Ergonomic Risk Assessment of Musculoskeletal Disorders (MSD) During Chest Compression in Three Different Position in A Rescuer Performing Paediatric Basic Life Support

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Abstract

Paediatric Cardiopulmonary Resuscitation (CPR) is a life-saving technique that involves the use of chest compressions and artificial ventilation to maintain circulatory flow and oxygenation during cardiac arrest. It is typically practised in hospitals, including the emergency room. Medical staff are required to perform CPR in any position and surface available. Musculoskeletal pain is one of the adverse effects from resuscitation. The aim of the study was to determine the ergonomic risk factor for musculoskeletal disorders in rescuers performing infant chest compression in three separate positions: beside a radiant warmer, in front of a radiant warmer, and standing next to a stretcher. The Emergency and Trauma Department of Hospital Universiti Sains Malaysia, Kelantan, conducted a cross-sectional study with 54 participants, all of whom were emergency medicine residents. The participants were asked to perform two cycles of chest compression in three separate positions, and the ergonomic risk score was calculated using the Rapid Entire Body Assessment (REBA) method. Two positions (standing beside the radiant warmer and the stretcher) had a mean REBA score of high risk, indicating they should be investigated, and changes implemented as soon as possible, while one position (standing in front of the radiant warmer) had a medium risk.

Keywords
CPR, Ergonomics, Musculoskeletal Disorder, and REBA.

1. Introduction
Infant resuscitation in the emergency department can be stressful due to the congestion of patients and the demand of staff for optimal resuscitation. Resuscitation in infants can be one of many reasons-either traumatic or non-traumatic causes. Resuscitation of infants can be done either on the floor, a stretcher or a radiant warmer, depending on the area availability at the resuscitation area. Continuous cardiac compression is part of the resuscitation algorithm. There is

literature on optimal technique for infant resuscitation but no literature on health care providers optimal posture to achieve adequate compression and to reduce work related musculoskeletal disorders among health care providers.

1.1 Objectives
To determine the ergonomic risk of musculoskeletal disorder (MSD) in rescuers performing chest compression in standing position in front of a radiant warmer, beside a radiant warmer and beside a stretcher.

2. Literature Review
Generally, ergonomics can be explained as the science of arranging items so that people can access them safely and easily (Merriam-Webster Online 2014). In specific, ergonomics is creating the job in order to fit the employee, instead of using force on the employee's body for the job fit (Stubbs 2000). The use of ergonomics generally increases work efficiency, comfort, and the ease of use without the compromise in safety and health. The workplace, which can be not ergonomically designed, may not immediately cause pain as the human body is able to adapt to a poorly designed workplace, to some extent. In the long term however, the lack of ergonomics will overcome the coping mechanisms in the body, which will result in pain, reduced performance, mental stress, and reduced work quality (Murphy 1997).

Occupational health professionals around the world have become more aware of the major disease burden associated with musculoskeletal disorders of the neck and upper limbs over the last decade (Stock 1991). These conditions are thought to be linked to extremely repetitive work and are caused, at least in part, by ergonomic factors. However, evidence on the prevalence of work-related musculoskeletal disorders (WMSDs) is scarce. There are papers published on musculoskeletal disorder in adult cardiopulmonary resuscitation but not in paediatric resuscitation.

Paediatric resuscitation requires a team of healthcare personnel to work together within a small physical space. Cardiopulmonary resuscitation (CPR) consists of the use of chest compressions and artificial ventilation in order to maintain circulatory flow and oxygenation during cardiac arrest (Bon and Bechtel 2020). Although providing high-quality patient care is paramount, each individual's biomechanics while conducting resuscitation procedures must also be considered (Yamada et al. 2019). Any given team of health care personnel (HCPs) may represent the full range of population anthropometry, and the "optimal" pose, location, and technique for one combination of height, weight, and limb lengths is unlikely to be adequate for the other members of the team (Yamada et al. 2019).

According to AHA guidelines, chest compression should be initiated in infants when there is no pulse. Compressions should be made on the lower third of the sternum (Orlowski 1996). Techniques which can be accepted are 2 thumbs on the sternum, superimposed or adjacent to each other according to the size of the infant, with fingers encircling the chest and supporting the back (the 2 thumb–encircling hands technique) and 2 fingers placed on the sternum at right angles to the chest with the other hand supporting the back (Thaler and Stobie 1963). The results of the analysis on the physical ergonomics of technical procedures during resuscitation can be used to guide future system design to better address the needs of all users (Yamada et al. 2019). For example, during a biomechanical study of health care workers performing neonatal resuscitation procedures, the preferred bed height for endotracheal intubation was 14 centimetres (cm) higher (p=0.05) than the preferred bed height for chest compressions. However, on many infant resuscitation beds, the foot pedal that allows for bed height adjustment is only accessible by HCPs standing on the bed's sides (Yamada et al. 2019). The HCP at the infant's head is in charge of the patient's airway and endotracheal intubation; however, this individual is the furthest away from the bed height adjustment mechanism (Yamada et al. 2019). Despite this, the ability to change the lateral angle or width of the bed to fit the HCPs on the resuscitation team's varied stature, horizontal reach, and abdominal depth is lacking (Yamada et al. 2019). As a result, in order to perform life-saving procedures including intubation and chest compressions, HCPs must change their posture (Yamada et al. 2019).

Compressions are usually delivered from the side of the centre of the infant with the body of the health care provider rotated to deliver the compression. This is due to the head end being occupied for delivering oxygen or intubation. There is a lack of literature review on the non-neutral postural adjustment made by health care providers during resuscitation procedure.

3. Methods

A cross-sectional, simulated manikin study of in-hospital cardiac arrest was carried out in Hospital Universiti Sains Malaysia, a teaching hospital in Kubang Kerian, Kelantan. The study was approved by the Human Ethics Committee of Hospital Universiti Sains Malaysia. All subjects provided informed and written consent. Fifty-four residents of emergency medicine voluntarily participated in the study. They have experience in doing CPR and have undergone training on infant CPR in Neonatal Resuscitation Programme (NRP)/Paediatric Advanced Life Support Course.

The participants had no established diagnosis of a prolapse intervertebral disc, having past fracture records of long bone or spine, congenital abnormality of extremities and trunk, history of surgery involving joints or currently pregnant. Study was carried out in a simulation room of the Department of Emergency Medicine. Each participant was enrolled when he or she was on their off day to minimize the effect of study on working performance and status quo of the participant.

Within-subject study design was used to reduce confounding factors. Each participant was given a task to perform CPR at 3 different positions: standing beside a radiant warmer, standing in front of a radiant warmer, and standing beside a stretcher. Standing beside a radiant warmer, the rescuer stood on the right/left side of the baby cot where the manikin had been placed in the centre. Standing in front of the radiant warmer position, the rescuer stood in front of the baby cot where the manikin was placed in the middle, head end facing the participant. At the side of the stretcher the manikin was placed at the head end of the bed aligned in the middle. The stretcher and radiant warmer with baby cot were set at 90cm. Participants were allowed to adjust the height accordingly.

The enrolled participant's names will be keyed into Microsoft Excel. A total of three stages, A: standing beside a radiant warmer, B: standing in front of a radiant warmer, and C: standing beside a stretcher will need to be completed by each participant, in a unique sequence. The unique sequences for each participant were randomly generated in Microsoft Excel, eg. A-B-C, B-C-A, C-A-B. Participants were not given a similar sequence of CPR to reduce confounding factors of fatigue after CPR at one position that will affect performance at the next position.

4. Data Collection

At first stage, participants are required to perform two cycles of 2 minutes continuous chest compression according to AHA 2015 paediatric BLS guideline (rate 100/min, depth of 1/3 of the anterior-posterior dimension of the chest, allow full chest recoil, using two thumb technique at lower half of sternum and minimize interruption) at first position that is predetermined for each group. Participants are given 2 minutes of rest between first and second cycle chest compression to fulfil the need of rotating the compressor every 2 minutes as recommended in AHA 2015 Paediatric BLS guideline. REBA score is taken as the longest-sustained posture during one cycle of 2 minutes continuous chest compression. A rest of 30 minutes was given from one position to another. Video recording was taken for this purpose. Performance data is recorded by a device attached to the Laerdal little baby QCPR manikin and data is transferred from manikin to iPad via Bluetooth and data was recorded in QCPR Training App downloaded from App Store. Participants were blinded from feedback on performance of CPR during the duration of the experiment. Performance data were only revealed to participants once he/she completed the task.

Rapid Entire Body Assessment (REBA) is a universal ergonomic assessment tool used to evaluate whole body postural risk of work-related musculoskeletal disorder (WMSD) developed by Hignett and McAtamney (2000). It is written to be simple to use, and the evaluator does not need an advanced degree in ergonomics to score it (Hignett and McAtamney 2000). REBA is a comprehensive assessment consisting of analysis of posture involving neck, trunk, legs, upper and lower arm in addition to force and load used to perform the task and consideration of dynamic of the task performed (static, repeated small range action or action causing rapid large ranges in posture or unstable base). The REBA worksheet is divided into 2 body segment sections which is section A (covers neck, trunk and leg) and section B (covers arm and wrist). REBA score is obtained by analysis of both sections giving out scores from 1 to 15 that represents level of MSD risk. Scores are divided into 5 categories which determine the risk of developing MSD: negligible (score 1), low risk (score 2-3), medium risk (score 4-7), high risk (score 8-10) and very high risk (score 11+).

5. Results and Discussions

Table 1 shows the participants demographic data. There were 54 participants in this study, 35 were male (65%) and 19 (35%) were female. The participants' age ranged from 29-40 years old with a mean age of 32.7 (SD 1.8). The mean weight of participants was 74.1 kg (SD 14.6) with a mean height of 1.67 metre (SD 0.09). All participants were emergency medicine residents. All had completed their NRP training with 20 (37%) participants also having PALS certification. Majority (50) participants had completed their NRP training more than 2 years and only 4 less than 2 years ago.

Table 1. Participants demographic and profile (n=54)

Variable	Mean (SD)
Gender	
Male	35
Female	19
Mean age (years)	32.7 (1.8)
Mean weight (kg)	74.1 (14.6)
Mean height (m)	1.67 (0.09)
CPR training	
NRP	54
PALS	20
Duration of last training (NRP)	
<2 years	4
>2 years	50

Table 2 showed the mean REBA score in position A, B and C respectively. The worst REBA score was achieved in position C; standing beside a stretcher with a mean score of 9.3 (SD 1.7). The second highest score is in position A; standing beside a radiant warmer with a mean score of 8.5 (SD 1.3). The lowest score was seen in position B; standing in front of a radiant warmer with a mean score of 5.5 (SD 1.2).

Table 2. REBA score in position A, B, C

Position	Mean (SD)
A (standing beside radiant warmer)	8.5 (1.3)
B (standing in front radiant warmer)	5.5 (1.2)
C (standing beside stretcher)	9.3 (1.7)

Table 3. Position A1 (standing beside a radiant warmer-first cycle)

POSITION	REBA SCORE												Mean (SD)
	1n (%)	2n (%)	3n (%)	4n (%)	5n (%)	6n (%)	7n (%)	8n (%)	9n (%)	10n (%)	11n (%)	12n (%)	
NECK	2 (3.7)	7 (13.0)	45 (83.3)										2.80 (0.36)
TRUNK	1 (1.9)	8 (14.8)	43 (79.6)	2 (3.7)									2.85 (0.32)
LEGS	48 (88.9)	6 (11.1)											1.11 (0.39)
UPPER ARM		1 (1.9)	50 (92.6)	3 (5.5)									3.04 (0.42)
LOWER ARM	54 (100)												1.00 (0.00)
WRIST			54 (100)										3.00 (0.00)
SCORE A		2 (3.7)	3 (5.5)	8 (14.8)	34 (63.0)	7 (13.0)							4.76 (0.22)
SCORE B					44 (81.5)	9 (16.6)	1 (1.9)						5.20 (0.35)
TOTAL SCORE						5 (9.2)	6 (11.1)	28 (51.9)	8 (14.8)	7 (13.0)			8.11 (0.16)

Table 4. Position A2 (standing beside a radiant warmer-second cycle)

POSITION	REBA SCORE												Mean (SD)
	1n (%)	2n (%)	3n (%)	4n (%)	5n (%)	6n (%)	7n (%)	8n (%)	9n (%)	10n (%)	11n (%)	12n (%)	
NECK	1 (1.9)	2 (3.7)	51 (94.4)										2.93 (0.43)
TRUNK	1 (1.9)	5 (9.2)	44 (81.5)	4 (7.4)									2.94 (0.33)
LEGS	37 (68.5)	16 (29.6)	1 (1.9)										1.33 (0.27)
UPPER ARM			42 (77.8)	12 (22.2)									3.22 (0.28)
LOWER ARM	54 (100)												1.00 (0.00)
WRIST			54 (100)										3.00 (0.00)
SCORE A		1 (1.9)	2 (3.7)	4 (7.4)	27 (50.0)	18 (33.3)	2 (3.7)						5.20 (0.18)
SCORE B					37 (68.5)	11 (20.4)	6 (11.1)						5.43 (0.25)
TOTAL SCORE						3 (5.6)	4 (7.4)	17 (31.5)	5 (9.2)	22 (40.7)	3 (5.6)		8.89 (0.14)

(a) Front View (b) Side View

Figure 1. Position A by views

Comparatively in Position A: first cycle as A1 and second cycle after 2 minutes of rest is A2, there is marked increase in REBA score. In both cycles the participants scored a high neck score 3 with a mean of 2.8 (SD 0.36) and 2.93 (SD 0.43) each. The participants had a neck flexion of >20% with twisted neck during the CPR. Their trunk position in both cycles scored a majority score of 3 with a mean of 2.85 (SD 0.32) from first cycle and 2.94 (SD 0.33) from second cycle due to flexion between 0-20 degrees and twisting of body to posture self during resuscitating an infant.

The leg position in both cycles scored a majority of 1 with a mean of 1.11 (SD 0.39) in the first cycle and a mean of 1.33 (SD of 0.27) in the second cycle. Both the neck and trunk adjustment majorly contributed to the Score A. Participants upper arm score majority of 3 in both cycles from flexion 20-45 degrees with upper arm abduction to position arm around the infant during resuscitation with a mean of 3.04 (SD 0.42) in position A1 and mean of 3.22 (SD 0.28) in position A2. The lower arm position was mainly in flexion between 60 to 100 degrees and contributed to a score of 1 for all participants in both cycles in all 3 positions. The wrist score for all positions and cycles scored 3 as the wrist is hyperextended >15 degrees and bent from the midline for the participants hand to compress the infant chest using 2 thumb technique. This upper limb adjustment contributed to the Score B.

Table 5 Position B1 (standing in front of a radiant warmer-first cycle)

POSITION	**REBA SCORE**												**Mean (SD)**
	1n (%)	**2n (%)**	**3n (%)**	**4n (%)**	**5n (%)**	**6n (%)**	**7n (%)**	**8n (%)**	**9n (%)**	**10n (%)**	**11n (%)**	**12n (%)**	
NECK	12 (22.2)	34 (63.0)	8 (14.8)										1.93 (0.21)
TRUNK	44 (81.5)	10 (18.5)											1.19 (0.31)
LEGS	50 (92.6)	4 (7.4)											1.07 (0.43)
UPPER ARM	1 (1.9)	8 (14.8)	45 (83.3)										2.81 (0.36)
LOWER ARM	54 (100)												1.00 (0.00)
WRIST			54 (100)										3.00 (0.00)
SCORE A	37 (68.5)	4 (7.4)	8 (14.8)	5 (9.3)									1.65 (0.25)
SCORE B			7 (13.0)	1 (1.8)	34 (63.0)	12 (22.2)							4.94 (0.23)
TOTAL SCORE			5 (9.2)	1 (1.9)	35 (64.8)	6 (11.1)	5 (9.3)	2 (3.7)					5.20 (0.22)

Table 6 Position B2 (standing in front of a radiant warmer-second cycle)

POSITION	**REBA SCORE**												**Mean (SD)**
	1n (%)	**2n (%)**	**3n (%)**	**4n (%)**	**5n (%)**	**6n (%)**	**7n (%)**	**8n (%)**	**9n (%)**	**10n (%)**	**11n (%)**	**12n (%)**	
NECK	2 (3.7)	39 (72.2)	13 (24.1)										2.20 (0.29)
TRUNK	38 (70.4)	15 (27.8)	1 (1.8)										1.31 (0.28)
LEGS	48 (88.9)	6 (11.1)											1.11 (0.39)
UPPER ARM		6 (11.1)	43 (79.6)	5 (9.3)									2.98 (0.33)
LOWER ARM	54 (100)												1.00 (0.00)
WRIST			54 (100)										3.00 (0.00)
SCORE A	27 (50.0)	4 (7.4)	15 (27.8)	8 (14.8)									2.07 (0.16)
SCORE B			4 (7.4)	2 (3.7)	32 (59.3)	13 (24.0)	3 (5.6)						5.17 (0.21)
TOTAL SCORE			4 (7.4)	1 (1.8)	21 (39.0)	13 (24.1)	10 (18.5)	4 (7.4)	1 (1.8)				5.74 (0.13)

(a) Front View (b) Side View

Figure 2. Position B by views

Comparatively in Position B: first cycle as B1 and second cycle after 2 minutes of rest is B2, there is marked increase in REBA score. However, comparatively to Position A and Position C the mean total REBA score was lower. In both cycles the participants scored a neck score 2 with a mean of 1.93 (SD 0.21) and 2.20 (SD 0.29) each. Majority of participants had a neck flexion of >20% however less neck twisting or bending during the CPR. Their trunk position in both cycles had a majority score of 1 with a mean of 1.19 (SD 0.31) from first cycle and 1.31 (SD 0.28) from second cycle as their trunk posture were upright during the resuscitation. The leg position of both cycles scored a majority of 1 with a mean of 1.07 (SD 0.43) in the first cycle and mean of 1.11 (SD of 0.39) in the second cycle. Only the neck adjustment was a major contribution to the Score A. Participants upper arm score majority of 3 in both cycles from flexion 20-45 degrees with upper arm abduction to position arm around the infant during resuscitation with a mean of 2.81 (SD 0.36) in Position B1 and mean of 2.98 (SD 0.33) in Position B2. The lower arm position in flexion between 60 to 100 degrees contributed to a score of 1 for all participants in both cycles in all 3 positions. The wrist score for all positions and cycles scored 3 as the wrist is hyperextended >15 degrees and bent from the midline for the participants hand to compress the infant chest using 2 thumb technique. This upper limb adjustment contributed to the Score B. Participants in Position B had less body adjustments as the manikin was in line with the participant during resuscitation. However, the increase of score from first to second cycle is due to fatigue.

Table 7 Position C1 (standing beside a stretcher-first cycle)

POSITION	**REBA SCORE**												**Mean (SD)**
	1n (%)	**2n (%)**	**3n (%)**	**4n (%)**	**5n (%)**	**6n (%)**	**7n (%)**	**8n (%)**	**9n (%)**	**10n (%)**	**11n (%)**	**12n (%)**	
NECK	1 (1.8)	11 (20.4)	42 (77.8)										2.76 (0.32)
TRUNK		7 (13.0)	36 (66.6)	11 (20.4)									3.07 (0.24)
LEGS	31 (57.4)	13 (24.1)	2 (3.7)	8 (14.8)									1.76 (0.20)
UPPER ARM		3 (5.6)	49 (90.7)	2 (3.7)									2.98 (0.41)
LOWER ARM	54 (100)												1.00 (0.00)
WRIST			54 (100)										3.00 (0.00)
SCORE A			1 (1.8)	8 (14.8)	21 (38.9)	14 (26.0)	2 (3.7)	7 (13.0)	1 (1.8)				5.61 (0.13)
SCORE B			3 (5.6)		42 (77.8)	9 (16.6)							5.06 (0.32)
TOTAL SCORE						1 (1.8)	7 (13.0)	21 (38.9)	4 (7.4)	11 (20.4)	3 (5.5)	7 (13.0)	9.00 (0.11)

Table 8 Position C2 (standing beside a stretcher-second cycle)

POSITION	**REBA SCORE**												**Mean (SD)**
	1n (%)	**2n (%)**	**3n (%)**	**4n (%)**	**5n (%)**	**6n (%)**	**7n (%)**	**8n (%)**	**9n (%)**	**10n (%)**	**11n (%)**	**12n (%)**	
NECK		6 (11.1)	48 (88.9)										2.89 (0.39)
TRUNK		5 (9.3)	33 (61.1)	16 (29.6)									3.20 (0.21)
LEGS	28 (51.8)	15 (27.8)	3 (5.6)	8 (14.8)									1.83 (0.17)
UPPER ARM		2 (3.7)	49 (90.7)	3 (5.6)									3.02 (0.41)
LOWER ARM	54 (100)												1.00 (0.00)
WRIST			54 (100)										3.00 (0.00)
SCORE A			1 (1.8)	5 (9.3)	16 (29.6)	18 (33.3)	5 (9.3)	6 (11.1)	3 (5.6)				5.94 (0.11)
SCORE B				2 (3.7)	41 (76.0)	10 (18.5)	1 (1.8)						5.19 (0.30)
TOTAL SCORE						2 (3.7)	3 (5.6)	12 (22.2)	4 (7.4)	19 (35.2)	6 (11.1)	8 (14.8)	9.57 (0.10)

(a) Front View (b) Side View

Figure 3. Position C by views

Comparatively in Position C; similar as other cycles: first cycle is C1 and second cycle after 2 minutes of rest in C2, there is marked increase in REBA score. In both cycles the participants scored a high neck score 3 with a mean of 2.76 (SD 0.32) and 2.89 (SD 0.39) each. The participants had a neck flexion of >20% with twisted neck during the CPR. Their trunk position in both cycles scored a majority score of 3 with a mean of 3.07 (SD 0.24) from first cycle and 3.20 (SD 0.21) from second cycle due to flexion between 0-20 degrees and twisting of body to posture self during resuscitating an infant. In position C the leg score varied as some participants opted to sit on the stretcher while resuscitating instead of standing hence the mean for leg score in Position C1 is 1.76 (SD 0.20) and Position C2 is 1.83 (SD 0.17). All 3 of this adjustment contributed to the Score A. Participants upper arm score majority of 3 in both cycles from flexion 20-45 degrees with upper arm abduction to position arm around the infant during resuscitation with a mean of 2.98 (SD 0.41) in Position C1 and mean of 3.02 (SD 0.41) in Position C2. The lower arm position in flexion between 60 to 100 degrees contributed to a score of 1 for all participants in both cycles in all 3 positions. The wrist score for all positions and cycles scored 3 as the wrist is hyperextended >15 degrees and bent from the midline for the participants hand to compress the infant chest using 2 thumb technique. This upper limb adjustment contributed to the Score B.

According to the REBA ranking, CPR performed while standing beside the warmer, standing in front of the warmer, and standing beside the stretcher predisposes the rescuer to developing musculoskeletal disorder (MSD). The mean REBA score for two positions (standing beside the radiant warmer and standing beside the stretcher) is high, indicating that they should be investigated and changed as soon as possible. Only one position (standing in front of the radiant warmer) showed medium risk however further investigation and change soon should be implemented. It is recommended that the best position for resuscitation is by standing in front of the radiant warmer.

Literature has shown that rescuers apply as much as 644 N of force to the victim's chest with each compression, while actual standards need one hundred compressions per minute during adult CPR (Baubin et al. 1997). Research suggests that forces transmitted through the rescuers' wrists of less than 10% of those seen during the performance of chest compressions significantly strains the scapholunate ligament (Lee et al. 2010). In infant CPR the force is via the thumb and the movements of the wrist to achieve adequate compression.

Fatigue begins at 2 minutes as shown in studies (Cobo-Vázquez et al. 2018). Rescuers exert muscular countervailing forces in order to maintain effective compressions (Cobo-Vázquez et al. 2018). This imbalance of forces could determine the onset of poor posture, musculoskeletal pain, and long-term injuries in the rescuer (Cobo-Vázquez et al. 2018). This study has shown fatigue after 2 minutes causes the REBA score to worsen after the first cycle of CPR to ensure effective compression is continued. Hence it is recommended to rotate between more compressors to achieve adequate chest compression during resuscitation.

6. Conclusion

The study has concluded that the best position for a health care personnel to resuscitate an infant will be from standing in front of the warmer rather than standing beside the radiant warmer or standing beside the stretcher. However, the best position is still considered medium risk based on the REBA score. Fatigue is another factor contributing to the risk of musculoskeletal disorder in health care personnel. This recommendation may not fit all as paediatric resuscitation involves a team and the team dynamic may eventually interfere with the position of the health care personnel delivering the compression with other ongoing life saving procedures delivered by the other members.

No adequate research has been done prior to this study to determine the ergonomics risk of musculoskeletal disorder in a health care provider during paediatric resuscitation. Despite the study's limited sample size and single centre study, it was able to point to the need for further research into improving technique and posture from an ergonomic standpoint to provide excellent treatment to the community. Poor ergonomics in CPR can be considered a key indicator for incorporating mechanical devices as medical technology advances, allowing medical healthcare workers to offer better treatment to patients.

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Biographies

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