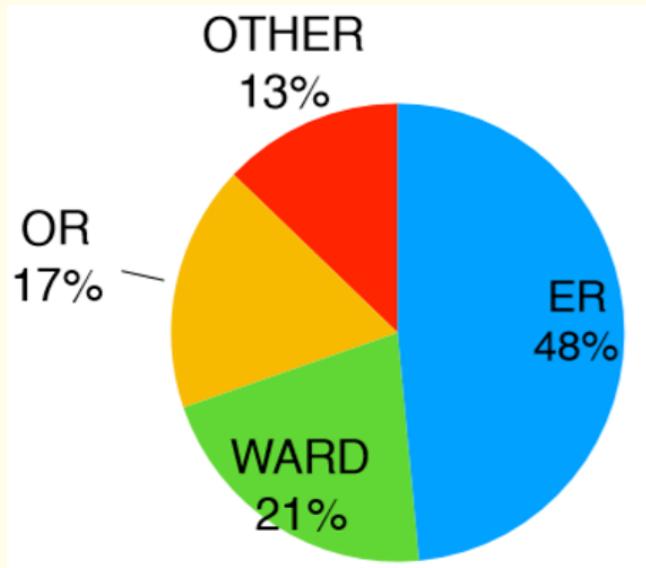
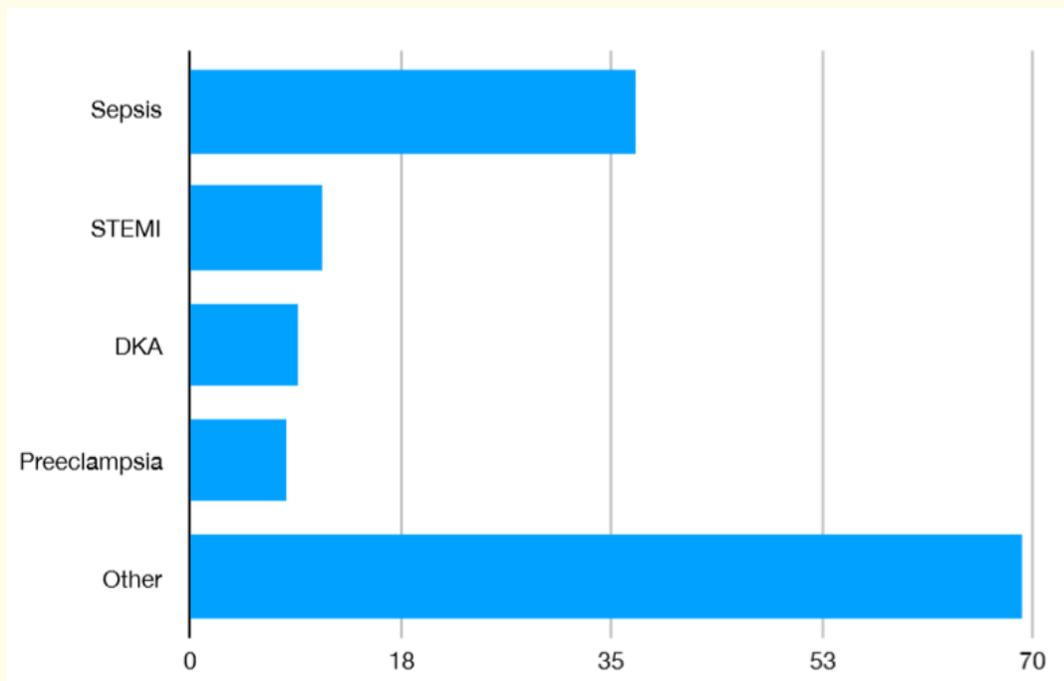
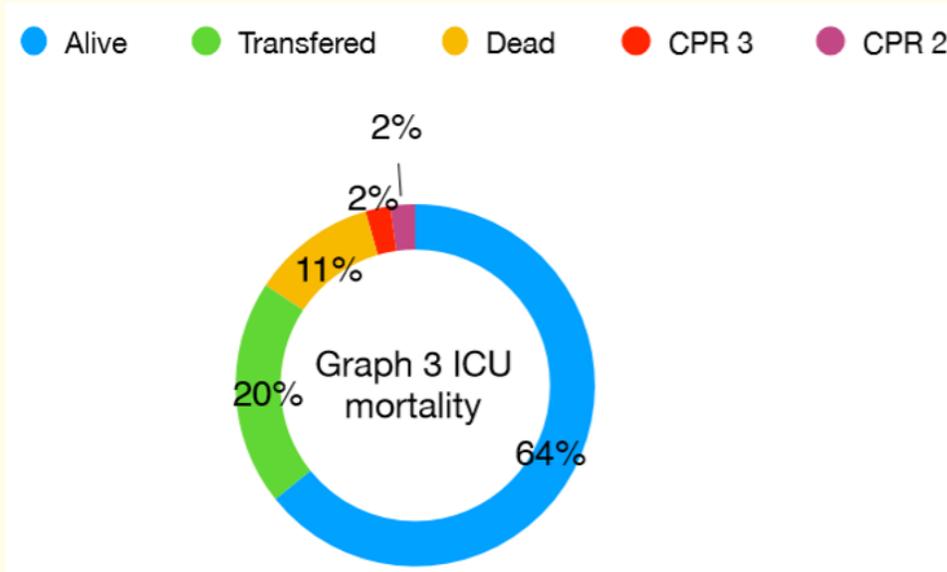


Figure 1: Site of origin. OR: Operating Room; ER: Emergency Room.

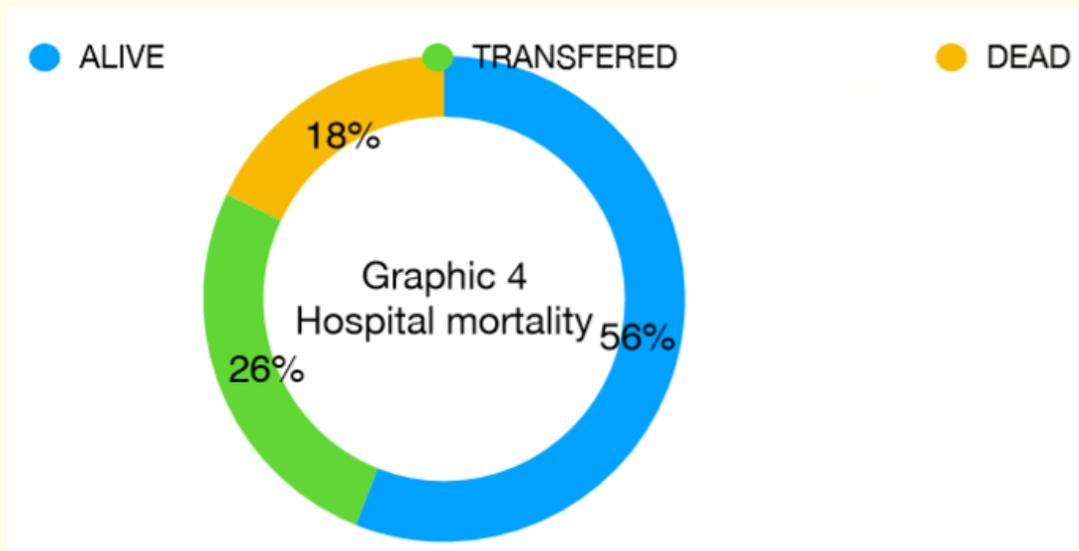


Graph 2: Principal diagnosis at admission. STEMI: ST-elevation Myocardial Infarction; DKA: Diabetic Ketoacidosis.

Mortality registered in ICU 11.19% (Graph 3) at hospital 17.9% with a percentage of 20.1% of patients transferred to another hospitals (Graph 4).

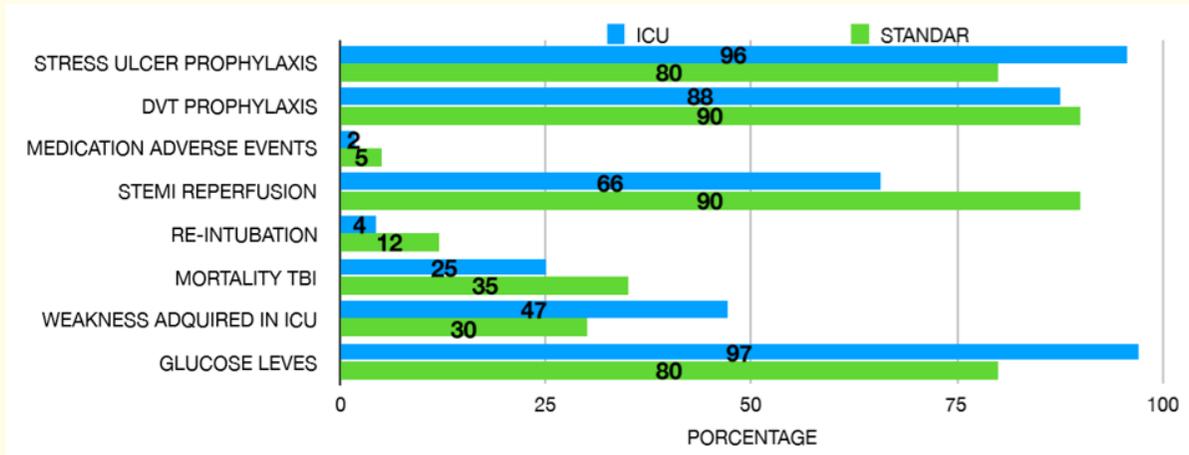


Graph 3: ICU mortality.

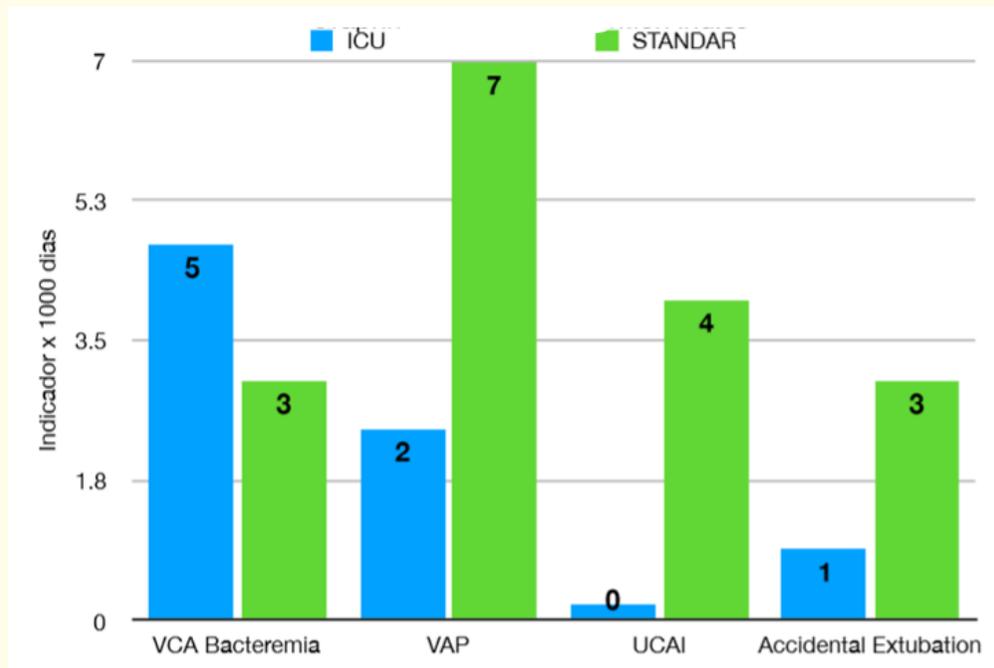


Graph 4: Hospital mortality.

Regarding the quality of attention indicators, the objective was not reached in: Deep Vein Thrombosis prophylaxis 87.5%, Venous catheter-associated bacteremia 4.5 for every 1000 days, Reperfusion in Acute ST-Segment Elevation Myocardial Infraction 62.5% and weakness acquired at ICU 47% (Graph 5 and 6).

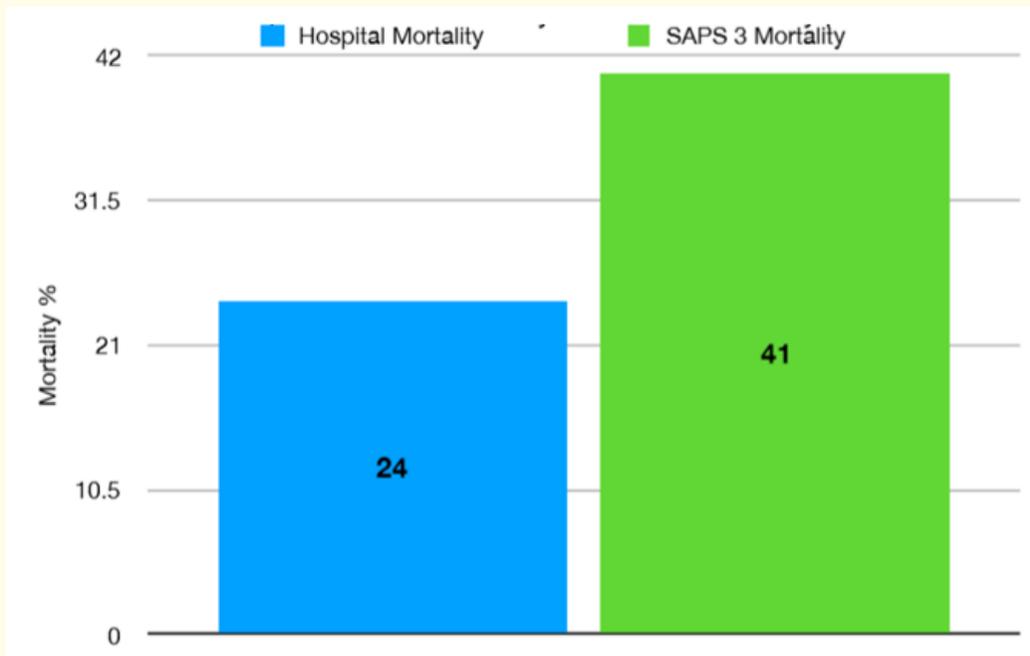


Graph 5: Quality of attention indicators.



Graph 6: Quality of attention indicators.

The hospital mortality registered, removing patients transferred (n = 99) was 24.2% and the average mortality calculated by SAPS3 was 40.8% with $p < 0.0001$ (Graph 7).



Graph 7: Actual mortality VS SAPS 3 mortality $p < 0.0001$.

A standard mortality rate analysis was done (SMR) with Mid-P test with value 0.44 IC 95% 0.29 - 0.65 $p < 0.001$.

Discussion

In our country, there is very little published data on ICU with limited resources, as far as we know, it is very important to generate information to develop improvements programs and to distribute resources where they are most needed.

Males presented a higher percentage (62.9%) with a small difference, this result is very similar to the one presented in international publications: 51% (3). A population of 148 patients were subject to the analysis.

The average age of our population 47.5 years (SD 19.6) represents the main group with laboral activity, situation that affects the local economy. The average age is similar to the one reported in other publications. Cubro., *et al.* [3] reported an average of 56 years, and Vukoja., *et al.* [8] registered an average of 45 years.

Most of our patients are dispatched alive; a follow up in their evaluation post-ICU and their integration into work and family activities must be analyzed.

This analysis showed that the service of origin was the ER, inpatient and Operating Room; which is very similar to the situations described by international analysis [5,6,8] and there are currently no publications regarding this subject in our country.

The main admission diagnosis was Sepsis 20%, Cardiorespiratory arrest 18.6%, and intoxication 15.7%.

The SOFA average was 6.6% and the unstable conditions in patients admitted were present in 30.6% of them, which means that patients with damage in soft tissue organs under treatment were assisted.

The main admission reasons: threat of organic failure 43.4%, mechanical ventilation 23.9%, and Shock 18.7% This is derived from the clinical assessment of the Intensivist Physician which conditions a risk of bias, although 91% of the patients admitted had a normal physical and health state.

The main finding of the present investigation is the positive evolution, in general terms, of the quality of the assistance provided to the critical ill patients in facilities with low technological and staff resources. The practice of critical medicine in low-resources situation is underestimated in most situations [3], which results in an increase in mortality in the population who by their age, remain active labor members of society. This situation increases the impact in the society in general.

The lack of staff trained to treat this kind of patients, derives in an inadequate application of the admission triage, using outdated or bad calibrated prognosis prediction tools, resulting in a wrongful distribution of resources.

The ICU units evaluated for this study where cataloged as limited resources facilities but with the capacity of transferring to a higher capacity facility [6], nevertheless the main transfer reason was the lack of specialized staff to perform cardio-thoracic surgery and neurological surgery.

The attention bias limitations in this study are due to the fact that there is only one Intensivist Physician in the city, number of patients and there is no information of another public ICU managed by Intensivist Physicians.

Despite of this limitations and the city's population, is proven that the attention of critical ill patients is a necessity in Piedras Negras and that the quality of the attention is positive although there is a lack of technology and staff.

The quality indicators of prophylaxis attention for STD (95.7%), medication mistakes (1.5%), reintubation (4.3%), mortality due to CET (25%), glucose level control (97.1%) they all accomplished the internal standards [4].

However, there are indicators without accomplishing due to the lack of staff and sedation and analgesic protocols that we must implement (weaknesses acquired in ICU 47.1%).

Regarding the mortality analysis it is below the average reported by SAPS3, the cost- benefits analysis is not available but this is a positive result that should motivate the increase in support of the attention of the city's patients [9,10].

Conclusion

1. A total of 134 patients were included in this analysis. A similarly genderfrequency was observed for males and females with 52.9% and 47.1%.
2. The average age analyzed of the population was 47.5 ± 19.6 years.
3. Most frequent admission diagnosis was Sepsis and the origin service was inpatient from different specialties
4. The median for the days at the hospital and at the ICU were of 7.9 ± 7.9 days and 3.8 ± 4.7 days respectively.
5. The SOFA, SAPS3 and SAPS 3 median in mortality we're 6.6, 57.9 and 40.8% for the population subject of the study.
6. The quality attention indicators for prophylaxis STD (95.7%), medication errors (1.5%), reintubation (4.3%), CET mortality (25%), glucose levels control (97.1%) accomplished international standards.

7. The real mortality is lower than the one predicted by SAPS3 at the population subject to our study.
8. The study presents important limitations regarding methodology and application of the indicators and population however it provided very important and preliminary information of the ICU attention of both low resources medical facilities.

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