ECRONICON OPEN ACCESS

EC PAEDIATRICS
Dissertation

When "First do not Harm" is Not Enough; Guiding Learning Curve Performance from Novice to Expert in Pediatrics Residents in Guatemala to Reduce Mortality

Luis Augusto Moya-Barquin*

Pediatric Intensive Care Unit, Hospital General San Juan de Dios, Critical Medicine and Pediatric Intensive Care, Universidad de San Carlos of Guatemala, Guatemala

***Corresponding Author:** Luis Augusto Moya-Barquin, Pediatric Intensive Care Unit, Hospital General San Juan de Dios, Critical Medicine and Pediatric Intensive Care, Universidad de San Carlos of Guatemala, Guatemala.

Received: May 06, 2019**; Published:** June 25, 2019

Abstract

Pediatric Simulation is defined as a teaching methodology. This allows a controlled and repetitive learning into a safe environment for both, the patient and the medicine fellow reducing the learning curve. In the Hospital San Juan de Dios in Guatemala, from 2003 to 2019 the number of admissions and number of deaths have substantially modified across time. From 2004 to 2010 procedures with the standard of the international guidelines for PICU attention were designed in the unit and implemented mainly for the Acute Pediatric Patient approach in the pediatric ward of the Hospital, and furthermore, these procedures were spread-out to other emergency units in provincial hospitals always supported with training mainly to the general pediatricians and attendant nurses. This article summarizes the described efforts and how this could be reproducible in other settings. The learning experience in low resource environment is not related only in medical science is important skills and competences related with performance, teamwork and leadership as part in medical simulation. First do not harm is not enough, is necessary to guide the learning curve in order to improve decision making. The impact in PICU Hospital General San Juan de Dios is to reduce mortality; then we conclude Frist Do Not Harm is not enough; make the Lex Art is as first and as fast. First, do no harm becomes the art of law as first speed.

Keywords: *Pediatric Simulation; Simulation; Acute Pediatric Patient; Emergency; Guatemala; Mortality; Primum Non Nocere; First Do Not Harm*

Based in the familiar dictum Primum non nocere (First Do Not Harm) we need to make a second taught in the common rule "See One, Do One and Teach One "could not be the better option based in patient safety in developing countries.

Pediatric Simulation is defined as a teaching methodology. Through this kind of method it is possible to re-create clinical situations with the potential of facilitating the medicine fellows learning. This allows a controlled and repetitive learning into a safe environment for both, the patient and the medicine fellow. This kind of methodology already demonstrated a reduction in the learning curve. Learning curve theory is a scientific theory with direct applicability to simulation education researchers [1,2].

One of the first recognized efforts for performing medical procedures teaching through simulation comes from the Middle Age using anatomic models mainly fixed with wax, this technique has been known as Moulage, and continues to be a pivotal aspect in the Pediatric Simulation activities. Other methods used in the past and not so far away are the use of human and animal corpses for anatomical dissection and the teaching of surgical procedures and techniques [3-5].

In the Hospital San Juan de Dios in Guatemala, from 2003 to 2019 the number of admissions and number of deaths have substantially modified across time. On 2003 with only 12 beds the annual number of PICU admissions was 608; on this time few attendance protocol existed in the unit but not was goal directed or defined by objectives. In the incoming years from 2004 to 2010 procedures with the standard of the international guidelines for PICU attention were designed in the unit and implemented mainly for the Acute Pediatric Patient approach in the pediatric ward of the Hospital, and furthermore, these procedures were spread-out to other emergency units in provincial hospitals always supported with training mainly to the general pediatricians and attendant nurses [6].

The adherence to Guidelines for the Acute Medical Management of Severe Traumatic Brain Injury in Infants, Children and Adolescents in 2003, the Surviving Sepsis Campaign in 2007 and the structure of our initial simulation skills in 2009 working on Pediatric Advance Life Support Courses were crucial for the performance enhancement; this was coordinated by our Pediatric Critical Care Unit. These actions were done with the support of the Red Iberoamericana de Estudio de la Parada Cardiorespiratoria en el Infancia (RIBEPCI), which was a network for pediatric CPR coordinated training project, set up in several Latin-American countries with the instructional and scientific support of the Spanish Group for Pediatric and Neonatal CPR. The program was divided in four phases: CPR training and preparation of instructors; training for instructors; supervised teaching; and independent teaching. Instructors from each country participated in the development of the next group in the following country. Pediatric Basic Life Support (BLS), Pediatric Immediate (ILS) and Pediatric Advanced (ALS) courses were organized in each country and adapted to local characteristics. We belong to one of the five Pediatric Resuscitation groups including Honduras, Dominican Republic and Mexico besides Guatemala located in Latin America plus the group in Spain. This model, quite close to the pediatric simulation has been shown as an excellent model program to develop Pediatric CPR training in low- and middle income countries and in emerging economies [7,8].

Working with this model, we found that it is possible to increase the learning opportunities to the medical students and former residents; these opportunities include: knowledge, skills and individual/team work attitudes learning; in this way the alumni acquire the required competencies learning-doing without using the "trial-error" method in the patients.

After this experience, we considered the Pediatric Simulation a pivotal method for teaching any procedure or technique to medical students and residents in any medical specialty; mainly skills on procedures that are basic for supporting life in any patient with almost any condition. Two good examples: the first one is the tracheal intubation, this is a core technical skill for pediatric critical care, and general pediatrics medicine fellows; this procedure has been considered quite complicated during the period for skill acquisition by trainees; even if limited data exist to describe current medicine fellows tracheal intubation skill acquisition through the training; we have seen that overall and first-attempt tracheal intubation success rates by pediatric and pediatric critical care medicine fellows improve over the course of a specific training; this have been seen also by other expert groups [9-11].

The second one is as simple as the hand washing procedure could be; this one has two challenging aspects: an adequate performance following only a piece of paper fixed in the wall and the second one, have the culture for doing it. In our Pediatric Critical Care Unit we are using Simulation for addressing both aspects, by repetition, thorough explanation and again: repetition, its making possible to have an increase in this practice in around 30% [12].

Had this been said, we started our Simulation Center for Pediatric Emergencies on March 2014; our center could be classified as low fidelity-low cost; and many efforts have been performed since we started for achieving this; even finding the adequate name was a signal of improvement pursuing: SOYUTZ. This word came from a fusion of the Russian word "Soyuz" that means "union" and the kiche Mayan word "utz" that means "good"; resulting in "Good Union". It is also well known that none of this kind of goals can be reached without the support of National and or Academic Authorities; in this case, the support from the University San Carlos de Guatemala and Ministerio de Salud Publica y Asistencia Social [13-16].

During the last few years, the use of pediatric simulation for medical education has been quickly extended; currently it is being used almost in all medicine fields, from basics to the clinics. In our hospital we started a simulation network between all the pediatric services including pediatric surgery and pediatric anesthesiology among others. Our experience is replicating the findings in many other clinical centers around the world. Nevertheless and even with all this new research in the field, consensus about simulation related topics are still under assessment by several expert groups.

Every day there is an increasing technology load and material related with simulation with important variations, it could be quite simple device to the most sophisticated robotic manikins; nevertheless the high technological fidelity is never superior when compared the low technological fidelity; in fact, the most determinant fidelity in the simulation results is the psychological fidelity. This one consists in a high realism scenario added to the facilitator´s experience [17-21].

For achieving the highest realism in a clinical simulated scenario, there are several tools that can be applied, one of them is Moulage, this is a French word that literally means (form "Le Dictionary Larousse"): "Reproduction d'un objet, ou "épreuve", faite à l'aide d'un moule ainsi obtenu"; in English: "Reproduction of a test object from a model). In this sense, Moulage in medicine could have several definitions, for simulation purposes we can define it as: "Simulation technique for the creation of lesions, alterations, attitudes, faces, external appearance and/or fictional scenarios, as closest as possible to the disease state or to the crisis situation that the trainer wants to recreate, always with educational purposes, and always protecting the integrity of the participants" [22].

The second one we found quite supportive for the teaching process based in simulation and already implemented in our Hospital is the use of video imaging. Considering that simulation is defined as a technique used for replacing or amplifying the real experiences under guidance; using experiences that are "not real" but can evoke the real ones in an interactive way, we are working over the consideration the academic background in Latin America Medicine Schools are not focused in performance. We are moving the education to have a great amount of knowledge but until today we need to improve the operative and explicit knowledge to improve the performance and increase the ethical demands about avoid neglect, incompetence and imprudence [23].

The professional performance in medical students and pediatrics residents needs to be revisited. Usually as equivalent in quality and safety of patient in medical practice, age, seniority, experience, jobs or charges, belonging to medical societies and be active member country boards. It has not been more than once that in the conditions of the hierarchy and seniority experienced outer towards prolongs is economic relations resulting from professional practice. Copying mostly the type of structure from colonial hospitals of ecclesiastical and military influence authoritarian, vertical, centralized in the authority, with the challenges to the institutions of today with dynamic, multidisciplinary teams of high performance on scenarios of high uncertainty and complexity. The HALO (High Accuracy Low Opportunity) events are common in pediatric emergencies and pediatric critical care; but need competent performance in postgraduate residents [24].

The multidisciplinary teams education should be privileged; the knowledge is not related with hierarchy, age or position; instead this must be related with the role and the performance. As said by a colleague; they earn the degree empty; it is only fulfilled after practice, when sufficient experience is developed to fill the competences. This is the moment to be able to feel that it might have a better predictability and attention to the uncertainties [25-29].

Since the traditional (like artisan) formation of the physician in previous generations, the production of large scale justified the need to produce more human resources in health, in contrast to privileged opportunities that would go to the health services in wealth people. We sought to balance resources and opportunities but within the same scheme that leaves behind the mobilization in rural areas and health as wealth is concentrated in urban areas [30-39].

The institutional vision of health from the social welfare point of view, unipolar and isolated from interaction with other social actors leads to a poor, limited and reactive health promotion activities and where primary care is seen as a basis of less importance to the development of one or more specialties; concentrated in hospital care in which contributions go directly to degenerative and chronic disease management emergency; creating an imbalance for the patients, and higher costs with a negative impact on the investments in health cost-effective actions, leading to less prevention and rehabilitation [40,41].

There is a need to bring to the country the accreditation of medical competences assuming that the practice generates quality; pursuing the patient safety. Standards, protocols and guidelines to have an accreditation of a practice area must be checked also through time, for assuring the physician has the knowledge, abilities and skills needed for performing in their place of work [42,43].

Development requires standards, procedures, objectives, goals, and performance evaluation; it cannot arrive only with a reference of quality of medical practice without assessing the performance; then I would like to emphasize that it must not be confusion between the academic degree given by a University duly recognized, to be active collegiate (mistakenly considered this equivalent to the payment of the fee to the institution; and coming to be secondary to the fulfillment of the hours credit to the College of physicians and Surgeons) with the accreditation of competences and of the quality of the performance [44,45].

An evaluation of Pan American Health Organization and Latin American Pediatric Society about the time spent in Medical Schools in Latin America show that 70% of the time is dedicated to hospitalized patient but only 10% will work in this field. Second find is about 10% of the time to Primary Care and Outpatient Clinic is related where 75% of graduates will work. Only 5% of time spent is related triage/ emergency [23].

The pediatric triage and emergency care need a newer approach as Acute Pediatric Patient Care. Is related to early recognition, treatment, re assessment and treatment of pediatric patient even in ward, operating room, transport, radiological rooms and others. We are using the experience in Guatemala including this for building training to widespread the competences on acute care approach [45-47].

Simulation introduces the management of Crew Resource Management method that allows the individual to do in a computer a common goal and through sharing the confluent vision of patient management can focus sensitive targets in time, doing that work, teamwork is facilitated by the situational awareness, the possible alternatives, the distribution of tasks according to abilities, knowledge and skills; where the team will have a phase of meeting at the "briefing" start explaining the scenario, the resources available and assigned roles; at the end is called "debriefing" are discussed where successes and failures in a non-punitive environment but that seeking mental processes to be corrected so that in a next opportunity is done with greater efficiency [48].

In table 1 we can observe the relationship with academic load on the domain or ability in the performance level. The reference from International Pediatric Simulation Society - IPSS- in training instructor simulation course was useful for us to have definition of milestones and levels to assure the performance, involvement, followership, leadership and the educational blueprint [49-53].

Challenges			+	+++	++++
Cultural Competencies		+	+++	++++	+++
Core Competencies	+	+++	++++	+++	++
Skills	+++	++++	+++	++	
Knowledge	++++	+++	++		
	Novice	Advanced	Competent	Competent Advanced	Expert

Table 1: *From novice to expert performance.*

The Utstein formula of survival show that not only the knowledge is related with survival, the performance and the measure of the implementation of any guideline, standard and protocol are related with survival. The almost well done performance (0.8/1) is not enough because times of each component over other produce around 51% of probability of survival; very close random result by chance [54].

The Utstein formula of survival			
Medical Science	**Educational efficiency**	**Local implementation**	**Survival**
100%	100%	100%	100%
80%	80%	80%	51.2%

Table 2: *The Utstein formula of survival.*

Data analysis comparing admission and mortality 2003 - 2019 in PICU

In a dissertation for Doctorate in the Department of Industrial Engineering and Management Systems in the College of Engineering and Computer Science at the University of Central Florida Orlando, in United States of America in 2017 about the a framework for measuring return on investment for healthcare simulation-based training shows that development in Hospital General San Juan de Dios is successful model based in the return of investment based in simulation training and saved lives compared with historical data previous and expected risk based in Pediatric Risk of Morality score - PRISM [55-57].

From 2003 to 2018 the number of admissions to the PICU decreased in a 64.5%, p-value 0.001 (from 608 to 216 respectively); and the number of beds were almost duplicated (from 12 to 25) but is recognized the difference between the Pediatric Risk of Mortality III score average in admitted patient was 9 points in 1998 and is 26 points in 2016. Furthermore, the numbers of deaths were also reduced in around 37.5% (from 208 in 2004 to 130 in 2018) p-value 0.001. Currently the admitted children have increased PRISM scores accomplishing criteria for PICU; the reduced number in the admissions has been the result of continuous medical education and the implementation of standard operational procedures [58,59].

Conclusion

In conclusion after we improve the adherence to guidelines, protocols and standards related to the learning of the performance; that impact the safety patient; we believe that first do not harm is not enough, then make the lex artis as fast as the first one. In latin quote primum non nocere, secundum fiat lex artis as primum as celerime. We need lead the learning over the pathway of safety patient and Lex Artis in developing countries [60].

Acknowledgement

Reyes-Maza JC, Cotto-Menchu EJ, Alvarez-Galvez EA, Sierra-Morales RC, Castro-Darce MC, Espinoza-Montes RF, Soto-Melgar SS, Coronel-Martinez DL.

Bibliography

1. Hugman R., *et al*. "When 'Do No Harm' Is Not Enough: The Ethics of Research with Refugees and Other Vulnerable Groups". *The British Journal of Social Work* 41.7 (2011): 1271-1287.

2. Kotsis SV and Chung KC. "Application of the "see one, do one, teach one" concept in surgical training". *Plastic and reconstructive surgery* 131.5 (2013): 1194-1201.

3. Pusic MV., *et al*. "Role of Scientific Theory in Simulation Education Research". *Simulation in Healthcare* 13.3S.1 (2018): S7-S14.

4. Cooke RA. "A moulage museum is not just a museum". *Virchows Archiv* 457.5 (2010): 513-520.

5. Coelho G., *et al*. "Anatomical pediatric model for craniosynostosis surgical training". *Child's Nervous System* 30.12 (2014): 2009-2014.

6. Moya-Barquin L and Martínez-Gómez JA. "Abstract 669: Physiological stability and malnutrition related to mortality in the pediatric intensive care". *Pediatric Critical Care Medicine* 15.4 (2014): 151.

7. López-Herce Jesús., et al. "Latin American consensus for pediatric cardiopulmonary resuscitation 2017: Latin American Pediatric Critical Care Society Pediatric Cardiopulmonary Resuscitation Committee". *Pediatric Critical Care Medicine* 19.3 (2018): e152-e156.

8. López-Herce J., *et al*. "Paediatric cardiopulmonary resuscitation training program in Latin-America: the RIBEPCI experience". *BMC Medical Education* 17.1 (2017): 161.

9. Reid RO., *et al*. "Associations between physician characteristics and quality of care". *Archives of internal medicine* 170.16 (2010): 1442-1449.

10. Ishizuka M., *et al*. "The Development of Tracheal Intubation Proficiency Outside the Operating Suite During Pediatric Critical Care Medicine Fellowship Training: A Retrospective Cohort Study Using Cumulative Sum Analysis". *Pediatric Critical Care Medicine* 17.7 (2016): e309-e316.

11. Lee SL., *et al*. "A multi-institutional comparison of pediatric appendicitis outcomes between teaching and nonteaching hospitals". *Journal of Surgical Education* 68.1 (2011): 6-9.

12. Schneider J., et al. "Hand hygiene adherence is influenced by the behavior of role models". *Pediatric Critical Care Medicine* 10.3 (2009): 360-363.

13. Smith., *et al*. "Resuscitation in a Simulated Delivery Room Environment Time for a New Paradigm in Pediatric Medical Education: Teaching Neonatal". *Pediatrics* 106.4 (2000): e45.

14. Emani SS., *et al*. "Simulation training improves team dynamics and performance in a low-resource cardiac intensive care unit". *Annals of Pediatric Cardiology* 11.2 (2018): 130-136.

15. "Centro De Simulacion De Emergencias Pediatricas" (2019).

16. Roussin CJ and Weinstock P. "SimZones: An Organizational Innovation for Simulation Programs and Centers". *Academic Medicine* 92.8 (2017): 1114-1120.

17. Guanà R., *et al*. "Skills Comparison in Pediatric Residents Using a 2-Dimensional versus a 3-Dimensional High-Definition Camera in a Pediatric Laparoscopic Simulator". *Journal of Surgical Education* 74.4 (2017): 644-649.

18. Yoshizawa J., *et al*. "Laparoscopic percutaneous extraperitoneal closure for inguinal hernia: learning curve for attending surgeons and residents". *Pediatric Surgery International* 29.12 (2013): 1281-1285.

19. Burjonrappa SC and Nerkar H. "Teaching single-incision laparoscopic appendectomy in pediatric patients". *Journal of the Society of Laparoendscopic Surgeons* 16.4 (2012): 619-622.

20. Griffin GR., *et al*. "Validity and efficacy of a pediatric airway foreign body training course in resident education". *Annals of Otology, Rhinology, and Laryngology* 120.10 (2011): 635-640.

21. Rehder R., *et al*. "The role of simulation in neurosurgery". *Child's Nervous System* 32.1 (2016): 43-54.

22. Cornele JT., *et al*. "Review Manual for the Certified Healthcare Simulation Educator Exam". *Springer Publishing Company*: 123-132.

23. Puga Teodoro F. "Pediatric training in medical schools of Latin America". ALAPE-IMCI Washington, D.C: PAHO. (Serie OPS/FCH/CA/05.58.I) (2006).

24. Chiniara G., et al. "Simulation in healthcare: A taxonomy and a conceptual framework for instructional design and media selection". *Medical Teacher* 35.8 (2013): e1380-e1395.

25. Levett-Jones T and Lapkin S. "A systematic review of the effectiveness of simulation debriefing in health professional education". *Nurse Education Today* 34.6 (2014): e50-e63.

26. Grant JS., *et al*. "Comparing the effectiveness of video-assisted oral debriefing and oral debriefing alone on behaviors by undergraduate nursing students during high-fidelity simulation". *Nurse Education in Practice* 14.5 (2014): 479-484.

27. Soucisse ML., *et al*. "Video coaching as an efficient teaching method for surgical residents-a randomized controlled trial". *Journal of Surgical Education* 74.2 (2017): 367-371.

28. Watmough S., *et al*. "Unexpected medical undergraduate simulation training (UMUST): can unexpected medical simulation scenarios help prepare medical students for the transition to foundation year doctor?". *BMC Medical Education* 16 (2016): 110.

29. Nystrom S., *et al*. "Debriefing practices in interprofessional simulation with students: a sociomaterial perspective". *BMC Medical Education* 16 (2016): 148.

30. Drummond D., *et al*. "Google Glass for Residents Dealing With Pediatric Cardiopulmonary Arrest: A Randomized, Controlled, Simulation-Based Study". *Pediatric Critical Care Medicine* 18.2 (2017): 120-127.

31. Noveanu J., *et al*. "Assessment of simulated emergency scenarios: are trained observers necessary?". *Prehospital Emergency Care* 21.4 (2017): 511-254.

32. Pascucci RC., *et al*. "Integrating actors into a simulation program: a primer". *Simulation in Healthcare* 9.2 (2014): 120-126.

33. Bong CL., *et al*. "Effects of simulation versus traditional tutorial-based training on physiologic stress levels among clinicians: a pilot study". *Simulation in Healthcare* 5.5 (2010): 272-278.

34. Li Z1 and Wang H. "Ocean Wave Simulation Based on Wind Field". *PLoS One* 11.1 (2016): e0147123.

35. Halamek LP. "Lost moon, saved lives: using the movie apollo 13 as a video primer in behavioral skills for simulation trainees and instructors". *Simulation in Healthcare* 5.5 (2010): 303-310.

36. Malik S., *et al*. "Impact of movie-based simulation training, with or without conventional verbal demonstration on observed OSPE scores in medical undergraduates: a double control study". *Journal of Ayub Medical College Abbottabad* 25.1-2 (2013): 127-128.

37. Pena G., *et al*. "Nontechnical skills training for the operating room: A prospective study using simulation and didactic workshop". *Surgery* 158.1 (2015): 300-309.

38. Dufrene C and Young A. "Succesful debriefing-best methods to achieve positive learning outcomes: a literature review". *Nurse Education Today* 34.3 (2014): 372-376.

39. Cheng A., *et al*. "Debriefing for technology-enhanced simulation: a systematic review and meta-analysis". *Medical Education* 48.7 (2014): 657-666.

40. Chumpitazi CE., *et al*. "Creation and assessment of a bad news delivery simulation curriculum for pediatric emergency medicine fellows". *Cureus* 8.5 (2016): e595.

41. Isaranuwatchai W., *et al*. "A cost-effectiveness analysis of self-debriefing versus instructor debriefing for simulated crises in perioperative medicine in Canada". *Journal of Educational Evaluation for Health Professions* 13 (2016): 44.

42. Steinemann S., *et al*. "Role confusion and self assessment in interpersonal trauma teams". *The American Journal of Surgery* 11.2 (2016): 482-488.

43. William A., *et al*. "Using simulation to address hierarchy-related errors in medical practice". *The Permanente Journal* 18.2 (2014): 14-20.

44. Podolsky DJ., *et al*. "Assessing Technical Performance and Determining the Learning Curve in Cleft Palate Surgery Using a High-Fidelity Cleft Palate Simulator". *Plastic and Reconstructive Surgery* 141.6 (2018): 1485-1500.

45. Matterson HH., *et al*. "Neonatal resuscitation experience curves: simulation based mastery learning booster sessions and skill decay patterns among pediatric residents". *Journal of Perinatal Medicine* 46.8 (2018): 934-941.

46. Moya-Barquin LA and Coronel-Martínez DL. "Abstract P-084: Moulage and scenic skills are tools to improve realism and performance of simulation training in guatemala and Mexico". *Pediatric Critical Care Medicine* 19.6S (2018): 74.

47. Pusic M., *et al*. "How much practice is enough? Using learning curves to assess the deliberate practice of radiograph interpretation". *Academic Medicine* 86.6 (2011): 731-736.

48. Lai A., *et al*. "Learning crisis resource management: Practicing versus an observational role in simulation training - a randomized controlled trial". *Anaesthesia Critical Care and Pain Medicine* 35.4 (2016): 275-281.

49. Schuepfer G and Jöhr M. "Psoas compartment block (PCB) in children: Part II--generation of an institutional learning curve with a new technique". *Pediatric Anesthesia* 15.6 (2005): 465-469.

50. Schuepfer G., *et al*. "Generating a learning curve for pediatric caudal epidural blocks: an empirical evaluation of technical skills in novice and experienced anesthetists". *Regional Anesthesia & Pain Medicine* 25.4 (2000): 385-388.

51. Larew Charles., *et al*. "Innovations in clinical simulation: Application of Benner's Theory in an Interactive Patient Care Simulation". *Nursing Education Perspectives* 27.1 (2006): 16-21.

52. Luctkar-Flude Marian., et al. "Educating novice to expert nurses: the simulation solution". *The Nursing Journal* 2 (2007): 32-41.

53. Thomas CM and Kellgren M. "Benner's Novice to Expert Model: An Application for Simulation Facilitators". *Nursing Science Quarterly* 30.3 (2017): 227-234.

54. Søreide E., et al. "Utstein formula for survival collaboraors. The formula for survival in resuscitation". *Resuscitation* 84.11 (2013): 1487-1493.

55. Hatim Ali Bukhari., *et al*., "A Framework For Measuring Return On Investment For Healthcare Simulation-Based Training". Dissertation for the degree of Doctor of Philosophy in the Department of Industrial Engineering and Management Systems in the College of Engineering and Computer Science at the University of Central Florida Orlando, Florida, United States of America, Fall Term (2017).

56. Pollack Murray., et al. "PRISM III: an updated pediatric risk of mortality score". *Critical Care Medicine* 24.5 (1996): 743-752.

57. Moya-Barquin LA and Espinoza-Montes R. "Abstract P-445: Improvement of physiological stability related mortality in malnourished children admitted a public hospital in guatemala through 20 years". *Pediatric Critical Care Medicine* 19.6S (2018): 185.

58. Moya-Barquin LA., et al. "Abstract P-209: Impact international guidelines management of severe sepsis /septic shock on mortality reduction due to septic shock in picu in central america, a 10 yr follow-up". *Pediatric Critical Care Medicine* 19.6S (2018): 111.

59. Moya-Barquin LA., et al. "Abstract P-085: A national objective structured clinical examination on management pediatric critical care patients by pediatrics residents in guatemala". *Pediatric Critical Care Medicine* 19.6S (2018): 74-75.

60. Moya-Barquin LA., et al. "Abstract P-358: Measuring return on investment for healthcare and mortality reduction for simulation-based training in guatemala". *Pediatric Critical Care Medicine* 19.6S (2018): 156.

Volume 8 Issue 7 July 2019