Background: Manual Defibrillators underwent a rapid technical progress. The accurate use of a manual defibrillator can prevent a delay in starting CPR and reduce interruptions of chest compressions. In order to obtain an objective evaluation of a device's usability, eye-tracking measurements have recently become a promising method. Eye-tracking can expose cognitive processes and visual attention during problem-solving tasks, which is an important part of understanding human reasoning. It was the aim of this study to evaluate the usability of modern manual defibrillators from 4 different manufacturers. We requested a series of tasks representing typical operator/device interactions during a cardiac arrest scenario. Successful task execution and processing times were measured. Additionally, while the operators were performing the tasks, their visual focuses were assessed via mobile eye-tracking. Thereafter, their subjective perception of usability was evaluated by a standardized usability questionnaire. The hypothesis of our study was that the usability of manual defibrillators differs between the devices according to the requested task.

Methods: After informed consent (ERB of the University of Freiburg), 43 voluntary operators were asked to execute 15 tasks representing typical operating steps during acute defibrillation, cardioversion or pace-maker stimulation (see Y-axis Figure 2), at 4 different defibrillators (Lifepak™ 20 (Physio-Control Inc., USA), Defigard Touch 7™ (Schiller, Switzerland), Corpuls 3™ (GS, Germany) and X Series™ ALS (Zoll-Chelmsford, USA) (Fig. 1). Operators were naïve to the included devices. The operators' gazes were measured via an eye-tracking device (Tobii Pro Glasses 2, Tobii AB, Sweden). From these data, task's processing time (TD) and the operator's gaze distribution (Heat Map) were analysed. After having executed the task, the operators' evaluated the usability via a standardized questionnaire. The primary endpoint was TD. Secondary endpoints included gaze distribution and usability score (data given as mean±SD; α<0.05 was considered significant).

Results: In certain tasks TDs differed significantly between the defibrillators (Fig. 2). Exemplary tasks showing TDs being longer compared to other devices were “Set defibrillation energy to...” in the Defigard Touch 7™ (41±34 s) and the Corpuls 3™ (26±16 s), "Activate pacemaker mode" in the Lifepak™ 20 (20±17 s) and "Connect the therapy cable" in the X Series™ ALS (71±30 s). Executing the task “Activate AED mode” in the Defigard Touch 7™ required long TD (40±32 s) and diffuse gaze distribution (Fig. 3), indicating some operators’ confusion on locating the function’s button. Overall, operators’ rated usability the best in the Lifepak™ 20 (all p<0.01), followed by Corpuls 3™, Defigard Touch 7™ and X Series™ (Fig. 4).

Conclusion: Our findings reveal evident differences of the usability of manual defibrillators, depending on the task in question. Shortcomings of the interfaces impair the operator's efficiency. Eliminating these issues might improve the operator’s performance and, as a consequence, the patient’s safety.