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Editorial

From changing four tyres to recalling the four H's and T's — Can the pit crew model work for in-hospital cardiac arrest?

Formula one pit crews are renowned for their team work and efficiency by streamlining tasks in order to change all four tyres and undertake minor mechanical work in a matter of a few seconds. To achieve this they undergo regular vigorous training sessions with simulations to rehearse and perfect their routine ready for race day. In recent years pit crew models have become increasingly common in the healthcare setting.[1–3] Adoption of such models is often implemented through a variety of different strategies such as classroom based training, simulation and post event debriefing. However formula one pit crews are trained to follow a set protocol, undertaking predefined tasks with minimal deviation from the overall plan which cannot always follow true of patient management especially those in cardiac arrest.

Can the pit crew model work for advanced life support?

Advance life support has several key components that can be used in a pit crew model. Firstly there is a protocol based algorithm, secondly there is a set target to achieve good neurological survival and finally there is a team which can be trained. The pit crew model allows each team member to act with autonomy working within predefined roles under supervision of the team leader. Several studies have shown benefit from such a model in the pre-hospital setting when responding to an out-of hospital cardiac arrest.[1,2] The "circle of life" position is recommended in the 2015 guidelines (Fig. 1).[4] This utilises four positions with a minimum of four clinicians, one at the head for airway management, one either side for chest compressions/defibrillation and chest compressions/IV access and finally a fourth hands off team-leader. However there is limited research testing its effectiveness in the in-hospital cardiac arrest setting.

The hospital setting brings about it own challenges. More specialist resources are available such as cardiac catheterisation labs and intensive care units adding extra decisions for the team-leader. The clinical response is two tiered; starting off with the first responders usually ward nurses and other clinicians in the immediate area when the emergency buzzer sounds, with the second tier being a dedicated cardiac arrest response team. Inpatient cardiac arrests tend to have different aetiologies than out-of-hospital arrests this is usually attributed to the patients clinical course and underlying pathology which is often complex. Many common problems faced by hospital cardiac arrest teams are due to non technical skills with team factors particularly communication frequently being a key issue.[5] Often there are issues with crowd control; having too many clinicians causes inefficiency either by multiple people attempting the same task or worse nobody doing it because they all presume someone else will. Resuscitation teams are frequently ad hoc therefore members will not necessarily know each other by name and indeed may not know each other's skill-set, both of which reduces efficiency. Team leaders are faced with a high mental workload from attending patients who they have little information on, co-ordinating the arrest team to establishing and treating reversible causes as well as making complex clinical decisions.

Strategies to overcome these factors involve clear communication and a well trained dedicated response team. The team leader needs to establish their authority and control the scene which may involve sending people away that are not core team members. The team members should have met at handover introducing themselves and pre-allocating roles for example airway management, IV access, defibrillation and chest compressions. Which in turn can help to offload some of the mental workload from the leader by allowing team members to work with autonomy positioning themselves around the patient and starting their pre-allocated tasks whilst the team leader can focus on the algorithm and clinical management. In particularly the pit crew model encourages team members to adhere to guidelines which in itself has been shown to correlate with improved survival.[6] In the UK, the Resuscitation Council (UK) advanced life support course teaches similar principles to "pit crew models" with a special emphasis on human factors and team dynamics. Without a standard definition of what a pit crew model is one asks the question are we already applying these principles in our current practice?

In this edition of *Resuscitation* Spitzer and colleagues present their findings from an in-hospital implementation of the pit crew model.[7] Their model takes into account the increase in personnel available in hospital with twelve different predefined roles acting in an inner and outer circle. They used a combination of e-learning, in-house life support training and mock codes to implement the model. The main outcome measure was to improve team communication with secondary measures to improve CPR quality metrics. There are

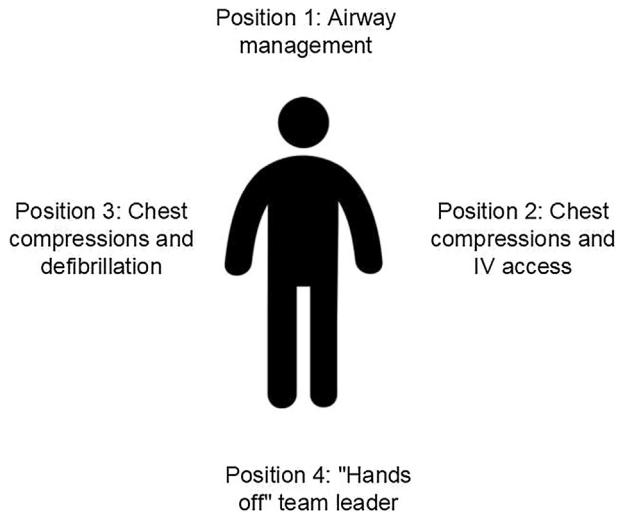

Fig. 1 – "Circle of life" rescuer positions.

several limitations of the study firstly the study was not powered to detect any improvements in patient outcome (survival to discharge). Secondly, unfortunately their equipment did not incorporate a feedback recording device able to give in-depth CPR quality data such as those used in other studies are were therefore limited to providing data on compression rate only.[8,9] Thirdly, due to multiple simultaneous interventions to improve the quality of in-hospital resuscitation it is difficult to directly implicate the pit crew model with any system-wide improvements. Similar findings have been shown in other studies where there has been a system-wide improvement which cannot be attributed to single intervention alone such as CPR feedback devices or post-event debriefing.[9] Interestingly in a simulation study a pit crew model did not show a benefit over standard training of teams when deploying a mechanical CPR device.[10] Whereas in-situ mock codes have being shown to correlate with improved in-hospital cardiac arrest survival.[11] Therefore for any quality improvement project the key is the plan, do, study, act cycle to ensure continuous improvements in patient care.[12]

Whilst there is research to support the pit crew model in the pre-hospital setting further research is needed to support its use for in-hospital cardiac arrest teams. Further research should aim to answer the following questions: Firstly, what is the standardised definition of a pit crew model and how is this different to current training of cardiac arrest teams? Finally for in-hospital cardiac arrest teams what are the optimum "pit crew" roles and responsibilities to improve team dynamics, CPR quality and most importantly patient outcomes?

Conflicts of interest

None.

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Richard A. Field
Anaesthetics Department, University Hospitals Birmingham NHS Foundation Trust, Heartlands Hospital, Bordesley Green East, Birmingham, B9 5SS, UKAnaesthetics Department, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK

E-mail address: richiefield@doctors.org.uk (R. Field).

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