CHAPTER II

REVIEW OF LITERATURE

A review of literature is an essential and important step for the scientific research projects. It helps the investigator to develop a deeper insight into the problem & gain intonation on what has been done into the field & illuminates about the significance of the new studies.

Research should be built on the previous knowledge. Before beginning a Quantitative Study, it is important to determine what knowledge exists relevant to the study topic.

According to Abdellah & Levine (1979), “A review of literature provides basis for the investigations. It justifies the need for replication & throws light on the feasibility of the study, indicates constraints of data collection, & helps to relate the findings from one study to another.”

Best (1986), stated that “A review of literature helps the researcher in many ways. It helps her to assess what is already known, what is still known & untested, justify the need for its replication, & throw light on the feasibility of the study, the problem that may be encountered by the investigator. It also helps to uncover promising methodological tools, which shed light on the ways to improve the efficiency of the data collection & obtaining useful information on how to increase the effectiveness of data analyses.”

Review of literature is a key step in the research process. It serves a number of important functions in the research process. From this prospective this review is based on the systematic and critical collective and evaluation of the important published scholarly literature and also the unpublished research findings. Critically reading the literature review is to develop a sound study that contributes to further the knowledge development for theory, research, education and practice. Literature provides current theoretical and scientific knowledge about a particular problem resulting in a synthesis of what is known and not known.
Literature review involves a systematic identification, location, scrutiny & summary of the written materials that contains information on a research problem. An attempt has been made by the investigator to follow these steps in the review of related research & also non research literature to broaden the understanding & gain an insight into the selected problem under the study. Investigator has done manual as well as online search for the review of related literature.

This chapter deals with the review of literature, which was done to obtain scientific material relevant to this study.

Research literatures was reviewed & organized under the following headings:

1. Studies related to ventilators in the pediatric intensive care unit
2. Studies related to ventilator associated pneumonia
3. Studies related to importance of protocol in pediatric intensive care unit.
4. Studies related to enteral nutrition
5. Studies related to endotracheal suctioning
6. Studies related to oral hygiene for patients on ventilator
7. Studies related to care of invasive lines
8. Studies related to arterial blood gas analysis
9. Studies related to weaning and extubation of children from mechanical ventilator
10. Studies related to knowledge of nurses in PICU

2.1 STUDIES RELATED TO VENTILATORS IN PEDIATRIC INTENSIVE CARE UNIT:-

A study was conducted by Sandrine Essouri, Laurent Chevret, Philippe Durand, Vincent Hass, Brigitte Fauroux & Denis Devictor (2006), to evaluate the feasibility and outcome of non-invasive positive pressure ventilation in daily clinical practice, a total of 114 patients were included, and 83 of the 114 patients (77%) were successfully treated by NPPV without intubation, the success rate of NPPV was significantly lower (22%) in the patients with acute respiratory distress syndrome. (p<.05) than is the other patients. This study demonstrates the feasibility and efficacy of NPPV in the daily practice of a pediatric intensive care unit. This
ventilator support could be proposed as a first-line treatment in children with acute respiratory distress, except in those with a diagnosis of acute respiratory distress syndrome.\textsuperscript{36}

A study on How is Mechanical ventilation Employed in a Pediatric Intensive Care Unit in Brazil was conducted by Dafne Cardose, Bourguignon Da Silva, Audrey Rie, Ogawa Shibata, Julio A Farias & Edvardo Juan Troster (2008). This study was to investigate the relationship between mechanical ventilation and mortality and the practice of mechanical ventilation applied in children admitted to a high complexity pediatric intensive care unit in the city of Sao Paulo, Brazil, it was a prospective cohort study of all consecutive patients admitted to a Brazilian high complexity PICU, who were placed on mechanical ventilation for 24 hours or more of the admitted children, 35.7\% received mechanical ventilation modes were standard of the children studied, 91\% had chronic functional status. There was a high incidence of acute respiratory distress syndrome but a lung protective strategy was not fully implemented. Inspiratory pressure at the beginning of mechanical ventilation was a predictor of mortality within 28 days and of a longer course of mechanical ventilation.\textsuperscript{37}

Invasive ventilation modes in children: a systematic review and meta-analysis by Anita Duyndam, Ervin Ista, Houmen R J, Van Driel B, Reiss I & Tibboel D (2011). In this study they addressed six different ventilation modes in 421 children; they were two trials which compared high frequency oscillation versus conventional ventilation. In the pooled analysis, the mortality rate did not differ between these modes (odds ratio=0.83, 95\% confidence interval=0.30 to 1.91). High frequency ventilation and volume diffusive respirator was associated with a better oxygenation after 72 hours than was conventional ventilation. Weaning was studied in 182 children assigned to a pressure support, a volume support protocol or no protocol. Most children could be weaned within 2 days and the weaning time did not significantly differ between the groups, however that high frequency ventilation reduced mortality and length of ventilation.\textsuperscript{38}

Ambosio IU, Woo MS, Jansen MT & Keens T G (1999) conducted a study on safety of hospitalized ventilator-dependent children outside of the intensive care unit, they included all the ventilator-dependent children who were hospitalized on the pediatric wards at children’s hospitalized Los Angeles and were reviewed retrospectively (N=63) and compared with the
general pediatric ward population hospitalized during the same period. Data collected included the number of unexpected ICU transfers from the pediatric ward and the number of deaths that occurred on the ward. The study concluded that ventilator-dependent children hospitalized outside of the ICU do not have an increased incidence of deaths and unexpected ICU admissions compared with non-ventilator-dependent in patients. They speculated that hospital care of stable ventilator-dependent children can be provided safety outside of an ICU and at lower cost.39

Peter C. Rimensberger, Mark J Heuitt, Jon Meliones, Marti Pons & Ronald A Bronicki (2011), conducted a study on mechanical ventilation in the pediatric cardiac intensive care unit, according to them ventilator a child or newborn in the post-operative course after repair of congenital heart disease requires a solid understanding of respiratory system mechanics and cardiopulmonary physiology. Furthermore, careful attention has to be paid to avoid damaging the lungs by potentially injurious mechanical ventilation. Optimizing ventilator settings during controlled and assisted ventilation, allowing as early as possible for spontaneous ventilation by still assisting mechanically the patients respiratory efforts are important features for lung protection, for minimizing potential hemodynamic side effects of positive pressure ventilation, and for early weaning from mechanical ventilation.40

According to Mehta NM and Arnold JH (2010) A study on Mechanical Ventilation in children with acute respiratory failure, says that mechanical ventilation strategies aiming for optimal alveolar recruitment with the judicious use of positive end expiratory pressure (PEEP) and low tidal volumes will remain the mainstay for managing respiratory failure in children. Dexamethasone may prevent post extubation stridor. Prone positioning, surfactant therapy HFOV, are evaluated for their effect on mortality and duration of ventilation.41

A multi data base literature search was done on clinical application on ventilator modes: ventilatory strategies for lung protection by Rose L (2010).According to her lung proactive ventilatory strategies are not consistently applied and weaning and extubation continue to be delayed. Critical care nurses need to establish a strong knowledge base to promote effective and appropriate management of patients requiring mechanical ventilation.42
Tuner DA, Arnold JH (2007) conducted a study on insights in pediatric ventilation: timing of intubation, ventilatory strategies and weaning, according to the author Mechanical ventilation with pressure limitation and low tidal volumes has become customary in pediatric intensive care units, and this lung protective approach will continue into the foreseeable future. Further investigations are warranted regarding use of high frequency oscillatory ventilation, airway pressure release ventilation and surfactant to assist Pediatric intensivist in application of these therapies. 43

An article by Marraro GA (2003), on innovative practices of ventilatory support with pediatric patients, suggest a strategy combining recruitment maneuvers, low tidal volume, and higher positive end expiratory pressure (PEEP) decreases barotrauma and volutrauma. Given that appropriate tidal volumes are critical in deterring adequate alveolar ventilation and avoiding lung injury, volume control ventilation with high PEEP levels has been proposed as the preferable protective ventilatory mode. Pressure related volume control ventilation and high frequency oscillatory ventilation (HFOV) have taken on an important role as protective lung strategies. The conviction emerges that the best ventilatory treatment may be obtained by applying a combination of types of ventilation and supportive treatment as outlined above. Early treatment is important for the overall positive final result. Lung recruitment maneuvers followed by maintain an open lung favor rapid resolution of pathology and reduce side effect. The methods proposed require confirmation through large controlled trials that can assess the efficacy. The optimal method(s) to treat individual pathologies in the various pediatric age groups are clearly defined. 44

Conclusion:-

This sections deals with the various modes of ventilators used in the pediatric intensive care unit, it emphasis on the use of non-invasive positive pressure ventilation in daily clinical practice in PICU as the first line of treatment in children with acute respiratory distress. Using inspiratory pressure at the beginning of mechanical ventilation can be a predictor of mortality in children admitted in PICU. High frequency ventilation reduced mortality & length of ventilation. Optimizing ventilator setting can protect the lungs & minimize the hemodynamic side effects. Critical care nurses need to establish a strong knowledge base to promote effective & appropriate management of patients requiring mechanical ventilation.
2.2 STUDIES RELATED TO VENTILATORY ASSOCIATED PNEUMONIA:

Hina Gadani (2010), conducted the study found that ventilator associated pneumonia (VAP) is a major cause of hospital morbidity and mortality despite recent advances in diagnosis and accuracy of management. The most common organism isolated in our institution was pseudomonas. The incidence of early onset VAP (within 96 hours) was found to be 27% while the late onset type (>96 hours) was 73%. Late–onset VAP had poor prognosis in terms of mortality of patients as compared to the non-VAP group was found to be 41% while that of VAP patients outcome and reduce length of intensive care unit stay and costs. Above all, every one of the critical care unit should understand the factors that the patients must be considered at risk of VAP and utmost importance must be given to prevent VAP.45

Ibrahim, Emad H, Ward, Suzanne, Sherman Glenda, Schaiff and et.al (2001) conducted the study on Experience with a clinical guideline for the treatment of ventilator-associated-pneumonia, in which the main outcome evaluated was the initial administration of adequate antimicrobial treatment as determined by respiratory tract cultures. Secondary outcomes evaluated included the duration of antimicrobial treatment for ventilator associated pneumonia, hospital mortality, intensive care unit and hospital lengths of stay, and the occurrence of a second episode of ventilator-associated pneumonia 50 consecutive patients with ventilator associated pneumonia were evaluated in the before period and 52 consecutive patients with ventilator associated pneumonia were evaluated in the after period. In the conclusion it was found that application of the clinical guideline for the treatment of ventilator associated pneumonia can increase the initial administration of adequate antimicrobial treatment and decrease the overall duration of antibiotic treatment. These findings suggest that similar types of guidelines employing local microbiological data can be used to improve overall antibiotic utilization for the treatment of ventilator associated pneumonia.46

Sedwick MB, Lance-Smith M, Reeder SJ, Nardi J (2012) conducted a study “Using evidence-based Practice to prevent ventilator-associated pneumonia”, the objective of the study was to develop a ventilator bundle & care practices for nurses in critical care units to reduce the rate of ventilator-associated pneumonia, the study concluded that strict adherence to bundled practices for preventing VAP, enhanced accountability for initiating protocols, use of a feedback
system, & interdisciplinary collaboration improved patients outcome& produced marked savings in costs.  

Decreasing VAP: getting on board an article written by Laux L, Herbert C (2006) says that, the prevention of ventilator associated pneumonia has been a quality effort that many organizations across the country have undertaken. Through a multidisciplinary approach, the best practice to prevent VAP for the organization was established. It was identified that through the interventions of securing the patient. Resuscitation bag in one location, maintaining the patients head of bed elevation to more than 30°; if not contraindicated, Yankauer suction tip care, & the use of chlorhexidine mouth rinse, the incidence of VAP had decreased by 43%.  

Conclusion:-

This section deals with the ventilator associated pneumonia infections in patients on ventilator, the critical care unit should be aware of the factors that place the children at risk for VAP and utmost precautions must be taken to prevent VAP. It also emphasizes on antibiotic utilization to treat VAP, the above section also stress on the importance of ventilator bundles, use of protocols, and use of feedback system to improve the patients’ outcome. The knowledge of VAP and its prevention can help the critical care nurse to be competent in her skill and improve the patient outcome.

2.3 STUDIES RELATED TO PROTOCOL IN CARE OF CHILDREN ON VENTILATOR:-

Philippe Jouvet, Patrice Hernert and Marc Wysocki (2011) prepared guidelines on the development and implementation of explicit computerized protocols for mechanical ventilation in children, according to the author mechanical ventilation can be perceived as a treatment with a very narrow therapeutic window, i.e. highly efficient but with considerable side effects if not used properly and in a timely manner. Protocols and guidelines have been designed to make mechanical ventilation safer and protective for the lungs. However, variable effects and low compliance with use of written protocols have been reported repeatedly. Use explicit computerized protocols for mechanical ventilation might very soon become a ‘must’. Several closed loop systems are ready on the market; preliminary studies are showing promising results
Adrienne G. Randolph MD, David Wypij, Shekhar T, Venkaraman, James H. Hanson et.al (2002) conducted a study on effect of mechanical ventilator weaning protocols on respiratory outcomes in infants and children. A randomized controlled trial free study was conducted to evaluate whether weaning protocols superior to standard care (no defined protocols) for infants and children with acute illnesses requiring mechanical ventilator support. The study was conducted in the pediatric intensive care unit, one hundred eighty two spontaneously breathing children (<18 years old) who had been receiving ventilator support for more than 24 hours and who failed a test for extubation readiness in minimal pressure support patients were randomized to pressure support ventilator protocol (n=62), volume support ventilator protocol (n=60), and no protocol (n=60), extubation failure rates were not significantly different for PSV (15%); VSV (24%) and no protocol (17%) (p=.44). In contrast with adult patients, the majority of children are weaned from mechanical ventilator support in 2 days or less. Weaning protocols did not significantly shorten this brief duration of weaning.

A study was conducted on preventing ventilator associated pneumonia in children - an evidence based protocol by Virginia Bonsal Cooper, RN, MS, et.al, (2013), according to the author, pediatric critical care nurses play a vital role in applying VAP prevention strategies and in identifying recommendations for improvement. After collecting data in the PICU, nursing staff can establish a VAP prevention bundle for children. Monthly documentation of hospital acquired infections in collaboration with the infection control department within the PICU and pediatric inpatients unit can keep the entire nursing staff abreast of concern and potential areas improvement. Initiating the use of a VAP prevention bundle provides evidence based alerts to adopt nursing care to prevention whenever a patient is being treated with mechanical ventilation is admitted to or a current patient is intubated in the PICU. Nurses can also be involved in designing studies that truly document the effectiveness of bedside protocols.
Bronagh Blackwood, Maeve Murray, Anthony Chisakuta, Chris R Cardwell, Peter O’Halloran (2013), conducted a study on protocolized versus non-protocolized weaning for reducing the duration of invasive mechanical ventilation in the critically ill pediatric children, to assess the effects of weaning by protocol on invasively ventilated critically ill children. To compare the total duration of invasive mechanical ventilation of critically ill children who are weaned using protocols versus those weaned through usual (non-protocolized) practice. 321 children were analyzed protocolized weaning significantly reduced total ventilation twice in the largest trial (260 children by means of 32 hrs. (95% confidence interval (CI) 8 to 56 p=0.01) two other trials (30 and 31 children, respectively reported non-significant reductions with mean difference of -88 hrs. (95% CI -228 to 52; p=0.2) and -24 hrs. (95% CI -10 to 58; p=0.06). Protocolized weaning significantly reduced, weaning time in those two similar trials for a mean reduction of 106 hrs. (95% CI 28 to 184; p=0.007) and 21 hrs. (95% CI to 32 p<0.001) these studies reported no significant effect for duration of mechanical ventilation before weaning, PICU and hospitalized length of stay PICU mortality or adverse events limited evidence suggests that weaning protocols reduce the duration of mechanical ventilation, but evidence is inadequate to show whether the achievement of shorter ventilation by protocolized weaning causes children benefit or harm. 52

A study conducted by Manias E, Aitken R, Dunning T (2005) on how graduate nurses use protocols to manage patient’s medications, the aim & the objective of the study was as follows: The aim of the study was to determine how graduate nurses use protocols in their graduate nurses use protocol in their medication management activities. The objectives were to examine the extent of adherence to various protocols in relation to medication activities & determine how the ward environment impacts on graduate nurses use of protocols to manage patients medication. A descriptive prospective quantitative design was used, participant observations were conducted with the graduate nurses during 2 hours period when medication was been advised to patient, in depth interview was conducted, the findings revealed 6 theme form the data, availability & use of protocol, scrutinizing patient’s identity before medication administration, double checking certain medication before administration, writing incident reports, following specific polices & timing the administration of medication. The study concludes that the graduate nurses adhered to protocols if they were perceived not to impede with other nursing activities. Participants were also more likely to follow protocols if they felt
encouraged to make their own decisions & if there was a decreased likelihood that disciplinary action would be involved.53

Gerald Plost, MD & Delores Privette Nelson, RN, BSN, (2007) conducted a study on empowering critical care nurses to improve compliance with protocols in the ICU. A baseline compliance range was obtained by using a sampling of 9 protocols for a 100% audit of 35 beds in an adult ICU; nurses were given positive reward to promote an initiative to improve compliance with protocols one month after the initiative was started. Compliance with protocols increased from a range of 62% to 77% to a compliance of almost 90% within 4 months, the compliance rate increased to a mean of more than 95%. 3 years later, the compliance rate was greater than 90% the study concluded that extrinsic rewards improved compliance with protocols & resulted in a change in the culture in the intensive care unit that had a cumulative outcome.54

Conclusion:-

This section deals with the importance of guideline on the development and implementation of protocols for mechanical ventilation in children. It also elaborates on the use of protocol to be used during weaning it also emphasis that nurses should be involved in designing bedside protocols which will be an effective documentation and utilized by nurses positively. These studies helped the investigator in the development of the protocol. The nurses showed interest for having a protocol in the pediatric intensive care unit.

2.4 STUDIES RELATED TO ENTERAL NUTRITION

Hamiton S, McAleer DM, Ariagno K, Baraett M, Stenquist N, Duggan CP, etal (2014) conducted a study on ‘A stepwise enteral nutrition algorithm for critically ill children helps achieve nutrients delivery goals’. The objective of the study was to evaluate the impact of implementing an enteral nutrition algorithm on achieving optimal enteral nutrition delivery in PICU. The sample consisted of the patients admitted to the PICU over 2-4 weeks period pre and post implementation, with a stay of more than 24 hours who received enteral nutrition, the study concluded that the implementation of an enteral nutrition algorithm significantly improved enteral nutrition delivery & decreased reliance on parenteral nutrition in critically ill children.55
Tume L, Latten L, Darbyshire A (2010) conducted an evaluation of enteral feeding practices in critically ill children. The aim of the study was to investigate how actual calorie intake compared with estimated caloric requirements & whether feeding guideline adherence resulted in improved nutritional intake, this study found that many children did not receive adequate nutrition in PICU & that the use of feeding guidelines significantly improved calorie delivery in PICU patients. Therefore the unit should be encouraged to develop their own guidelines based on the best evidence available.56

A study conducted by Mehta NM, McAleer D, Hamilton S, Naples E, Leavitt K, Mitchell P, et.al (2010) on ‘Challenges to optimal enteral nutrition in a multidisciplinary Pediatric Intensive care Unit’. The objective of the study was to describe nutrients intake in the critically ill children, identify risk factors associated with avoidable interruptions to enteral nutrition, & highlight opportunities to improve enteral nutrient delivery in a busy tertiary PICU. The study concluded that enteral nutrition interruption is common & usually avoidable in critically ill children. The knowledge of existing barriers to enteral nutrients such as those identified in this study will allow appropriate interventions to optimize nutrition provision in the PICU.57

Anderson C wrote an article on ‘Enteral feeding: a change in practice’ (2000).According to this article, there is an unacceptably high incidence of malnutrition in PICU. The delivery of nutritional support requires a structured approach. Early enteral feeding has shown to reduce the stress response. Implementing a change in practice involves identification of resources, objectives & motivations for change. A randomized retrospective audit of the change in practice did demonstrate the value of earlier commencement of enteral feeding. Informal interviews with practitioners suggested improved practice & knowledge.58

Tume L, Carter B, Latten L, (2013) conducted a study on ‘A UK & Irish survey of enteral nutrition practices in pediatric intensive care units’.The aim of the study was to describe the present knowledge of health care professions & the practices surrounding enteral feeding in the UK & Irish PICU, a cross-sectional survey was done in all PICU’s. The overall breakdown of professional groups was 59% nursing staff, 27% medical staff, 13% dieticians & 1% physicians’ assistants. Most units (96%) had some written guidance on enteral nutrition; 85% of staff, across all professional groups (p=0.672), thought that guidelines helped to improve energy delivery included: fluid-restrictive polices (60%), the child just been too ill to feed (17%), surgical post-
operative orders (16%) nursing staff being too slow in starting feeds (7%) frequent procedures requiring fasting (7%) & hemodynamic instability (7%). What constituted an ‘acceptable’ level of gastric residual volume varied markedly across respondents, but GRV featured prominently in the decision to both stop enteral nutrition & to determine feed tolerance & was similar for all professional groups there was considerable variation across respondents about which procedures required fasting & the duration of this fasting, the survey had high lightened variability of the present enteral feeding practices across the UK & Ireland, particularly with regards to the use of GRV & fasting for procedures.59

Conclusion:-

This section deals with the importance of having enteral nutrition algorithm which significantly improved enteral nutrition delivery and decreased reliance on parental nutrition in critically ill children. It also emphasized that the PICU unit must have a feeding guidelines to improve the outcome of the children it also showed that early feeding had reduced the stress response.

2.5 STUDIES RELATED TO ENDOTRACHEAL SUCTIONING

Assessment of pain during endotracheal suction in the pediatric intensive care unit was conducted by SonmezDuzlayer&Kuguoglu (2014). It was a two-level definitive & comparative study to evaluate pain during endotracheal suction (ETS) in PICU. Routine ETS was applied as the first level of the study. For the second level, an inquiry on the knowledge of nurses about suction was given to the nurses, & they were asked to apply suction according to the guidelines they were given. Patients who received bolus dose of analgesia & sedative drugs had lower Wong-Baker faces pain rating (4.38+- 0.96; n=4) & face, leg, activity, cry, consolability scores (4.61+-1.94; n=4) (p>0.05). According to these findings, the patients were distressed because of the pain related with suction. Therefore, it is recommended that suction guidelines be used in PICU’s during ETS. 60

Celik SS, ElbasNO (2000) conducted a study on ‘The standard of suction for patients undergoing endotracheal intubation’. The purpose of the study was to determine whether using a standard method of endotracheal suctioning to ensure consistent use of available knowledge had any impact on patient care. The researcher used experimental study design. The result of the two
different methods of suctioning in cardio-vascular surgery intensive care unit was compared. One method was suctioning procedure applied by the nurses working in the ICU, the other one, standard suctioning procedure development based on the related literature & applied to the . The difference between the two methods were statistically significant (p<0.05).  

Swartz K, Noonan DM, Edward-Beckett J, (1996) conducted a survey of endotracheal suctioning technique in the pediatric population, to examine the current suctioning practices nationally of experienced PICU nurses. A written survey method was used for this descriptive study. Staff nurses with more than 3 years’ experience were included in the study. The findings showed that a wide range of suctioning technique was used. Most respondents reported hyper oxygenation, hyperventilation, & for hyperinflation of the patients respiratory system before suctioning. Nursing judgment & the patients’ clinical condition were used to determine when a suctioning procedure was needed. Most respondents (71%) indicated inserting the suction catheter until resistance was met. Normal saline solution irrigant was used by all. A manual resuscitation bag was used routinely during suctioning. 80% of the respondents reported that few patients displayed an adverse response to the suctioning procedure. 

A study conducted by Kylie Davies (2008) on ‘Determining Standard Criteria for Endotracheal suctioning in the Pediatric Intensive Care patients’. It was an exploratory and a four phase study which used both qualitative and quantitative methodological approaches. In phase one a comprehensive literature review was performed to determine the most commonly used criteria for assessing the need for endotracheal tube suction. It was analyzed using descriptive statistics: Spearman rank order correlation coefficient. This phase concluded that ETT suction should only be performed based on the clinical conduction and requirements of the individual patients, rather than standardized unit protocol or guidelines. In phase 4 the empirical evidence generated from this study was used to develop an endotracheal suction assessment tool (ESAT). The findings of this study contribute to PICU nursing theory and practice. Practice implications focus on the need for individualized assessment of the need for ETT suction according to patients’ clinical condition.
Conclusion:-

This section highlighted and recommended that there must be suction guidelines in PICU during endotracheal tube suctioning in order to prevent pain while suctioning. It also emphasized that there must be a standard method for endotracheal tube suctioning. Nursing judgment and patients’ clinical condition must be used to determine when a suctioning procedure is needed. There are studies which emphasized that ETT suctioning should be performed based on the clinical condition and requirements of the individual patients rather than on standardized unit protocol or guidelines. It stressed on the need for ETT suctioning according to patients clinical condition.

2.6 STUDIES RELATED TO ORAL HYGIENE FOR PATIENTS ON VENTILATOR

QuX, Xie H, Zhang Q, Zhou X, Shi Z, (2014) conducted a survey on oral care practices for ventilator – assisted patients in intensive care units in 3A hospitals of Mainland China, The objective of the study was to explore the current status of oral care practices, attitudes, education & knowledge among intensive care unit (ICU) nurses care for ventilator-assisted patients. The tool used was Self-assisted Questionnaire. It was identified that the most common oral care methods were foam swabs & mouth rinse containing antibiotics or disinfectants. Although the majority of ICU’s provided continuing training for oral care, most of the training was conducted by head nurses. The content & scope of training were not consistent among the hospitals in the study; therefore it was clear that evidence – based oral care standard manual was urgently needed for oral practice in ICU’s in Mainland China. 64

Oral hygiene care in the pediatric intensive care unit: practice recommendations by Johnstone L, Spence D, Koziol-MacClain J (2010).It was identified that oral hygiene significantly affected children’s well-being. It was an integral part of intensive & critical care nursing because intubated & ventilated children in the PICU are dependent on the health care team to tend to their everyday basic needs. This research highlighted the relationship between poor oral hygiene in the intensive care unit & an increase in dental plaque accumulation, bacterial colonization of the oropharynx, & higher nosocomial infection rates, particularly ventilator associated pneumonia. Therefore it is understood that children in the PICU need their
masks regularly be assessed & cleaned. Maintaining consistent, regular, & standardized oral hygiene practices in the PICU will also set examples for children & their families, encouraging & teaching them about the life-long importance of oral hygiene.65

Zongdao Shi, Huixu Xie, Ping Wang, Qi Zhang, Yan Wu, E Chen, et.al (2013) conducted a study on oral hygiene care for critically ill patients to prevent ventilator associated pneumonia, to assess the effects of oral hygiene care on the incidence of VAP in critically ill patients receiving mechanical ventilation in intensive care units in hospitals. According to the author effective oral hygiene care is important for ventilated patients in intensive care. OHC that includes either chlorhexidine mouthwash or gel is associated with 40% reduction in the odds of developing ventilator associated pneumonia in critically ill adults. However, there is no evidence of a difference in the outcomes of mortality, duration of mechanical ventilation or duration of ICU stay. There is no evidence that OHC including CHX and tooth brushing is different from OHC with CHX alone. Proviodone iodine mouth rinse is more effective than saline in reducing VAP. There is insufficient evidence to determine whether powered tooth brushing or other oral care solutions are effective in reducing VAP.66

A study by Mohsen Adib-Hajbaghery, Akram Ansari & Ismail Azizi-Fini, (2013) conducted a study on ‘Intensive care nurses’ opinions and practice for oral care of mechanically ventilated patients’. This study was cross sectional which was conducted on 130 intensive care nurses. They found that more than 21% of subjects did not perform oral care in their visual duties. It was found that high load of writing tasks and personnel shortages were the major barriers to oral care, only 20% of the patients’ charts contained a report on oral care. Therefore the above study concluded that nurses did not consider oral care in intensive care patients as a high priority. This result highlights the need to continue education programs on oral care for improving the knowledge and attitude of intensive care nurses with respect to oral care.67

Conclusion:-

This section helped to know that it was important to have oral care standard manual in order to have uniformity in the practice, it also highlighted that oral hygiene was an integral part of intensive/critical care nursing because intubated and ventilated children in PICU dependent on the health care team to met their basic needs. There was a need to continue education program on
oral care for improving the knowledge and attitude of intensive care nurses with respect to oral care.

2.7 STUDIES RELATED TO CARE OF INVASIVE LINES

McKee C, Berkowitz I, Cosgrove SE, Brandley K, Beers C, Perl TM, et.al (2008) conducted a study on ‘Reduction of catheter associated blood stream infection in pediatric patients experimentation & reality’. The objective of the study was to eradicate catheter associated blood stream infection, with a multifaceted pediatric relevant intervention proven effective in adult patients. The design used for the study was prospective cohort. The study concluded that improving practices for insertion of central catheters leads to a reduction of CA-BSI among pediatric patients, but not elimination of CA-BSI. Therefore more research is needed to identify best practices for maintenance of central catheters for children.68

An article written by Smith M on, ‘A care bundle for management of central venous catheter’ (2004) states that CVC’s are an essential tool in pediatric intensive care, providing a mean to monitor patients hemodynamic & to administer fluids, nutrition, blood products & medications. Because multiple factors constitute to the high risk of catheter related infection, a multi-strategy approach is required to prevent such infections. Using contemporary literature & clinical audit findings a ‘Care bundle’ was created for use within the PICU at Birmingham Children hospital. This care bundle group’s together best practices in order to prevent catheter related blood stream infection.69

Ahmed SS, Mccaskey MS, Bringman S, Eigen H (2012), conducted a study on catheter-associated bloodstream infection in the pediatric intensive care unit. A multidisciplinary approach the objective of the study was to decrease the pediatric intensive care unit rate of catheter-associated bloodstream infections, became a high priority for all the intensive care unit team affiliated with central venous catheter insertion and maintenance. A multidisciplinary approach towards insertion & maintenances bundles & collaboration among pediatric intensive care unit physicians & nurses in all aspects of central catheter care was used in this study. The findings revealed that statistically significant interventions included improvements to central venous catheter insertion practices the development of a dedicated central catheter team, & regular collaborative discussion of central venous catheter necessity.70
‘Evaluating central venous catheter care in a pediatric intensive care unit’ (2009) this study conducted by Halter C, Buckwald L, Salas-Allison Z, Murphy-Taylor C. The objective of the study was to describe the extent of evidence-based practices for care of insertion sites of central venous catheters in the pediatric intensive care unit of an urban tertiary care center, & the other goal was to determine the influence of two different regimens for dressing changes on rates of catheter-related bloodstream infections & costs. A convenience sample & an exploratory design were used to collect data during which patients received dressing care for a central venous catheter with a transparent dressing plus a chlorhexidine-impregnated dressing. The findings revealed that there were few differences found between the transparent dressing alone & a chlorhexidine-impregnated dressing finding was the number of times that central catheters were accessed daily. Therefore the result of the project suggested that infection control efforts may be most appropriately focused on the processes rather than on products. 71

A study conducted by Costello JM, Morrow DF, Graham DA, Potter-Bynoe G, Sandora TJ, Laussen PC (2008) conducted a study on Systematic intervention to reduce central line-associated bloodstream infection rates in a Pediatric Intensive care Unit. The objective of the study was to determine whether an intervention involving staff education, increased awareness, & practice change would decrease central line-associated bloodstream infection rates in a pediatric cardiac intensive care unit. A retrospective, interventional study using an interrupted time-series design was used to compare central line-associated bloodstream infection rates during 3 time periods for all patients admitted to the pediatric cardiac ICU. The findings suggested that the estimated mean pre-intervention central line-associated bloodstream infection rate was 7.8 infections/1000 catheter-days which decreased to 4.7 infections/1000 catheter-days in the partial intervention period & 2.3 infections/1000 catheter-days in the full intervention period. The study conducted that a multidisciplinary, evidence-based initiative resulted in a significant reduction in central line associated bloodstream infections in the pediatric cardiac ICU. 72

nurses reported hand washing practices & the local policies, & patterns in duration of procedural hand washing for specific procedures. The study found an enormous level of variation among & between nurses reported practices & local policies. This variation extended across all aspects of hand washing practices-duration & extent of hand wash, type of solution & drying method used. The rigor of hand washing varied according to the procedure undertaken, with some evidence that nurse made their own risk assessment based on the proximity of the procedure to the patient. In conclusion the study findings substantiate the need for standardization of practice in line with the current centers for disease control & prevention guidelines including the introduction of alcohol swabs.  

**Conclusion:-**

This section helped to know that there was a need to have “care bundle” in order to prevent catheter related blood steam infection. To prevent this there was an emphasis on central line catheter care to prevent infection and also stress on the importance of hand washing before and after the procedure.

### 2.8 STUDIES RELATED TO ARTERIAL BLOOD GAS ANALYSIS:-

Schneiderman J, Corbridge S, Zerwic JJ (2009), conducted a study on ‘Demonstrating the effectiveness of an online, computer based learning module for arterial blood gas analysis. The objective of the study was to determine the effectiveness of computer based learning module specific to ABG interpretation. A pre-test & posttest design was used to assess staff nurses ability to interpret ABG’s before & after engaging in computer based module. The findings revealed that staff nurses’ knowledge increased significantly after viewing the computer-based learning module (+=6.3;p<.001). This study concluded that computer based, online learning has emerged as a means of providing continuing education to nurses. Such a teaching strategy helps to overcome barriers pertinent to traditional class-room settings.

Local anesthesia in arterial puncture: nurse’s knowledge & attitude, (2008) this study was conducted by Valero Marco AV, Martinez Castello C, MaciaSoler L. The objective of the study was to examine attitudes & beliefs among nurses & 3rd year undergraduate nursing
students in hospital training regarding the use of local anesthesia when performing puncture & to assess their knowledge of the technique. The tool used for this study was 15 item questionnaires consisting of 2 parts. The first part contains questions on the nurses’ use of local anesthesia while extracting arterial blood for analysis & the second part involved questions regarding technical knowledge of this test. The study findings concluded that local anesthesia is used very little in arterial puncture; knowledge about how to perform arterial blood extraction for blood gas analysis is insufficient & needs to be improved among both nurses & nursing students.75

Salam A, Smina M, Gada P, Tilluckdharry L, Upadya A, Amoatency-Adjepong Y, etal (2003) conducted a study on the effect of arterial blood gas values on extubation decisions. The objective of the study was to determine how often ABG values change extubation decisions. The findings of the data suggest that ABG values did not change extubation decision in 93% of cases. However it was found that in 7 cases the ABG values changed the extubation decision few of the cases failed extubation. It was identified that without the knowledge of the ABG values, the increased patient risk & cost associated with failed extubation would more than offset the relatively small cost of collecting ABG values from all patients who undergo spontaneous breathing trials.76

Using an algorithm to interpret arterial blood gasses (2000) an article by Shoulders Odom B, says that the ABG analysis is one of the most common tests ordered, provides clinicians with valuable information’s on a patients oxygenation & acid-base balance. Interpreting ABG analysis results can be challenging, even for the most experienced practitioners, because it requires knowledge & the physiology & cause-and effect relationship of the disturbances. Applying the principles & the ABG algorithm will provide nurses with a systematic way to interpret uncomplicated arterial blood gas results including primary, mixed, & compensated acid base disturbances.77

Simpson H (2004) in his article on interpretation of arterial blood gases: a clinical guide for nurses enlightens that, arterial blood gas analysis has become an essential skill for all health care practitioners. It provides important information with regards to adequacy of ventilation, oxygen delivery to the tissues & acid-base balance. Although each patient clinical presentation will be judged individually, situations that warrant analysis of a blood gas sample include respiratory comprise, post cardiorespiratory arrest, evaluation of intervention such as oxygen
therapy, respiratory support & as a baseline before surgery. This article reviews the different parameters that are measured by various machines, with a focus on basic measurement of arterial blood gases. This include partial pressure of carbon dioxide in arterial blood (PaCo2), partial pressure of oxygen PaO2) bicarbonate levels (HCO3) in the arterial blood & base excess/deficit. The physiology of acid base balance is reviewed & the causes & presentation of the four acid-base disturbances is described. A systematic method to acid arterial blood interpretation is identified, together with discussion regarding the importance of interpreting PaO2 readings relation to the amount of inspired O2 a patient is receiving FiO2, the practice of temperate correction & the relationship between standardized & actual bicarbonate readings.78

**Conclusion:-**

This section helped to know that there must be provision for nurses to learn about the arterial blood gas interpretation, a learning module must be developed if they develop a ABG algorithm this will provide nurses with a systematic way to interpret uncomplicated arterial blood gas results.

2.9 **STUDIES RELATED TO WEANING AND EXTUBATION FROM MECHANICAL VENTILATION:-**

Boegner E (1990) wrote an article on ‘Modes of ventilatory support & weaning parameters in children. According to him pediatric respiratory therapy management has become increasingly complex; mechanical ventilation has become a main stay in neonatal & pediatric intensive care units. Thorough knowledge of the modes of ventilatory support & criteria for weaning are essential for the critical care nurse to anticipate patient needs. Ventilatory support is initiated when a patient exhibits respiratory failure. Indications for mechanical ventilation in children include marked hypoxia, hypercapnea, peripheral airway obstructions, chest wall deformities & central nervous system abnormalities. Nurses caring for these children must possess adequate knowledge of the underlying disease process as well as normal respiratory physiology & technical features of ventilation. Nursing strategies can then be directed towards weaning children from the mechanical ventilatory support.79

The aim of the study was to explore variability in perceptions of nurse managers & physician directors regarding roles, responsibilities & clinical-decision making related to mechanical ventilator weaning in Norwegian intensive care units. Respondents agreed that nurse collaborated in assessment of patient response to ventilator changes & titrating ventilator setting. Both groups acknowledged the importance of knowing the patient for weaning success, & agreed that the assessment of work of breathing, well-being, clinical deterioration were important for determining weaning tolerance, therefore the study conducted that nurse managers perceived nurse to have greater autonomy, influence & collaborative interaction regarding decisions on mechanical ventilation than physician directors, greater awareness & acknowledgement of nurses’ role may promote inter-professional collaboration patient care.\textsuperscript{80}

Crocker C, Scholes J (2010), conducted a study on weaning from ventilation needs to be tailored to individual patients & involve them. The aim of the study was to improve understanding of how nurses use technology to wean patients from mechanical ventilation. An ethnographic approach was adopted to understand how nurses used technology to wean patients from ventilation. The study concluded that participants implied during interviews that ‘knowing the patient’ was essential to delivery patient centered care. The two main factors are necessary for nurses to know their patients continuity of care & expertise. Way of knowing relied on gaining information about patients & their roles as passive recipients of treatment. Therefore through the study it is understood that staff allocation systems should enable them to learn from experienced nurses, while work schedules should be organized to ensure nurses begin defined as a characteristic of experts nursing. To be truly patient centered, nurses need to address the barriers that prevent them from getting to ‘know’ patients.\textsuperscript{81}

Eckerblad J, Eriksson H, Karner A, Edell-Gustafsson U, (2009) conducted a study on ‘Nurses conceptions of facilitative strategies of weaning patients from mechanical ventilation a phenomenographic study’. The purpose of the study was to describe different conceptions of nurses facilitating decision-making strategies regarding weaning patients from mechanical ventilations cared for intensive care units. The findings of the study revealed three main categories of nurses pre-understanding. ‘The instrumental strategy’ involved analysis & assessment of technological & physiological parameters. The cooperative strategy was characterized by interpersonal relationships in work situation. Absences of common strategies
were lack of understanding of others strategies were a source of frustration. The main goals were to end mechanical ventilator support, create a sense of security, & avoid further complications. Therefore the study concluded that nurses’ variable uses of individual strategies are more likely to complicate an efficient & safe weaning process of the patients from mechanical ventilation.\textsuperscript{82}

Ferguson LP, Walsh BK, et.al (2011), conducted a study on A spontaneous breathing trial with pressure support overestimates readiness for extubation in children. This study is a retrospective chart view, all infants and children admitted to the PICU unit requiring intubation were eligible for this study, A spontaneous breathing trial using pressure support set at higher levels for smaller endotracheal tubes overestimates readiness for extubation in children and contributes to a higher failed extubation rate. The objective data obtaining during an extubation readiness test may help to identify patients who will benefit from extubation to non-invasive ventilation.\textsuperscript{83}

Louise Rose, Marcus J Schultz, et.al, (2012), conducted a study on Automated versus non-automated weaning for reducing the duration of mechanical ventilation for critically ill adults and children pooled data from 15 eligible trails (14 adults 1 pediatric) totaling 1173 participants (1143 adults, 30 children) indicated that automated closed loop system reduced the geometric mean duration of weaning by 32% therefore automated closed loop systems may result in reduced duration of weaning, ventilation, and ICU stay. Reductions are likelier to occur in mixed or medical ICU populations. Due to the lack of, or limited, evidence on automated systems other than Smart Care/PS and adaptive support ventilation no conclusions can be drawn regarding their influence on these outcomes. Due to substantial heterogeneity in trials there is a need for an adequately powered. High quality, multi Centre randomized controlled trial in adults that excludes simple to wean patients. There is a pressing need for further technological development and research in the pediatric population.\textsuperscript{84}

Ingrid Egerod (2003) conducted a descriptive comparative study of nurses decisions and interventions related to mechanical ventilator weaning the research design was qualitative as well as quantitative method. The study had an instrumental multiple case multi-center designs with triangulation of methods and sources. The findings were reported in relation to the context, the case, that the conditions and circumstances for nurses were similar on a formal level, while local variations exist in relation to physical layout, patients categories, personnel categories,
staffing ratios, patients assignment practices, meeting practices, mechanical ventilation equipment. Nurses lack formal competencies in relation to mechanical ventilation, and the formal competencies do not increase as the qualifications increases informal competencies increase with experience. Therefore it says that critical care education for nurses is not mandatory, reward rather than a pre-requisite for work in critical care.\textsuperscript{85}

**Conclusion:**

This section helped to know that it is important for the nurses to have knowledge regarding underlying disease process and normal respiratory physiology to improve the weaning procedure in children from the mechanical ventilator.

\textbf{2.10 STUDIES RELATED TO KNOWLEDGE OF NURSES IN PEDIATRIC INTENSIVE CARE UNIT}

A study was conducted by Long DA, Young J, Rickard CM, Mitchell ML, (2013) on ‘Analyzing the role of the PICU nurse to guide education of new graduate nurses’ a practice analysis is survey of 15 nurse educators was conducted in all 8 Australian & New-Zealand PICU during 2008. Three areas of practice essential to PICU nursing competence were explored: patients most commonly cared for; frequency critically of activities performed; & level of independence again critical care nursing competency standards; the study concluded that PICU nurses are performing activities & caring for a breadth of complex patients with in a year of entering the workforce using a practice & expectations can assist in the identification & prioritization of content for graduate & other educational programs.\textsuperscript{86}

Sorce L, Simone S, Madden M, (2010) conducted a study on ‘Educational preparation & postgraduate training curriculum for pediatric critical care nurse practitioners. The objective of the study was describe the current educational preparation & scope of practice of pediatric nurse practitioners & provide guidelines for post-graduate training to successfully integrate NPs into the PICU. A group of NP’s practicing in pediatric critical care recognized the imminent need for comprehensive orientation guidelines that are readily accessible to physicians & other nurse practitioners to successfully transition entry level NP in to the PICU. Therefore it was identified
that a PICU orientation model for entry-level pediatric critical care nurse practitioners was developed.  

Reflections on student nurse placements in the PICU, an article written by Cochrane J, Heron A, Lawlor K (2008). According to them student placements in the PICU have a number of benefits including the recruitment of staff to this specialty students learning of important observational skills & reinforcing the knowledge & skills of existing staff. However, the combination of critically ill children & large amounts of complex equipment can be daunting for the student nurse commencing a clinical placement in PICU. Careful induction, ongoing mentoring & opportunities to explore issues help to overcome students’ fears of being unable to cope, & support the application of theory to practice in this challenging environment.

Fatima H Abbas & Eqbal G Mua’ala, (2013) conducted a study on ‘Impact of education program upon nurses knowledge towards children’s under mechanical ventilation at pediatric teaching hospital in Baghdad city’. The objective of the study was to find the impact of the education program for nurses’ knowledge towards children under mechanical ventilation, and to find out the relationship between nurses knowledge & their general information. A quasi-experimental study was conducted, with the help of purposive sampling technique, a 23 sample nurses working in respiratory care units were selected from children welfare & pediatric central teaching hospitals. The finding of the study indicated that nurses have moderate knowledge in pre-test. But posttest evaluation revealed high level of knowledge among nurses at RCU towards children under mechanical ventilation. The program reflects an effect on knowledge. There was no statistical significant associated between nurses’ knowledge & their general information. The study recommended that great focusing should be directed towards the educational aspects at respiratory care units by providing educational posters, guidelines, pamphlets & manuals to enhance nurses’ knowledge at RCU.

Conclusion:-

This section emphasized on the importance of PICU nurses to have additional education program inform of continues nursing education program to improve their knowledge on patient care, there must be an ongoing induction program and mentoring of the nurses working in PICU.
SUMMARY:

The total numbers of studies reviewed were 200 out of which 53 studies were relevant to the topic.

This chapter deals with studies related to the Knowledge and practices of nurses regarding care of children on ventilator. All the above stated studies done in different countries show various aspects related to procedures in caring those children requiring ventilator support.

Thus from the above literature and studies it was concluded that nurses are responsible person in caring the children on ventilator. It is also essential for the nurses to be knowledgeable to understand the various cases getting admitted in the PICU. With proper care and responsibility they can prevent infection and help in early recovery of patients. It is important for a nurse to be knowledgeable and skillful in all the procedures which are commonly done for the patients on ventilator.

The main aim of conducting the review of literature was to identify what was already known about the topic, to develop the study framework, to plan the study methodology, to develop a strong knowledge base regarding the knowledge & practices of nurses on care of children on ventilator & the influence of any socio demographic variable on the knowledge & practice of the nurses.