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Cardiopulmonary Resuscitation (CPR): Collaboration in Medical Team Work

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Abstract. This paper investigates how situations of medical emergency (CPR) are organized as collaborative practice. Whilst studies have assessed CPR mainly with regard to timing of medical actions, we suggest that interactional micro-coordination between the participants and their involvement in multiple activities may contribute to such timing.

Introduction: Medical Emergencies & Team Work

To deal with situations of medical emergency requires collaboration in professional teams, as in Cardiopulmonary Resuscitation (CPR) after a cardiac arrest. A team of medical personnel attempts to re-establish spontaneous blood circulation by oxygenating the brain, performing chest compressions, giving medications, and using defibrillation (ERC 2015, 2). The standardized guidelines need to be practiced regularly for improving the patients' survival rate. From 700.000 persons affected by sudden cardiac arrests in Europe every year, only 10% survive (ERC 2015, 82). The success of CPR highly depends on timing, e.g. starting chest compressions early (Hunziker et al. 2010), keeping no-flow time (without chest compressions) low (Fernandez Castelao et al. 2013), and reaching a certain rhythm of chest compressions/oxygen ventilations (Marsch et al. 2004). Yet, little is known about the collaborative practices which allow a team to achieve such timing and good medical performance. Therefore, we investigate: How do participants coordinate their actions given time pressure and being involved in multiple parallel actions?

Cardiopulmonary Resuscitation Protocol

CPR guidelines are provided by the American Heart Association (AHA) and the European Resuscitation Council (ERC). They both stress the importance of keeping a low no-flow time, maintaining a certain depth of chest compressions, and sustaining a relation of 30 chest compression to 2 ventilations. They differ e.g. in starting either by compressions/ventilations or by use of the defibrillator. Our study participants are trained with the ERC (ERC 2015), which consist of several building blocks with the aim of establishing a return of spontaneous circulation (ROSC):

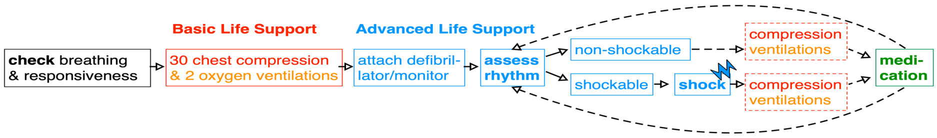

Figure 1. The Cardiopulmonary Resuscitation Protocol according to the ERC 2015.

Usually, these tasks are carried out by a team of several medical professionals. Some activities are carried out collaboratively by two persons (e.g. chest compression/oxygen ventilation) and, at the same time, are in parallel to other actions (e.g. attaching the defibrillator). Since the teams are often established ad hoc without predefined roles/tasks (Kolbe et al. 2014), one member needs to coordinate the team's actions. Studies show that CPR of teams with a declared leader result more often in a return of spontaneous circulation than teams without leadership (Marsch et al. 2004). Team leaders can positively affect their team's hands-on-times, which leads to early CPR (Hunziker et al. 2010). A team leader's efficiency reduces when s/he not only focuses on managing the activities, but also engages in medical measures her/himself (Fernandez Castelao et al. 2013). Whilst these studies point to central issues of collaboration and team leadership, little is known about the interactional practices involved in such team work and their 'risks and side effects'.

Study & Data

In early 2020, we carried out a pilot study in which two cases of authentic CPR trainings were recorded in German language (10' each). An ad hoc team of four physicians was asked to deal with a sudden cardiac arrest. One team member was assigned the role of team leader (TML) before the recording; no further instructions were given. The setting was recorded with four 4k video, two GoPro and one 360° camera, four wireless microphones and four mobile eye-tracking glasses (Tobii Pro, v2). Participants wore Aruco markers (with K. Essig & A. Krause, HSRW).

Case Analysis: From Timing to Coordinating Actions

(A) **Timing of Actions.** Central differences can be measured in the teams' performances: (a) The Basic Life Support has been started 24'' (team 1) vs. 52'' (team 2) after the Call for Help. (b) The assessment of the heart rate rhythm has been established after 1'48'' (team 1) vs. 2'20'' (team 2). (c) Team 1 establishes a rhythm of compression/ventilation which – while not fully realizing the ideal of 30 to 2 – provides a stable basis. Team 2 fails to establish a regular and coordinated rhythm of compression/ventilation with initially frequent individual ventilations and following long stretches of no-ventilation. The question arises whether and how these differences might relate to issues of interaction and collaboration?

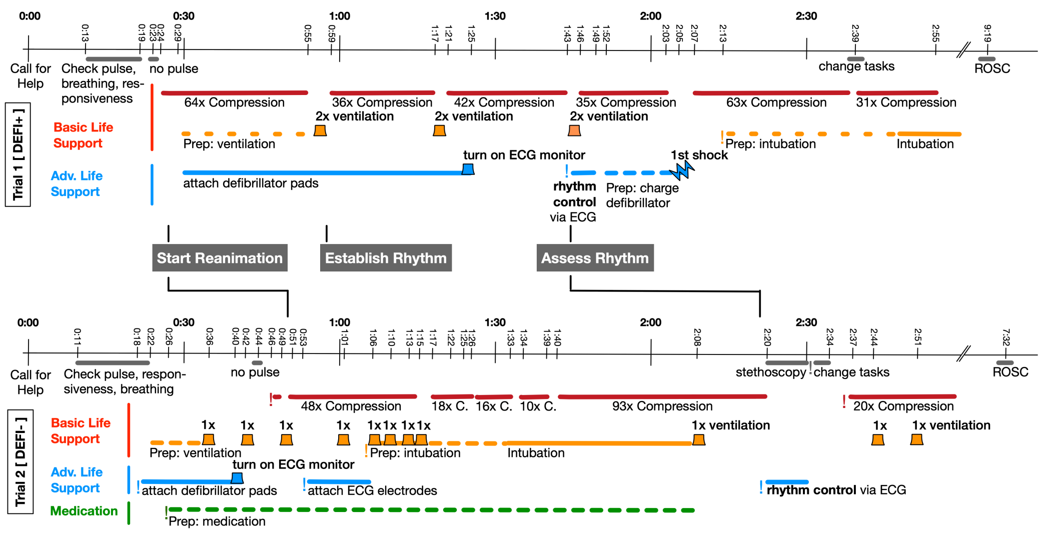

Figure 2. Timeline-based Overview of Activities in comparison of Team 1 and Team 2.

(B) **Interactional Coordination. (a) Implications of spatial configurations:** When entering the room, the team members position themselves around the bed/ patient. While the team-leader in team 1 (TML-1) stands in second row at the side, the team-leader in team 2 (TML-2) positions herself at the patient's head. As the head-position is linked to the task 'oxygen ventilation', this spatial position creates a situation of engagement in multiple activities, i.e. to coordinate the team's actions, *and* to perform the ventilation. **(b) Coordinating Multiple Activities (team 2):** In the following example from team 2 (at 1'05''), TML has to provide two ventilations after physician A has produced 30 compressions ("l"). A counts aloud up to 30 (l. 01-02). In parallel, TML asks physician B to prepare the tube (l. 01-02) and bends her upper-body sideways to directly address B (01:07.24). At the end of her request, TML regains her regular posture and produces one ventilation (l. 02: X) while A's count, however, is only at 28. Once A has reached 30, TML's hand is not touching the 'ball' (01:12.00) – A continues compressing suggesting that another ventilation might not be projectable immediately. TML then rushes to ventilate once (01:13.68), realizes that A is still compressing, tells her to stop compressing, ventilates once (l. 03), and reorients to B (01:16.80). This instance shows that the involvement in the ‘double duty’ of actions renders interactional coordination complex, which can lead to situations of trouble in carrying out (otherwise well-known) medical tasks and lead to flaws in team performance.

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01 A         (.)                 [twenty-six        twenty-seven,]
   A-Compr    |                    |      |         |          |
   TML        could you please   [insert uh the tube,             ]

02 A         (.)[twenty-eight] thi- twenty-nine, thirty;
   A-Compr    |   |       |            |      |    |      |
   TML       in [there,       ]
   TML-Ven          X

03 TML                       [just stop,       ]  continue,
   A-Compr     |    |    |    |                    |   |   |
   TML-Ven  X                                  X
   B        what kind of [tube do you want,]
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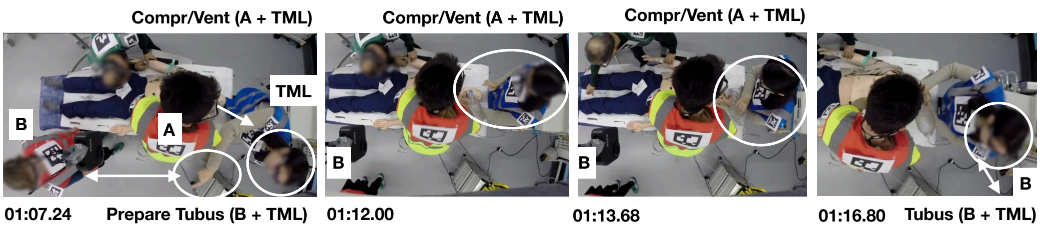

Summary & Future Work

Whilst studies so far have assessed situations of CPR mainly with regard to timing of medical actions, this initial exploratory analysis suggests that interactional micro-coordination may contribute to such timing. In future, we will enlarge the database, establish a multi-sensorial corpus, extend analysis and conceptualization.

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