CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

2.1.1 This chapter deals with selected studies which were related to the objectives of the proposed study. Review of literature is a key step in research process.

Review of Literature is done under following sections:

- Cardio Pulmonary Resuscitation Training
- Importance of Cardio Pulmonary Resuscitation
- Knowledge of Nurses regarding Cardio Pulmonary Resuscitation
- Effectiveness of training on Cardio Pulmonary Resuscitation
- Studies related to training of nurses

Literature related to Cardio Pulmonary Resuscitation Training

2.2 A study on ‘impact of advanced cardiac life support training program on the outcome of cardiopulmonary resuscitation in a tertiary care hospital was conducted by Kanwalpreet Sodhi, Manender Kumar Singla with an aim to evaluate the impact of the American Heart Association (AHA) certified Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS) provider course on the outcomes of CPR in their hospital.

2.2.1 Authors have provided AHA certified BLS and ACLS provider training programme in their hospital in the first week of October 2009, in which all doctors in the code blue team from Intensive Care Units were given training. The retrospective study was performed over a period of 18-months. All in-hospital adult cardiac arrest victims in the pre-BLS/ACLS training period (January, 2009 to September, 2009) and the post-
BLS/ACLS training period (October, 2009 to June 2010) were included in the study. They compared the outcomes of CPR between these two study periods.

2.2.2 There were a total of 627 in-hospital cardiac arrests, 284 during the pre-BLS/ACLS training period and 343 during the post-BLS/ACLS training period. In the pre-BLS/ACLS training period, 52 patients (18.3%) had return of spontaneous circulation, compared with 97 patients (28.3%) in the post-BLS/ACLS training period (p<0.005). Survival to hospital discharge was also significantly higher in the post-BLS/ACLS training period i.e 67 patients (69.1%) than in the pre-BLS/ACLS training period i.e 12 patients (23.%) (p<0.0001).

2.2.3 The authors concluded that formal certified BLS and ACLS training of healthcare professionals leads to definite improvement in the outcome of CPR. The study with 627 sample size provided adequate plan to work on the study by the present researcher.

2.3 A study was conducted by Dine CJ, Gersh RE, Leary M, et al 45 on improving CPR quality & resuscitation training by combining audio visual feedback and debriefing with an objective ‘delivery of high-quality cardiopulmonary resuscitation increases survival from cardiac arrest’, yet studies have shown that cardiopulmonary resuscitation quality is often poor. Furthermore, authors have hypothesized that a multimodal training method comprising of audiovisual feedback and immediate debriefing would improve cardiopulmonary resuscitation performance.

2.3.1 The prospective randomized interventional study was conducted in simulated cardiac arrests at an academic medical center on a total of 80 nurses who were randomized in two groups.

2.3.2 Intervention for each group who underwent three trials of simulated cardiac arrest. The ‘Feedback group’ received real-time audiovisual feedback during the second and third trials, whereas the ‘Debriefing-only group’ performed cardiopulmonary resuscitation without feedback. Both groups received short individual debriefings after the second trial.45
2.3.3 Cardiopulmonary resuscitation quality was recorded using a cardiopulmonary resuscitation-sensing defibrillator that measured chest compression rate/depth and could deliver audiovisual feedback messages for both groups during the three trials. An adequate compression rate was defined as 90 to 110 compressions / minute and an adequate depth as 38 to 51 mm.

2.3.4 The results were only in the debriefing group, the percentage of participants providing compressions of adequate depth increased after debriefing from 38% to 68% (p = 0.015). In the feedback group, depth compliance improved from 19% to 58% (p = 0.002). Compression rate did not improve significantly with either intervention alone. The combination of feedback and debriefing improved compression rate compliance from 45% to 84% (p = 0.001) and resulted in a doubling of participants providing compressions of adequate rate and depth, 29% vs. 64% (p = 0.005).

2.3.5 In conclusion, the authors have found that significant cardiopulmonary resuscitation quality deficits exist among healthcare providers. Debriefing or feedback alone improved cardiopulmonary resuscitation quality, but the combination led to marked performance improvements. Cardiopulmonary resuscitation feedback and debriefing may serve as a powerful tool to improve rescuer training and care for cardiac arrest patients.

2.3.6 Authors have commented that they have learnt from the last five years of resuscitation research that good CPR and prompt defibrillation are the two critically important treatments to improve the likelihood of survival for victims of sudden cardiac arrest. They have also commented that from the last 30 years of research that the current methods of CPR training are seriously deficient, and that the consequence is that inadequate CPR is being performed—meaning patients are less likely to survive.

2.3.7 It is widely believed that CPR is a relatively simple skill to learn. But the overwhelming majority of studies have documented that both laypersons and healthcare providers learn CPR poorly and forget it rapidly, with little to none of the skills retained after 6 to 12 months. And, despite changes in training methods such as the use of video-based
instruction, training remains largely ineffective. Studies continue to point out that CPR is performed poorly, with inadequate compressions and ventilations and long pauses in compressions. The fact is that health care professionals have not properly learnt how to perform effective CPR, and EMS patients get poorer care as a result.

2.3.8 This study was attempted to find a solution for this widespread deficiency. The authors showed that healthcare professionals could perform much better CPR after a brief Manikin training session that combined immediate visual feedback on the adequacy of each chest compression followed by a five-minute counseling/debriefing session.

2.3.9 Generations of healthcare providers have been poorly trained by listening to lectures, practicing without adequate feedback, and being tested by observers who couldn't accurately measure rate, depth or full chest recoil. Authors feel that they have accepted this as adequate, but it is not. EMS systems should look at increasing their focus and upgrading their CPR training and measure the improvement in patient survival that results.  

Literature related to Importance of Cardio Pulmonary Resuscitation

2.4 According to ‘Heart and Stroke Foundation of Canada’ (HSFC) there are about 35,000 – 40,000 deaths in Canada due to cardiac arrest. The HSFC expects that up to 30% of these victims of sudden cardiac arrest could be saved if Cardiopulmonary Resuscitation is performed and performed early.

2.4.1 This emphasizes the importance of training in resuscitation skills.

2.4.2 To bring down the incidence of heart disease by year-end, i.e. 2012, Cardiological Society of India, Karnataka, intended to screen, 10,000 Rotarians across the state. The deaths due to coronary artery disease in the age group of 30 to 65 years had jumped up to 23 percent.  

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A study was conducted on ‘Quality of cardio-pulmonary resuscitation (CPR) during paediatric resuscitation training: time to stop the blind leading the blind’ by Arshid M, Lo TY, Reynolds F. Recent evidence suggested that the quality of CPR during adult advanced life support training was suboptimal. The study aimed to assess the CPR quality of a paediatric resuscitation training programme and to determine whether it was sufficiently addressed by the trainee team leaders during training.

2.5.1 CPR quality of 20 consecutive resuscitation scenario training sessions was audited prospectively using a pre-designed proforma. A Consultant Intensivist and a senior nurse, who were also Advanced Paediatric Life Support (APLS) instructors, assessed the CPR quality which included ventilation frequency, chest compression rate and depth, and any unnecessary interruption in chest compressions. Team leaders' response to CPR quality and elective change of compression rescuer during training were also recorded.

2.5.2 The results showed that airway patency was not assessed in 13 sessions while ventilation rate was too fast in 18 sessions. Target compression rate was not achieved in only one session. The median chest compression rate was 115 beats/min. Chest compressions were too shallow in 10 sessions and were interrupted unnecessarily in 13 sessions. More than 50% of training sessions did not have elective change of the compression rescuer. 19 team leaders failed to address CPR quality during training despite all team leaders being certified APLS providers.

2.5.3 In conclusion the quality of CPR performance was suboptimal during paediatric resuscitation training and team leaders-in-training had little awareness of this inadequacy. Detailed CPR quality assessment and feedback should be integrated into paediatric resuscitation training to ensure optimal performance in real life resuscitations.

2.6 A study was conducted on ‘Adult Basic Life Support’ by Sarin H, Kapoor D. The MONICA (multinational monitoring of trends and determinants in cardiovascular disease) Project set up by the World Health Organization evaluated deaths from coronary artery disease in the age group of 35-64 years. According to its findings, one third of people who developed myocardial infarction, died before reaching hospital.
Ventricular Fibrillation (VF) and pulseless ventricular tachycardia (VT) accounts for 40 to 50% of all out-of-hospital cardiac arrests.

2.6.1 Cardio respiratory arrest in hospitalized patients is not a sudden unpredictable event. A few hours before cardiac arrest, clinical signs of deterioration occur in approximately 80% of the cases. The most common abnormalities are shortness of breath, an increase in respiratory rate, fall in oxygen saturation, fall in arterial oxygen tension, acidosis, increase in heart rate, and fall in cardiac output and urine output < 30 ml/hr. Patients tend to be cold, clammy, confused, lethargic, or there may be a fall in the level of consciousness. Therefore it is important to recognize these signs as early identification, and intervention decreases the likelihood of cardiac arrest.

2.6.2 After ensuring his own and the victim's safety, the rescuer should check the victim and see if he responds. This can be done by gently shaking the shoulders and asking loudly whether he is all right or not. If the victim responds, he should be left in the same position and the rescuer should get help if needed. The AHA guidelines state that if the victim is unresponsive, a lone rescuer should first call the national ambulance number and then open the airway and check for breathing. In case there are two rescuers, one of them should leave and call the national ambulance number. However, the International Liaison Committee on Resuscitation (ILCOR) and European Resuscitation Council (ERC) guidelines state that if there is no response, the rescuer should only shout for help and call for an ambulance after checking the victim's breathing.48

2.7 A study was conducted on ‘Chest Compression Fraction Determines Survival in Patients with Out-of-Hospital Ventricular Fibrillation’ by Jim Christenson, Douglas Andrusiek, Siobhan Everson-Stewart, et al.49

2.7.1 Quality cardiopulmonary resuscitation contributes to cardiac arrest survival. The proportion of time in which chest compressions are performed in each minute of cardiopulmonary resuscitation is an important modifiable aspect of quality cardiopulmonary resuscitation. It was sought to estimate the effect of an increasing proportion of time spent performing chest compressions during cardiac arrest on
survival to hospital discharge in patients with out-of-hospital ventricular fibrillation or pulseless ventricular tachycardia.\textsuperscript{49}

2.7.2 This is a prospective observational cohort study of adult patients from the Resuscitation Outcomes Consortium Cardiac Arrest Epistry with confirmed ventricular fibrillation or ventricular tachycardia, no defibrillation before emergency medical services arrival, electronically recorded cardiopulmonary resuscitation before the first shock, and a confirmed outcome. Patients were followed up to discharge from the hospital or death. Of the 506 cases, the mean age was 64 years, 80\% were male, 71\% were witnessed by a bystander, 51\% received bystander cardiopulmonary resuscitation, 34\% occurred in a public location, and 23\% survived. After adjustment for age, gender, location, bystander cardiopulmonary resuscitation, bystander witness status, and response time, the odds ratios of surviving to hospital discharge in the 2 highest categories of chest compression fraction compared with the reference category were 3.01 (95\% confidence interval 1.37 to 6.58) and 2.33 (95\% confidence interval 0.96 to 5.63). The estimated adjusted linear effect on odds ratio of survival for a 10\% change in chest compression fraction was 1.11 (95\% confidence interval 1.01 to 1.21).\textsuperscript{49}

2.7.3 Authors concluded that an increased chest compression fraction is independently predictive of better survival in patients who experience a pre-hospital ventricular fibrillation/tachycardia cardiac arrest.

2.8 A research was conducted on ‘Awareness about BLS among medical students: status and requirements’ by Zaheer H, Haque Z.\textsuperscript{50} Authors conducted the research with an objective to study the awareness on Basic Life Support (BLS), CPR in undergraduate medical students. A cross sectional study was conducted by using responses to a questionnaire regarding BLS by 61 students. The results were analyzed with SPSS version 11.101.

2.8.1 Out of 61 students only 9 (14.7\%) had taken a BLS (CPR) course while 52 (85.3\%) students had not attended any such course. Significantly more number of students had the theoretical knowledge about BLS (76.07\% vs 49.18\%, p<0.00). Practical knowledge about BLS was scored as having no, some and complete knowledge of the course. Of all
the students, 57.3% had no knowledge, among those 34% had heard BLS from somewhere, 22.9% had some knowledge, out of which 50% had heard about it. Significantly less number of students had complete knowledge about BLS (4% p<0.05). Among the students who had taken the course, 22% had complete knowledge (p<0.05). Significantly less number of students knew about the skills for BLS (21% p<0.05).

2.8.2 It was concluded that most of the medical students although had not attended the course, still they had some knowledge about BLS. Inclusion of this course in the undergraduate curriculum will increase awareness and application of this valuable life saving maneuver.50

2.9 A study was conducted on ‘Compressions-only CPR may be best’ by BJ Cardio staff.51 The meta-analysis included three studies that randomized patients to receive one of the two CPR techniques according to dispatcher instructions. This showed that chest-compression-only CPR improved the patient’s chance of survival compared with standard CPR (14% vs. 12%).

2.9.1 The authors commented that: “By avoidance of rescue ventilation during CPR, which is often fairly time-consuming for lay bystanders, a continuous uninterrupted coronary perfusion pressure is maintained, which increases the probability of a successful outcome”.

2.9.2 But authors added that cohort studies suggest that standard CPR might be better than compressions-only CPR in patients whose cardiac arrest has a non-cardiac origin, such as drowning, trauma, or asphyxia. And there are not enough data on treating children with out-of-hospital cardiac arrest, which is often of non-cardiac origin.

2.9.3 But an accompanying editorial suggests that a few rescue breaths may be beneficial during CPR, as long as they don’t interfere with the compressions. They recommend that dispatchers instruct the bystander/rescuer to give 600 compressions over about six minutes followed by two rescue breaths and then compressions and ventilations in a ratio of 100:2 until the emergency medical personnel arrive.51
2.10 A study was done by Robert James, Akashdeep Singh on ‘Cardiopulmonary resuscitation decisions should be extended to nurses - A nurse trained in CPR can reduce mortality’. According to the authors nurses should be involved in decision making regarding cardio pulmonary resuscitation. They should be the ones who should know it properly. Nurse on duty is one of the first ones who attend a sick patient in casualty department. A nurse is one of the first who assesses the patient, gathers vital information about the patient, checks vital signs and thereby detects a patient in crisis who might require a CPR.

2.10.1 Authors further added that a nurse’s duty usually is in one ward for a long time and she has the experience of working with various consultants and junior doctors on rotatory posting. Hence she knows exactly when to intervene and what all medications would be required and when to administer them, and thus saves precious time.

2.10.2 Authors of the study emphasized that a good CPR should be started immediately; there are three minutes to secure airway, breathing and circulation. It should be secured within three minutes of stoppage of spontaneous cardiac and respiratory activity. A doctor might not be available always immediately; he might be busy attending another patient. So if the nurse is trained to execute a successful CPR and if she has the right to take crucial decisions, then precious time can be saved and also mortality can be reduced. In many cases a busy ward or ICU might be left under supervision of a junior doctor, and in the event of a cardiac arrest an experienced nursing staff in the ward can be a big boost to morale and help save a life.

Literature related to Knowledge of Nurses regarding Cardio Pulmonary Resuscitation

2.11 Coleman S, Dracup K and Moser DK (1991) in their study on ‘Comparing methods of cardiopulmonary resuscitation instruction on learning and retention’ described two methods of teaching CPR where immediate and long-term retention of CPR skills and knowledge were compared. The findings of the study supported modular instruction schemes in CPR training, which the authors found to be equal as didactic methods but
more cost effective in terms of time. This particular piece of research used the Mandel observation instrument to evaluate skills retention (Coleman et al, 1991). Despite in depth search, the instrument could not be found for use. If the present researcher had an access to this instrument, it could have aided establishing reliability of the observation instrument used in this research.

2.11 Moser, Dracup and Coleman (1991)\textsuperscript{53} acknowledged that CPR skill retention begins to decline very early. They have, with a review, recommended as early as 2-4 weeks, after training. From then on, periodic reviews of every 3-6 months until one year are recommended. This information is based on an in-depth review of research that makes specific reference to CPR skill retention, rather than knowledge retention. Discussion within the paper highlights the point that there is a distinction between skill and knowledge retention, as they are not synonymous with each other. The American Heart Association suggest knowledge retention decline at the same rate as skill retention.

2.11.2 Moser, Dracup and Coleman (1991)\textsuperscript{53} produced a summary of studies, performed over 9-year span (1980-89) describing cardiopulmonary resuscitation skills retention. Three authors particularly Gass and Curry \textsuperscript{54}(1987), Martm et al (1983) and Wright et al (1989), all noted statistically significant decrease in CPR skills over relatively short time periods, specifically Wright et al (1989) who noted skills decreasing in 1-2 weeks after training. Retention of skill has not been observed in the Nursing staff for a long period.

2.12 A study was conducted on ‘Basic Life Support knowledge of undergraduate nursing students and chiropractic students’ by Patricia Josipovic, Ian Mc Grath, Michael Webb (2009).\textsuperscript{55} The aim of this study was to examine retention of cardiopulmonary resuscitation and basic life-support (CPR/BLS) knowledge of third year nursing and fourth year chiropractic students following instruction and assessment of CPR/BLS skills and knowledge as part of their undergraduate degree program. It was a non-experimental exploratory survey to determine perceived ability and knowledge of CPR/BLS following completion of CPR/BLS instruction.

2.12.1 The study was conducted by the authors in University Health Sciences School. Eighty-seven third year undergraduate nursing and forty-three fourth year undergraduate
chiropractic students at Royal Melbourne Institute of Technology (RMIT) formed the sample. The level of knowledge of CPR/BLS was assessed via the number of correct responses to questions regarding CPR/BLS. A visual analogue scale was used for the students to score their self-rated perceived knowledge and skill. The majority of students (78%) felt that they were well prepared to perform CPR/BLS; however there were deficiencies in both groups about knowledge of current guidelines.

2.12.2 According to the authors chiropractic students were less likely to identify the correct compression rate compared to the nursing group (Spearman’s rho 0.669, p<0.001) with 95% of the chiropractic students not able to identify the correct rate. 34% of the students were unable to identify the correct ventilation compression ratio with nursing students again more likely to respond correctly (Spearman’s rho 0.508, p<0.001). Nursing students scored high for self-rated knowledge and ability to perform CPR. Chiropractic students tended to score at a lower rating in these areas than the nursing students. Although students from both disciplines had significant gaps in knowledge of CPR/BLS, nursing students outperformed chiropractic students in all aspects of CPR/BLS knowledge.55

2.12.3 Having read the article, it was obvious for the present researcher to conclude that nursing students remain more enthusiastic and learnt the matter quickly.

2.13 Research was conducted on ‘Nurses’ perceptions of attempting cardiopulmonary resuscitation on old patients’ by Trygve JohannSaevareid and Susan Balandin.56 The article discussed a study on the perceptions of nurses towards cardiopulmonary resuscitation among old patients aged 85 years and above.

2.13.1 The aim of the study was to explore nurses’ thoughts and attitudes about cardiopulmonary resuscitation of old patients. Although it is recognized that nurses and doctors have different approaches to resuscitation, little is known about nurses’ attitudes towards attempting resuscitation of the old (85+ years) patients. Ten nurses working in three hospitals participated in in-depth interviews during 2009-2010. The data was analyzed according to a constructivist-grounded theory tradition.
2.13.2 The results showed that the appropriate availability of ‘Do not attempt resuscitation’ orders was important to the participants. Participants experienced stress in end-of-life care situations when resuscitation status was not decided for patients. They considered that ‘Do not attempt resuscitation’ order is a must. Participants acknowledged the difficulties in end-of-life decision making, but stated that ‘Do not attempt resuscitation’ orders are underused and sometimes delayed. Participants were susceptible about attempting resuscitation: Nevertheless, respect for patient autonomy was strong, and participants were adamant about the necessity of following the legal requirements governing resuscitation.56

2.13.3 Five of the participants had been asked by physicians to use ‘slow codes’, cardiopulmonary resuscitation efforts that intentionally are conducted too slowly for resuscitation to occur and agreed this was unethical. Some participants described the information on cardiopulmonary resuscitation and ‘Do not attempt resuscitation’ given by the physicians to patients as inadequate conclusions. End-of-life decisions impact on nurses’ comfort in their working situation as they face ethical dilemmas and anxiety about performing cardiopulmonary resuscitation. Greater collaboration between all stakeholders might reduce these. Nurses may need additional education or updates about laws of end-of-life treatment, as participants were unaware of current legislation concerning end-of-life decision-making.56

2.14 A research was done by Chandrasekaran S, Sathish Kumar, Shamin Ahamed Bhat et al 57with an objective to study ‘Awareness of basic life support among medical, dental, nursing students and doctors.’

2.14.1 A cross-sectional study was conducted by the authors by assessing the responses to 20 selected basic questions regarding BLS, among students, doctors and nurses of the medical, dental, homeopathy and nursing colleges in a city in Tamilnadu, India.

2.14.2 A questionnaire with 20 questions regarding the awareness and skills involved in BLS was used by the authors to assess the levels of awareness to BLS and its practical knowledge. The aspects on which they were interrogated were about the abbreviation of Basic Life Support (BLS), Automated External Defibrillators (AED) and EMS
(Emergency Medical Service), sequential steps in BLS, assessment and resuscitation techniques with regard to airway, breathing, circulation in unresponsive victims of different age groups, techniques regarding removal of foreign body obstruction, recognition of early signs of stroke and acute coronary syndrome.57

2.14.3 The study results showed that medical, dental and nursing students and faculty in the study group were severely lacking in the awareness of BLS. According to the authors awareness of BLS was very poor in all the students. This study emphasized the cognitive approach to the general perception and skills of BLS, early recognition of stroke and acute coronary syndrome. The practicing and teaching doctors in this study scored less compared to the nursing teaching faculty. This explained why many doctors were not good in carrying out effective CPR. In the real sense many practicing doctors, who were the teaching staff for the medical students did not come forward to respond to the questionnaire. It is now essential to standardize training in advanced life support and make it a mandatory component of all medical, nursing and Para-medical school undergraduate curricula. According to the authors it is also equally important that teachers, school children, public and all lay persons from the community be taught the facts of BLS and First aid.57

2.14.4 The awareness on emergency medicine is increasing and The Medical Council of India (MCI) has already approved emergency medicine as a separate specialty. Spreading awareness and teaching the basics of Advance Life Support to the medical and paramedical team as well as teaching BLS and First aid to the community will be the prime responsibility of this new emergency specialty.57

2.14.5 Studies showed that 1190 responders were included and 136 were excluded, as the forms they had filled were incomplete. Thirty-one percent of the responders did not know the abbreviation of BLS as Basic life support. Fifty-nine failed to insist on looking for safety as the first step in BLS. Eighty-nine percent failed to insist on activating EMS immediately after confirming the unresponsiveness in an adult. Seventy-four percent did not know that the right location of chest compression was the mid chest. Seventy-three percent of the responders did not know that the correct location of chest compression in an infant was one finger breadth just below the nipple line. Eighty-three percent of the
responders did not know alternative techniques of resuscitation when mouth-to-mouth ventilation was not opted.

2.14.6 According to the authors eighty-four percent of the responders failed to select mouth-to-mouth and mouth-to-nose technique as the rescue breathing for infants. Sixty-seven percent did not know that the depth of chest compression in an adult was 1.5 to 2 inches. Eighty-three percent did not know that the depth of chest compression in a child was one-third to one-half the depth of the chest. Thirty-five percent did not know that the chest compression in an infant was one-third to one-half the depth of the chest. Only thirty-five percent of the responders answered the rate of chest compression as 100/minute in adults and children during CPR. Only fifteen percent of the responders had correctly answered that the compression ventilation ratio in a child and adult single rescuer CPR was 30:2. Only twenty-six percent knew that the ratio of compression ventilation in a new born was 3:1. Sixty-six percent of the responders did not know that the abbreviation of AED was 'Automated External Defibrillator', and only fifty-six percent knew that the abbreviation of EMS was 'Emergency Medical Service'.

2.14.7 According to the authors eighty-four percent did not know that the first step in helping a suspected foreign body obstruction victim is to confirm the severity of obstruction by talking to him. Only thirty percent were aware about the right technique of foreign body removal from an infant. Only thirteen percent knew about the role of the recovery position in a spontaneously breathing unresponsive victim. Sixty-six percent of the responders did not know the early signs of stroke and only fifty-four percent knew how to recognize and help a patient with acute coronary syndrome.

2.14.8 To conclude awareness of Basic Life Support (BLS) among students, doctors and nurses of medical, dental, homeopathy and nursing colleges is very poor and needs to be improved.

It was felt by the present researcher that author has used many parameters for measurement.
2.15 A research study was done by Renan G Oliveira; Maria M Gonzalez, Rafaela F Soares et al.\textsuperscript{58} on ‘Evaluation of knowledge levels in basic life support of students from last year of Medicine Graduation’.

2.15.1 The Researchers studied 136 medical students in the last year of medicine graduation. The assessment of knowledge levels of BLS was performed by an experienced instructor with the check-list of the BLS test of AHA according to the 2005 Guidelines of Cardiopulmonary Resuscitation by AHA. Skills were checked on a BLS manikin.

2.15.2 The results showed that the mean age was 24.4 ±1.8 years, 68% were male. Five students had the BLS course certificate by AHA. It was observed that all of the participants did not accomplish, at least, one of the evaluation requirements. According to the criteria of the test BLS: 94% checked for response, 68% told someone to phone emergency response number, and 86% got an AED, 70% opened the airway correctly, 55% checked for breathing, 45% gave two breaths, 71% evaluated carotid pulse, 64% delivered first cycle of compressions at correct rate, 52% gave two breaths, 46% delivered second cycle of compressions at correct hand position, 56% gave two breaths. Concerning the AED use, 36% turned AED on, 74% selected proper AED pads and placed correctly, 40% cleared victim to analyze, 69% cleared victim to shock, 95% restarted chest compressions, 83% kept pads on the chest of the manikin.\textsuperscript{58}

2.15.3 In conclusion the results showed that an unsatisfactory level of knowledge in BLS is presented in the final year of medicine graduation, and suggests that the BLS course should be part of the curriculum of medical schools.\textsuperscript{58}

2.16 A study was done by Xanthos T, Akrivopoulou A, Pantazopoulos et al.\textsuperscript{59} on ‘Evaluation of nurses’ theoretical knowledge in Basic Life Support.’

2.16.1 This study was undertaken with an objective of Nurses being usually the first-responders in cases of in-hospital cardiac arrest, their competence in Basic Life Support (BLS) is important in improving patient outcome. The purpose of this study was to evaluate the nurses' BLS knowledge in a small district hospital.
2.16.2 Data was collected by an anonymous questionnaire, distributed to all nursing personnel in that hospital.

2.16.3 The Data/Results read in the following manner. The failure rate of the BLS theoretical questionnaire was 84%. Regarding self-assessment 10.3% of the participants rated their BLS knowledge as very good, whereas 31.2%, 44.2% and 14.3% of them rated it as good, moderate or not good respectively. This self-assessment did not co-relate significantly with the final performance in the written test. No difference regarding the performance in the written test was observed between nurses who had participated in a refresher BLS course after graduation and those who had not. The nurses without any previous personal experience in the BLS had a higher probability to pass the written test.59

2.16.4 In conclusion author has mentioned that our results indicate a low level of BLS knowledge among the study participants. Having an occasional refresher BLS course or prior experience in BLS, does not affect the level of knowledge. This information and the report helped the present researcher a great deal in drawing research plans for the present study.59

2.17 A quasi-experimental research was done to investigate the ‘retention of basic cardiopulmonary resuscitation skills and knowledge by qualified nurses following a course in professional development’ by Broomfield R.60

2.17.1 The research was undertaken with the intention of testing six null hypotheses regarding the retention of basic CPR skills and knowledge of registered nurses. The hypotheses were formulated from the broad aims of the research, which were to investigate conclusions reached by other researchers highlighting the speed with which retention of CPR skills and knowledge deteriorates, and to investigate the need for regular updating in CPR. The research was quasi-experimental in nature. The nurses 19 of them participating in the research were qualified staff undertaking the English National Board (ENB) 923 course in Professional Development, which included a refresher on basic CPR skills and included some discussion regarding advanced techniques.60
2.17.2 The latest guidelines issued by the Resuscitation Council (1993) were used, which also aided in the design and use of the two research tools, namely an eight-point skills-testing observation tool and a 26-point knowledge-testing questionnaire. While a 3-hour update in CPR skills revealed an initial improvement, the decrease in retention of skills 10 weeks later was significant (P = 0.0000). The update in CPR knowledge also revealed an initial improvement but the decrease in retention of knowledge 10 weeks later was significant (P = 0.0000). The findings of the research reflect similar results to previous research undertaken and discussed in the literature review, suggesting that retention of skills and knowledge quickly deteriorates if not used or updated regularly. Therefore this research supports the importance of CPR refresher courses on a regular basis.60

2.18 A study was done on ‘undergraduate nursing students’ acquisition and retention of CPR knowledge and skills’ by Madden. C. 61 the ability to respond quickly and effectively to a cardiac arrest situation rests on nurses being competent in the emergency life-saving procedure of cardiopulmonary resuscitation (CPR). The aim of this study was to investigate the extent to which Irish nursing students acquire and retain CPR cognitive knowledge and psychomotor skills following CPR training.

2.18.1 A quasi-experimental time series design was used. A pre-test, CPR training programme, post-test, and re-test were conducted. CPR knowledge was assessed by a multiple-choice assessment and psychomotor skills were assessed by observing CPR performance on a Resusci Anne skill-meter manikin. The findings showed an acquisition in nurses’ CPR knowledge and psychomotor performance following a 4 h CPR training programme. Despite this, at no point in this study, did any nurse pass the CPR skills assessment? Deterioration in both CPR knowledge and skills was found 10 weeks following CPR training.

2.18.2 However, students’ knowledge and skills were improved over their pre-training scores, which clearly indicated a positive retention in CPR cognitive knowledge and psychomotor skills. The study findings present strong evidence to support the critical role of CPR training in ensuring that nursing students progress to become competent and confident responders in the event of a cardiac related emergency.61
2.19 A study was done by Kimberly K Smith, Darlene Gilcreast and Karen Pierce on ‘evaluation of staff’s retention of ACLS and BLS skills.’ The objective of the study was to test registered nurses’ abilities to retain basic or advanced life support, psychomotor skills and theoretical knowledge.

2.19.1 Findings show nurses retain theoretical knowledge but performance skills degrade quickly. ACLS skills degrade faster than BLS skills with 63% passing BLS at 3 months and 58% at 12 months. Only 30% of participants passed ACLS skills at 3 months and 14% at 12 months. These findings are similar to the results of other investigators in over a decade of research.

2.19.2 Study results showed a decline in skills retention with nurses unable to perform ACLS and BLS skills in a standard way for the entire certification period. The need for more frequent refresher training is needed. No formal research in that institution indicates skill degradation adversely affected patient outcomes. Further research on ACLS and BLS course content, design, management, and execution is needed.

2.20 A study was conducted by Fiona Anthony Pillai to find out ‘the retention of advanced cardiopulmonary resuscitation knowledge by intensive care trained nurses.’ The teaching and reinforcing of advanced cardiopulmonary resuscitation (ACPR) is an important part of the role of an intensive care nurse manager.

2.20.1 This study highlights the need for a structured training programme, as well as regular updates in ACPR. Current research shows poor retention of CPR skills amongst nursing staff.

2.20.2 A small study was undertaken amongst intensive care trained nurses at The Middlesex Hospital intensive care unit (ICU). 18 nurses took part in the study, and were each interviewed with regard to their knowledge of ACPR in December 1990. The period of time since last trained in ACPR ranged from 2 months-4 years. Those who had been recently updated in ACPR (up to 4 months prior to interview) scored higher than those who were updated more than 2 years ago.
2.20.3 The results showed that most nurses interviewed were only able to answer correctly half the questions asked. These results indicate that the nurses in the study generally demonstrated a severe lack of knowledge of ACPR.

2.20.4 This indicates the need for a structured training package in ACPR, followed by frequent reinforcement of ACPR knowledge and skills for nurses practicing in an ICU environment.

2.21 A study was conducted on ‘knowledge of nurses towards cardiopulmonary resuscitation in a tertiary care teaching hospital in Nepal’ by Sita Parajuli, Valarmathi Selvaraj. 64

2.21.1 Among the total 175 nurses, 70 of them filled the questionnaire (response rate of 40%) and all of them were females. A high percentage (84.29%; n=59) of them belonged to the age group of 20-25 years and the mean ± SD age of the respondents was 22.07 ± 2.30 years. The duration of experience of the respondents varied and the mean ± SD duration of experience was 11.45 ± 2.67 months.

2.21.2 The mean ± SD of the overall total scores was 11.45 ± 2.67. There was no association between the knowledge scores of the respondents and ‘age’ (p=0.823) and ‘duration of experience’ (p=0.239). However, there was a statistically significant association between the knowledge scores and the ‘worksites’ of the respondents (p=0.013). A high percentage (94.29%; n=66) of the respondents knew the components of ‘A-B-C’ as ‘airway, circulation and breathing’. However, only 31.34% (n=22) of the respondents knew the CPR ratio of the infants. 64

2.21.3 The study identified that the nurses have poor knowledge regarding the CPR techniques and it suggested the need for regular CNE programs.

2.22 A study was conducted on ‘Permanent Education in BLS and ACLS: impact on the knowledge of nursing professionals’ Lima SG, Macedo LA, Vidal Mde L, Sá MP. 65 The theoretical knowledge and practical skills of the Basic Life Support (BLS) and the Advanced Life Support (ALS) are among the most important determining factors of the cardiopulmonary resuscitation success rates. The study was conducted by the authors with an aim to assess the impact of a permanent training program in BLS and ALS on the knowledge of nursing professionals.
2.22.1  A cross-sectional study was conducted. Population was made of nursing professionals of a tertiary level hospital. Assessments were carried out before and after training. The critical points of the International Liaison Committee on Resuscitation (ILCOR) analysis were addressed.

2.22.2  213 professionals were assessed (76 nurses, 35.7%; 38 assistants, 17.8%; and 99 technicians, 46.7%). Pre-course assessment average grades were statistically different (p<0.001) among assistants (3.25), technicians (3.96) and nurses (4.69). Single professional without kids showed performance significantly superior to married professional with kids (p=0.02 and 0.004 respectively). Pre-training level of knowledge was inversely proportionate to the time elapsed since the completion of undergraduate course or technical course. Main deficiencies were related to the initial approach of airways, to post-resuscitation cares and to the external cardiac massage technique. The post-course general average grade was 7.26. Assistants achieved a performance of 131.2%, technicians, of 78.9% and the nurses, of 85%, with no significant statistic difference (p=0.43).  

2.22.3  According to the author the permanent training program in BLS and ACLS resulted in important increment in the level of knowledge of nursing professionals.

2.23  A study was done by Na JU, Sim MS et al 66 on ‘BLS skill retention of medical interns and the effect of clinical experience of cardiopulmonary resuscitation.’ The objective of the study was to investigate the level of basic life support (BLS) skill retention of medical interns 6 and 12 months after BLS education and analyze the correlation between clinical experience of cardiopulmonary resuscitation (CPR) and BLS skill retention.

2.23.1  The baseline performance of BLS skills in medical doctors during their internship was tested immediately after the BLS provider course. The subjects were divided into two groups, which were tested using the same method after 6 months or after 12 months. Data on the subjects’ CPR experience were collected through CPR records-specifically, the number of CPR experiences and the feedback given by the CPR team leaders. To
evaluate BLS skill retention, baseline BLS skill performance was compared with the skill performances measured after 6 or 12 months.

2.23.2 56 subjects were enrolled in the 6 month group and 36 in the 12 month group. For non-compression skills, the points for skills declined from 12 to 6 points in the 6 month group and from 12 to 6 points in the 12 month group and the declines in both groups were statistically significant. For compression skills, in the 12 month group, the hands-off time improved from 9.9 s to 8.7 s, with statistical significance. In the multivariate linear regression test, the number of times feedback was given had a statistical relationship with improvement in hands-off time in the 12 month group (coefficient 0.58, 95% CI 0.12 to 1.05).\(^{66}\)

2.23.3 Authors concluded that in medical doctors, the compression skills were well preserved, but the retention of non-compression skills was poor.

**Literature related to Effectiveness of training on Cardio Pulmonary Resuscitation**

2.24 A study was conducted by Paul F\(^ {67}\) on ‘exploration of student nurses thoughts and experiences of using a video recording to assess their performance of basic life-support (BLS) and cardiopulmonary resuscitation (CPR) during a mock objective structured clinical examination. An action research project was conducted with six students who were assessed by an examiner at a video-recorded mock objective structured clinical examination. Students assessed their skills using the video and a checklist. Semi-structured interviews were conducted to compare checklist scores, and explore students’ thoughts and experiences of the objectively structured clinical examination.

2.24.1 The findings indicate that students may need to repeat this exercise by comparing their previous and current performances to develop both their self-assessment and CPR skills. All students reported the benefits of participating in this project, by discussion and identification of knowledge and skills deficits, thus emphasizing the benefits of
formative assessments to prepare students for summative assessments and ultimately clinical practice.\textsuperscript{67}

2.25 A study was conducted on ‘Evaluation of the Basic Life Support CD-ROM, its effectiveness as learning tool and user experiences by Pam Moule.\textsuperscript{68}This study presents the evaluation of a Basic Life Support (BLS) CD-ROM, developed as part of the Interactive Teaching and Learning (INTAL) staff development project. Student nurses’ pre- and post-test percentage results were compared using the non-parametric Wilcoxon test. Competencies in delivering BLS skills were measured at one of the sites. A Pearson’s co-efficient test was applied to measure any co-relation between knowledge attainment and skill performance. Focus groups facilitated an exploration of the students’ experiences and feelings of using interactive multi-media technology for learning. Lecturers’ views were sought through individual interviews. Learning had occurred across all groups, though this was not uniform. There was no correlation between knowledge of BLS and skill attainment measured through expired air.

2.26 A study was done by Niles D, Robert Sutton et al \textsuperscript{69}with an objective to ‘investigate the effectiveness of brief bedside “booster” cardiopulmonary resuscitation (CPR) training to improve CPR guideline compliance of hospital-based pediatric providers.’

2.26.1 A prospective randomized trial design was selected by the authors to do this study. CPR recording/feedback defibrillators were used to evaluate CPR quality during simulated paediatric arrest. After a 60-sec pre-training CPR evaluation, subjects were randomly assigned to one of three instructional/feedback methods to be used during CPR booster training sessions. All sessions (training/CPR manikin practice) were of equal duration (2 mins) and differed only in the method of corrective feedback given to participants during the session. The study arms were as follows: 1) instructor-only training; 2) automated defibrillator feedback only; and 3) instructor training combined with automated feedback.\textsuperscript{69}

2.26.2 Measurements and Main Results of the study according to the authors are that before instruction, 57% of the care providers performed compressions within guideline rate recommendations (rate >90 min\textsuperscript{-1} and <120 min\textsuperscript{-1}); 71% met minimum depth targets
(depth, >38 mm); and 36% met overall CPR compliance (rate and depth within targets). After instruction, guideline compliance improved (instructor-only training: rate 52% to 87% [p .01], and overall CPR compliance, 43% to 78% [p < .02]; automated feedback only: rate, 70% to 96% [p = .02], depth, 61% to 100% [p < .01], and overall CPR compliance, 35% to 96% [p < .01]; and instructor training combined with automated feedback: rate 48% to 100% [p < .01], depth, 78% to 100% [p < .02], and overall CPR compliance, 30% to 100% [p < .01]).

2.26.3 In conclusion before booster CPR instruction, most certified Paediatric Basic Life Support providers did not perform guideline-compliance CPR. After a brief bedside training, CPR quality improved irrespective of training content (instructor vs. automated feedback). As per the recommendation of the author future studies should investigate bedside training to improve CPR quality during actual pediatric cardiac arrests.

2.27 A study was conducted on ‘Effects of training in cardiopulmonary resuscitation on competence and patient outcome’ by Curry L. and Gass D between 1981 and 1985. Curry L. and Gass D. (1987) carried out a study in two medium-sized nonteaching community hospitals to determine the rate of deterioration of knowledge and skills in cardiopulmonary resuscitation (CPR) among physicians and nurses, the accuracy of their perceptions of their knowledge and skills, the effects of practice on retention and the effect of CPR training on mortality. The participants' knowledge and skills were measured before training and immediately after, 6 months after and 12 months after training. Information on all attempts of CPR involving hospital staff was collected from medical records and from interviews with the participants.

2.27.1 A total of 31 physicians and 54 nurses were followed by the authors during the study. Six months after training there was no difference in CPR knowledge or skills between the physicians and the nurses. In both groups CPR skills had deteriorated to near pre-training levels. By 6 months the physicians' knowledge had deteriorated to a level not significantly different from that before training. The nurses maintained a significant improvement in knowledge test scores at 12 months over those before training (p = 0.037). The physicians had an accurate perception of their knowledge but not their
skills 6 months and 12 months after training, whereas the nurses did not accurately perceive either their knowledge or their skills after training.54

2.27.2 Experience with CPR did not contribute to post-training knowledge or skills in either group. There was no evidence that death rates were lower when basic life support (BLS) was begun by trained staff than when it was begun by untrained staff. The probability of survival was greater when BLS was begun within 4 minutes of arrest than when it was begun after 4 minutes, regardless of whether advanced cardiac life support was begun within 10 minutes. According to the authors it does seem reasonable to invest the time and money into the CPR courses.54

2.28 A research study was done to understand ‘the effectiveness of Cardiopulmonary Resuscitation Training targeted for Nursing Students’ by Han JS, Ko IS, Kang KS, Song IJ, Moon SM, Kim SH 70

2.28.1 The purpose of the study is to evaluate the effectiveness and competence level of trainees of Cardiopulmonary resuscitation training targeted for nursing students. 70 nursing students of Y nursing college are recruited as subjects from Dec. 1st, 1998 through Dec. 8th, 1998. For the pre-test, demographic data related to CPR and knowledge of CPR were evaluated. For the post-test, the next week of pre-test, three different groups of subjects were tested for their knowledge of CPR. CPR training was designed by two components which were 90 min. lecture and demonstration by one professor and individual practice using two educational models with two professors.

2.28.2 As the tool of measurement was estimating pre or post knowledge of CPR, questionnaires were developed based on self-diagnosis questionnaires of American Heart Association (AHA). The questionnaires were multiple choice (50 questions) and open ended questions regarding CPR process. Each multiple choice questions valued 2 points (Score varied min. 0 point to max. 100 points.). Collected data were computerized and analyzed by SPSS-WIN. Frequency and percentage of each questions analyzed. The differences of the knowledge and competency level of subjects between pre and post test was analyzed by paired t-test.
2.28.3 The followings were research outcomes.

1. In the pre-test, 95% of subjects answered that they already knew what CPR was, but only 82% described correctly what CPR was. 49% learnt CPR before, and 80% of them learnt at high school.

2. 37 questions scores increased, and 10 questions scores decreased. For three questions score did not change. After getting training, ratio of 80% correct score significantly increased 4 times.

3. In post-test, knowledge level of trainees increased compared to that of pre-test. (t= -15.075, p=0.000)

4. Competence level also increased (t= -14.86, p=0.00). In result, after getting CPR training, most CPR knowledge increased except open the air way, toddler CPR, and alternative behavior when the air tract is blocked. CPR training needs to extend the educational scope not only for CPR lecture but also for psychomotor skill practice. CPR trainees are in need of appropriate feedback as well as enough opportunities for skill practice.

2.29 A research was conducted on ‘Basic life support and automated external defibrillator skills among ambulance personnel: a manikin study performed in a rural low-volume ambulance setting’ by Anne Moller Nielsen, Dan Lou Isbye, et al. According to authors ambulance personnel play an essential role in the ‘Chain of Survival’. The prognosis after out-of hospital cardiac arrest was dismal on a rural Danish island and in this study authors assessed the cardiopulmonary resuscitation performance of ambulance personnel on that island.

2.29.1 Methods used were the Basic Life Support (BLS) and Automated External Defibrillator (AED) skills of the ambulance personnel were tested in a simulated cardiac arrest. Points were given according to a scoring sheet. One sample ‘t’ test was used to analyze the deviation from optimal care according to the 2005 guidelines. After each assessment, individual feedback was given.

2.29.2 On 3 consecutive days, authors assessed the individual EMS teams responding to out-of-hospital cardiac arrest on the island. Overall, 70% of the maximal points were achieved.
The hands-off ratio was 40%. Correct compression/ventilation ratio (30:2) was used by 80%. A mean compression depth of 40–50 mm was achieved by 55% and the mean compression depth was 42 mm (SD 7 mm). The mean compression rate was 123 per min (SD 15/min). The mean tidal volume was 746 ml (SD 221 ml). Only the mean tidal volume deviated significantly from the recommended (p=0.01). During the rhythm analysis, 65% did not perform any visual or verbal safety check.

2.29.3 It was concluded that the EMS providers achieved 70% of the maximal points. Tidal volumes were larger than recommended when mask ventilation was applied. Chest compression depth was optimally performed by 55% of the staff. Defibrillation safety checks were not performed in 65% of EMS providers.  

2.29.4 A fundamental rule in all first aid is safety first and therefore it is surprising that more than half of the EMS providers did not perform any hands off checks during rhythm analysis and only 30% performed both a visual and verbal hands off safety check before pushing the shock button. During training it was learnt that safety checks in relation to the AED should be reinforced.

2.29.5 With regard to recognition of cardiac arrest it is recommended in AHA guidelines 2010 that looking for signs of life should take not more than 10 sec. But in this study delay from start of the scenario to the first compression or ventilation was 35 (+ 9) sec. When recognizing cardiac arrest 25% did not make any attempt at opening the airway which is higher than the reported 11% in a manikin study with trained emergency health care professionals.

2.29.6 All the issues mentioned by the authors are simple cognitive skills and one could speculate if attention has been paid to maintenance of EMS providers’ resuscitation skills. This study took place on a rural island with only approximately 50 cardiac arrests annually calling for frequent training in BLS / AED.

2.30 A research was conducted on Adult Basic Life support (BLS) awareness and knowledge among medical and dental interns completing internship from deemed university’ by Raghava Sharma, Nazir R. Attar. The study was aimed to assess the awareness, knowledge, and attitude towards basic life support (BLS) among the interns completing
their internship from both medical and dental streams of the Nitte university (a deemed university at Mangalore, Karnataka) and also to identify the areas to be addressed for improving the standards of BLS among the interns at their crucial juncture of moving out to the community, society as health care providers.

2.30.1 A descriptive study was conducted by using a questionnaire comprising of 19 questions to collect the data pertaining to demographic details, awareness and knowledge of BLS, attitude towards BLS among all the medical and dental interns completing their internship during March 2012. The study was conducted in the last week of their one year internship programme. After excluding the incomplete response sheets which were none in the present study, the data from 162 interns were subjected to the analysis. The Main outcome measure was the overall score in the BLS knowledge. Knowledge of BLS was assessed as per the data contained in the Basic life support manual from American Heart Association.

2.30.2 The results were drawn by the authors based on the comparisons between Medical and Dental streams and also within each stream. Out of 162 interns, 84 were medical interns and 78 were dental interns. All of them (100%) were aware of the BLS and its usefulness. 16 (19%) medical interns had complete knowledge of BLS while none (0%) among dental interns had complete knowledge of BLS. A score of less than 50% was evident in 37(44%) of medical interns and 69(88%) of dental interns thus indicating a poor knowledge of BLS among both medical and dental interns who were completing their internship. However medical interns scored better in comparison to dental interns. Resuscitation experience (performing BLS) and Training (attending BLS work shop) resulted in better BLS knowledge and better scoring pattern among the medical interns thus boosting the confidence among interns. (Statistically significant with P < 0.05).

2.30.3 In conclusion the authors have recommended the need for a structured training of BLS and inclusion of BLS in the Medical and Dental academic curriculum.
2.31 A study was conducted on ‘assessing basic life support skills without an instructor: is it possible?’ This study was carried out by Nicolas Mpotos, Bram De Wever, et al. Authors felt that current methods to assess Basic Life Support skills (BLS; chest compressions and ventilations) require the presence of an instructor. This is time-consuming and causes instructor bias. Since BLS skills testing are a routine activity, it is potentially suitable for automation. They developed a fully automated BLS testing station without instructor by using innovative software linked to a training manikin. The goal of the study was to investigate the feasibility of adequate testing (effectiveness) within the shortest period of time (efficiency).

2.31.1 As part of a randomized controlled trial investigating different compression depth training strategies, 184 medicine students received an individual appointment for a retention test six months after training. An interactive Flash (Adobe Systems Inc., USA) user interface was developed, to guide the students through the testing procedure after login, while Skills Station software (Laerdal Medical, Norway) automatically recorded compressions and ventilations and their duration (“time on task”). In a subgroup of 29 students the room entrance and exit time was registered to assess efficiency. To obtain a qualitative insight of the effectiveness, student’s perceptions about the instructional organization and about the usability of the fully automated testing station were surveyed.

2.31.2 During testing there was incomplete data registration in two students and one student performed compressions only. The average time on task for the remaining 181 students was three minutes (SD 0.5). In the subgroup, the average overall time spent in the testing station was 7.5 minutes (SD 1.4). Mean scores were 5.3/6 (SD 0.5, range 4.0-6.0) for instructional organization and 5.0/6 (SD 0.61, range 3.1-6.0) for usability. Students highly appreciated the automated testing procedure.

2.31.3 In conclusion authors have commented that automated testing station was an effective and efficient method to assess BLS skills in medicine students. Instructional organization and usability were judged to be very good. This method enables future
formative assessment and certification procedures to be carried out without instructor involvement.\textsuperscript{73}

\subsection*{2.32}
A research was conducted on ‘Hospital employees improve basic life support skills and confidence with a personal resuscitation manikin and a 24-min video instruction’ by Bjorshol CA, Lindner TW, Soreide E, Moen L, SundeK.\textsuperscript{74} The use of a personal resuscitation manikin with video instruction is reportedly as effective as traditional instructor-led courses in teaching lay people basic life support (BLS). Authors applied this method to an entire hospital staff to determine its effect on their practical and self-judged BLS skills.

\subsubsection*{2.32.1}
Authors have further added that all 5382 employees at Stavanger University Hospital were asked to learn or refresh their BLS skills with the personal resuscitation manikin and video instruction. Prior to and nine months after training, all employees were asked to rate their BLS skills on a scale from one to five. Additionally, randomly chosen study subjects were tested for BLS skills pre-training and six months post-training during 2min of resuscitation on a manikin.

\subsubsection*{2.32.2}
The results of the study by the authors were in the following manner. In total, 5118 employees took part in the BLS training program. The number of correct chest compressions increased significantly from 60 (5-102) to 119 (75-150) in the pre- vs. post-training periods, respectively, P<0.01, but the number of correct MTM ventilations did not change. Self-reported BLS skills increased from 3.1 (+/-1.0) pre-training to 3.8 (+/-0.8) post-training, P=0.031.

\subsubsection*{2.32.3}
It was concluded by the authors that after distributing a personal resuscitation manikin with video instruction to an entire hospital staff, the median number of correctly performed chest compressions doubled and self-confidence in BLS skills improved significantly. This is a simple and less time-consuming method than instructor-led courses in preparing hospital employees in the basic handling of cardiac arrest.\textsuperscript{74}

\subsubsection*{2.32.4}
The present investigator felt, by reading this article that an extensive study can be undertaken in the present Indian context in a large hospital setting and with good
strategic education system and better training modules - with better results can be achieved.

2.33 At this stage the present investigator having reviewed over 200 journal articles and various text materials, has understood the impact of repeated learning of CPR knowledge and skill that will predominantly make the nursing staff to become perfect in performing the task of CPR and allow the patients to go on discharge in more satisfying manner with less neurological deficit. It was obvious that repeated exposure in learning CPR helps in delaying the decay of knowledge and skill.

2.34 A study was conducted to ‘Assess improvements in effectiveness of cardiopulmonary resuscitation skills based on 2010 CPR guidelines’ by Zhan Hong et al\textsuperscript{75} with an aim to evaluate and analyze the improvement in effectiveness of cardiopulmonary resuscitation skills based on 2010 CPR guidelines in emergency medicine.

2.34.1 Sixty clinical training doctors in the first affiliated hospital of Sun Yet-Sen University, who were trained in the emergency department from August, 2010 to March, 2011 were taken as the research groups. Among them, 30 doctors assigned to the control group, entered the emergency department before 2010 CPR guidelines were published and were supposed to be trained based on 2005 CPR guidelines and the other 30 doctors assigned to the experimental group, were trained after the 2010 CPR guidelines were published and were trained based on 2010 CPR guidelines.

2.34.2 The study revealed that total scores of the experimental group are higher than those of the control group. The theory test scores have no significant difference between the two groups, while the experimental group performed better in skill practice test. More prompt initiation of chest compression and defibrillation, higher rates and superior quality of chest compression as well as better self-evaluation among trainees, are obtained in the experimental group. However, other items including self-protection awareness, airway opening skills and ventilation quality are similar between the two groups.
The authors concluded that training based on the revised guidelines resulted in improvement in effectiveness of basic life support procedures in medical staff.75

Studies related to training of nurses

A study was done by De Regge M, Calle PA, De Paepe P, Monsieurs KG76 on ‘Basic life support refresher training of nurses: individual training and group training are equally effective.’ Basic life support (BLS) skills of hospital nurses are often poor. The author compared individual BLS refresher training (IT; one instructor to one trainee) with group refresher training (GT; one instructor to six trainees). The author hypothesized that IT would result in better skill acquisition and retention.

Nurses from non-critical care wards (n=120) were randomized to IT or GT. Skills were assessed by a three minute BLS test on a computerized manikin (Laerdal, Norway) immediately before training (T0), immediately after training (T1), and 10 months after training (T2). Results are expressed as median and inter-quartile range.

The results showed that the study was completed by 103 nurses (IT 56, GT 47). For GT the median group size was 5[4-5] minute. The median duration of IT was 20[17-21] minute. The median duration of GT was 90[84-95] or 19 minute per trainee. Baseline skills did not differ between GT and IT, except for less compression with correct depth for IT. At T1 and T2 there were no clinically significant differences between GT and IT for number of ventilations, ventilation volume, number of compressions, compression depth, compression rate and hands off time. Total instructor time was similar for IT and GT training strategies.76

In conclusion there was no difference in IT and GT immediately and 10 months after training. However, training time per nurse for IT was only one fifth, whereas total instructor time did not increase. Although not superior in outcome, IT may be a cost-effective alternative for GT.
A study was conducted by Vedran Frkovic, Alan Sustic, Fred Zeidler, Alen Protic and Kristian Desa on ‘a brief re-education in CPR after 6 months- the benefit from timely repetition,’ Sudden cardiac death is a major cause of death in today’s world. During the minutes passing from the onset of cardiac arrest to the arrival of professional help, the cardiac arrest victim can only rely upon cardio-pulmonary resuscitation (CPR) provided by educated bystanders. The author’s aims were to explore the possibility of whether a short and affordable course of CPR re-education could have a significant effect on skills retention and quality of CPR delivered.

Authors performed a prospective randomized study that included 72 first and second year medical students who had no clinical experience and no prior training in CPR. Subjects were educated in CPR in accordance with a standardized CPR education protocol. Six months later, half of the studied group (randomly chosen) underwent short re-education in CPR. One year after initial education they were all tested for CPR skills. The results were printed and filmed by the authors.

The results showed that students who attended the short re-education were significantly better in approaching the victim safely, in obtaining a clear airway and in checking the pulse of the victim.

In conclusion authors expressed that a short and inexpensive course of re-education, carried out six months after initial education, may render CPR performance more effective for the victim and safer for the rescuer. Investigators found the concluding remarks very encouraging to make this kind of recommendation.

A study was conducted on ‘determinants of the quality of basic life support by hospital nurses’ by Verplancke T, De Paepe P, Calle P.A., De Regge M, M. Van Maele G, Monsieurs K.G. with following outcomes.

Good quality Basic Life Support (BLS) results in better survival. BLS is a core competence of nurses but despite regular refresher training, the quality of BLS is often poor and the reasons for this are not well known. Authors investigated the relation between BLS quality and some of its potential determinants.
During a BLS refresher course, 296 nurses from non-critical care wards completed a questionnaire including demographic data and a “self-confidence” score. Subsequently, they performed a BLS test on a manikin connected to a PC using Skill reporting System software (Laerdal, Norway). The following variables were recorded by the authors. Number of ventilations/min, tidal volume, number of compressions/min, compression rate, compression depth, “good ventilation” \( (n \geq 4 \text{ min}^{-1} \text{ and tidal volume} = 700–1000 \text{ ml}) \) and “good compression” \( (n \geq 40 \text{ min}^{-1} \text{ and rate} = 80–120 \text{ min}^{-1} \text{ and compression depth} = 40–50 \text{ mm}) \). To detect independent determinants of BLS quality, associations between the demographic data and the objective variables of BLS quality were examined.\(^78\)

Results were noticed that forty-three percent of the nurses rated their confidence as good or very good. Male gender was associated with good compression \( (P < 0.001) \). Greater self-confidence was also associated with good ventilation \( (P < 0.03) \) and with good compression \( (P < 0.001) \). BLS training was associated with a higher number of ventilations/min \( (P = 0.01) \). Experience of CPR was associated with a higher number of compressions \( (P < 0.01) \).\(^78\)

Author concluded that Male gender, greater self-confidence, recent BLS training and recent CPR were associated with better quality of BLS.

A study was conducted on ‘trials of teaching methods in basic life support comparison of simulated CPR performance after first training and at 6 months with a note on the value of re-training’ by Douglas Chamberlain, Anna Smith Malcolm, et al.\(^79\)

The findings of the study revealed that a randomized controlled trial comparing staged teaching of cardiopulmonary resuscitation (CPR) with conventional training provided the additional opportunity to investigate skill acquisition and retention in those attending conventional CPR classes. All subjects were tested immediately after their first instruction period and again at 6–9 months at an unheralded home visit. Author of the article was able to assess how far performance was related to poor acquisition of skills and how far it was related to skill decay.\(^79\)
2.38.2 According to the authors out of 262 subjects who were randomized to receive conventional CPR instruction, 166 were available for home testing for 6–9 months. An invitation to attend for re-training had been accepted by 39 of them. The remaining 127 who attended only a single class comprises the principal study group, with additional comparative observations on the smaller re-trained cohort group. Important findings were observed in the acquisition of skills in all modalities tested after the initial instruction. These were particularly marked in skills related to ventilation. Immediately after a class, 68% of trainees performed an effective check of breathing, but only 33% opened the airway as taught and no more than 18% provided an ideal ventilation volume.79

2.38.3 The technique of chest compression was also less than ideal. Although 80% of subjects placed their hands in an acceptable position, compression to an adequate depth and an adequate rate of compression were achieved by 54% and 63%, respectively. 78% demonstrated a careful approach, and 46% remembered to call for help. A carotid pulse check was simulated by 61% of trainees. When tested 6–9 months later, skill deterioration from this baseline was observed in all modalities tested except for the ventilation volume. The skill decay was significant ($P<0.05$) for the careful approach, performing an effective breathing check, the carotid pulse check, placing the hands in an acceptable position for chest compression, and compressing at an optimal rate.

2.38.4 According to the authors the minority who attended for re-training showed a trend to protection against skill decay for seven of the ten variables, compared with those who had attended only one training session. This improvement was significant for only two of them, but all were relatively small with limited practical value. Many who attend conventional CPR classes fail to acquire the necessary skills, and the skills that are acquired decline appreciably over the subsequent 6–9 months. The value of conventional re-training was modest in this study of community volunteers.79
A research was conducted on ‘Nurses knowledge and skill retention following cardiopulmonary resuscitation training: a review of the literature’ by Hamilton R. Poor knowledge and skill retention following cardiopulmonary resuscitation training for nursing and medical staff has been documented over the past 20 years. Cardiopulmonary resuscitation training is mandatory for nursing staff and is important as nurses often discover the victims of in-hospital cardiac arrest. Many different methods of improving this retention have been devised and evaluated. However, the content and style of this training lack standardization.

A literature review was undertaken using the Cumulative Index to Nursing and Allied Health Literature, MEDLINE and British Nursing Index databases and the keywords 'cardiopulmonary resuscitation', 'basic life support', 'advanced life support' and 'training'. Papers published between 1992 and 2002 were obtained and their reference lists scrutinized to identify secondary references, of these the ones published within the same 10-year period were also included. Those published in the English language that identified strategies to enhance the acquisition or retention of Cardiopulmonary resuscitation skills and knowledge were included in the review.

Authors concluded that resuscitation training should be based on in-hospital scenarios and current evidence-based guidelines, including recognition of sick patients, and should be taught using simulations of a variety of cardiac arrest scenarios. This will ensure that the training reflects the potential situations that nurses may face in practice. Nurses in clinical areas, who rarely see cardiac arrests, should receive automated external defibrillation training, and have access to defibrillators, to prevent delays in resuscitation. Staff should be formally assessed using a manikin with a feedback mechanism or an expert instructor to ensure that chest compressions and ventilations are adequate at the time of training. Remedial training must be provided as often as required. Resuscitation training equipment should be made available at ward/unit level to allow self-study and practice to prevent deterioration between updates. Video self-instruction has been shown to improve competence in resuscitation. An in-hospital scenario-based video should be devised and tested to assess the efficacy of this medium.
in resuscitation training for nurses. The present researcher felt that an extensive study was done by the authors.

2.40 A study was conducted on ‘Improved basic life support performance by ward nurses using the CAR Event Public Access Resuscitator (PAR) in a simulated setting’ by Monsieurs KG, De Regge M, Vogels C, Calle PA.

2.40.1 The CAR Event Public Access Resuscitator (PAR, O-Two Medical Technologies, Ontario, Canada) is a new oxygen-driven device alternating two ventilations with 15 prompts for chest compressions. The PAR is designed for use with a standard resuscitation face mask and is equipped with mask leakage and obstruction alarms. The purpose of this study was to assess the quality of basic life support (BLS) by hospital nurses and to evaluate if BLS with the PAR is better than BLS using the mouth-to-mask technique.

2.40.2 The study group consisted of 352 nurses from Ghent University Hospital working outside the critical care and emergency departments. BLS skills were measured using a Laerdal Skill reporter manikin (Laerdal, Norway) connected to a Laerdal PC Skill reporting system. To assess base line skills, 200 nurses were tested without previous notice in single rescuer BLS using pocket masks (PM, Laerdal, Norway) or a bag-valve mask device (Laerdal, Norway) over a period of 2 min. A separate consecutive sample of 152 nurses was randomized to the PM or PAR groups after a standard BLS refresher course. The PAR group received a short period of training in PAR use. Immediately after training, both groups performed the 2 min single rescuer BLS test.

2.40.3 Unprepared nurses achieved only 26 compressions and 3 ventilations/min. Immediately after training, nurses using the PAR delivered 54 compressions/min as opposed to 35 for the PM group (p<0.0001). PAR users ventilated six times/min compared to five times for PM users (p<0.0001).

2.40.4 Authors concluded that immediately after training, the use of the PAR improved BLS performance by ward nurses significantly, bringing the number of ventilations and
compressions per minute close to the theoretical maximum achievable within the current guidelines. Retention tests after 6 and 12 months will show if the effect is sustained.\textsuperscript{81}

2.41 A study was conducted on ‘Impact of additional module training on the level of basic life support knowledge of first year students at the university of Maribor’ by Lešnik D, Lešnik B, Golub J. et al.\textsuperscript{82} The aim of the study was to investigate the impact of additional (two versus one session) basic life support (BLS) training of university students on knowledge and attitude concerning the performance of cardiopulmonary resuscitation.

2.41.1 A total of 439 students in three separate groups were tested: those with no prior BLS training; BLS training in high school (part of the driver's education course); and BLS training in high school (in the driver's education course) and additional BLS training at the university.

2.41.2 The study conducted by authors showed the best results of BLS education in a group of university students who took an additional BLS module approximately half a year after the driver's education BLS course. In the study, they observed equal levels of knowledge between the group with BLS training in high school and the group without any formal BLS education. The questionnaire revealed a disappointing level of knowledge about BLS in both groups.\textsuperscript{82}

2.41.3 Authors of the study concluded that additional basic life support training (two BLS training sessions: high school and university) improves retention of knowledge and attitudes concerning performing CPR in first year university students.

2.42 A study was conducted on ‘Rescuer's position and energy consumption, spinal kinetics, and effectiveness of simulated cardiac compression’ by Alice Y M Jones, Raymond Y W Lee\textsuperscript{83} with an aim To compare energy expenditure, compression effectiveness, and kinetics of the spine during simulated chest compression with the rescuer in different positions.
2.42.1 A 3-group design with 46 nurses (26 females) and (20 males) emergency medical technicians was used. Participants performed chest compressions on a mannequin while kneeling on the floor, standing, or kneeling on the bed at the edge of the mattress (bed mount). Oxygen consumption and effectiveness of chest compression were recorded. Muscle moment and power at the lumbosacral joint were determined by recording motions of the lower limbs and pelvis with an electromagnetic tracking device and measuring ground reaction forces with a force plate.

2.42.2 A total of 80% of chest compressions delivered by male rescuers vs 40% delivered by females were effective, irrespective of position. Male rescuers consumed less oxygen when delivering chest compressions while standing than while kneeling (P = .03), but effective compression ratio also was lower. In female rescuers, effective compressions correlated positively with oxygen consumption in the standing (r = 0.42, P = .04) and bed-mount (r = 0.53, P = .008) positions. Administering chest compressions while standing involved a larger moment magnitude and required more power than doing so while kneeling.83

2.42.3 Authors concluded that administering chest compressions while standing demands more power but consumes less oxygen than doing so while kneeling, perhaps because fewer cardiac compressions delivered while standing are effective.

2.43 A study was conducted on ‘Basic Life Support training in various undergraduate health care professionals’ by Jordan T, Bradley P 84 with an objective to assess the frequency of use of Basic Life Support (BLS) skills among hospital staff of all disciplines. Design: Postal survey of 9600 teaching hospital staff. Participants: 3807 responders from all disciplines.

2.43.1 As per the studies Frequency of attendance and the use of BLS skills, of patients with cardiac arrest were main outcome measures.
2.43.2 Results were noticed by the authors in this manner that most responders reported having attended BLS training previously: 27.9% in the prior 6 months; 24.5% 6-12 months previously; 17.1% over 1 year ago; and 11.5% over 2 years ago. 17.1% reported never having received BLS training. 1.9% gave no valid response. Nearly half of all respondents had never attended a cardiopulmonary arrest. Among those most likely to have attended, i.e. qualified nursing and medical staff, the median frequency of attendance was less than once per year. Ventilation delivered using a pocket mask or bag-valve-mask was reported by 9.4 and 29.2% of respondents, respectively. Less than 7% reported the use of mouth-to-mouth ventilation.84

2.43.3 Only among qualified nursing (8.8%) and medical (24.7%) staff, did this proportion exceed 5%. The vast majority of non-qualified nursing staff (84.9%), allied health professionals (86%) and administrative and clerical staff (98%) had used neither chest compressions nor mouth-to-mouth ventilation. The author has drawn the conclusions that some skills taught during BLS training are used infrequently in the in-hospital situation. The likelihood of attendance at arrest events and of the use of BLS skills is extremely low among some identified professional groups. BLS skills teaching should be targeted at those groups most likely to actually use them in order to make best use of the resources available.

2.44 This chapter dealt with the review of published and unpublished literature related to the research study. This enabled the investigator to have deep insight into the problem under study and helped to develop tool, methodology and in completing the research study.