though, the quality of resuscitation – even performed by medical personnel – is often insufficient. Paramedics perform chest compressions exceeding the recommended maximum rate and not reaching the recommendation for chest compression depth.

The aim of the study was to assess the quality of manual chest compressions performed with a standard cycle of 30 compressions: 2 rescue breaths or with continuous manual chest compressions.

A randomized cross-over controlled simulation study was performed, and involved 32 novice physicians. Before the start of the study, all participants successfully completed training in basic life support procedures conducted by accredited AHA instructors. To simulate a patient requiring resuscitation, the Resusci Anne manikin (Laerdal, Stavanger, Norway) was placed on standard transport stretchers at 1/3 of the thigh height of the person performing chest compression.

The study participants performed 2-min cardiopulmonary resuscitation based on two scenarios: Scenario A – cardiopulmonary resuscitation with manual chest compressions with a standard cycle of 30 compressions: 2 rescue breaths; Scenario B – cardiopulmonary resuscitation with continuous manual chest compressions. For this purpose, an independent instructor performed endotracheal intubation allowing for asynchronous resuscitation. The order of the study participants and the research scenarios was random.

The study involved 32 novice physicians, with a maximum of 1 year of experience. Median chest compression rate during Scenario A were 126 (IQR; 124–137), and during Scenario B 129 (IQR; 123–133). Median chest compression with a rate within the goal range during Scenario A and B varied and amounted to 14 (IQR; 6–19) vs. 25 (14–22) %. Median chest compression depth during Scenario A was 43 (IQR; 36–45) mm, and 46 (IQR; 42–48) mm for Scenario B ($p = 0.021$). The median of full chest relaxation achieved 63 (IQR; 56–73) % for Scenario A and 71 (IQR; 59–85) for Scenario B ($p = 0.014$).

In summarize novice physicians performed higher quality chest compressions using continuous chest compressions compared to CPR with standard cycle of 30 compressions: 2 rescue breaths. It is important to note that the frequency of chest compressions performed by the study participants was exceeded recommended value by the current CPR guidelines. Research by Field et al. [9] has shown that chest compressions above 120 CPM statistically significantly affected the reduction of the chest compression depth, additionally faster chest compression can also affect the rescuer's fatigue and thus lead to a deterioration in chest compression quality. Further research is needed to confirm the results.

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Jolanta Majer
Polish Society of Disaster Medicine, Warsaw, Poland

Jacek Smereka
Department of Emergency Medical Service, Wroclaw Medical University, Wroclaw, Poland

Mateusz Puslecki
Department of Rescue Medicine, Poznan University of Medical Sciences, Poznan, Poland

Lukasz Szarpak*
Lazarski University, Warsaw, Poland
Corresponding author at: Lazarski University, Swieradowska 43 Str., 02-662 Warsaw, Poland.
E-mail address: lukasz.szarpak@gmail.com.

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Double sequential defibrillation and the tyranny of the case study

In recent years, double/dual sequential defibrillation (DSD) has captured the attention and imagination of Emergency Medical Services (EMS) researchers and clinicians alike. This year, the American Journal of Emergency Medicine published articles on DSD by Hajjar et al. [1] and Pourmand et al. [2] The article by Hajjar et al. reviewed and analyzed data on 12 previously published papers representing 38 DSD cases, and described one additional case study not previously published. The article by Pourmand et al. was a comprehensive literature review. Both articles demonstrated that the majority of the current EMS DSD literature is derived from case studies and case series. These results of the individual case studies and case series may lead readers to draw overly optimistic conclusions regarding the efficacy of DSD.

Among the 38 individual patients represented in the nine case studies and three case series included in the analysis by Hajjar, the combined rate of hospital discharge with favorable neurologic outcomes (CPC 1 or 2) was an impressive 29% ($n = 11$). In Hajjar's analysis, published case studies contributed the minority of patients ($n = 9$; 24%), but a majority of the favorable neurologic outcomes ($n = 7$; 64%). Conversely, published case series contributed the majority of patients ($n = 29$; 76%), but the minority of favorable neurologic outcomes ($n = 4$; 36%).

Among the case studies presented in the review, the rate of survivors with favorable neurologic outcome was 78%. Even with the addition of the manuscript's featured case study, which ended in the patient's death, that number is still 70%. This is far greater than the 14% favorable neurologic outcomes found in the case series ($p < 0.001$) or the 6% favorable neurologic outcomes in the single retrospective cohort analysis referenced in the paper [3] ($p < 0.00001$). The rates of favorable neurologic outcomes separated by study designs are shown in Fig. 1.

While case studies play an important role in introducing novel therapies and approaches [4], they are limited in their ability to offer generalizable results [5]. Case series may be more suggestive of causal relationships and be more generalizable than individual case reports [5]. However, both case studies, and case series are at a greater risk of publication bias towards positive results than studies with more robust study designs as studies with positive results are more likely to be

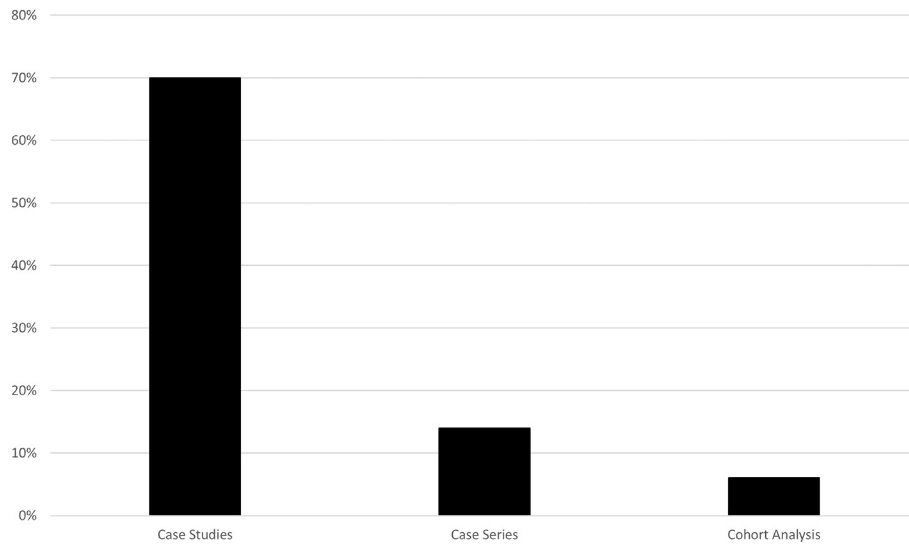

Fig. 1. Favorable neurological outcomes by study type.

submitted and cited by authors and recommended and accepted for publication by reviewers and editors [5,6].

At the present time, there exists an inverse relationship between the level of evidence and rates of favorable neurologic outcomes among the available DSD literature. Hajjar et al. correctly point out "the unfeasibility in inferring meaningful clinical associations from our gathered data." [1] However, the growing quantity of low quality evidence to support DSD may lead to an irrational exuberance for this promising, yet still unproven therapy.

The literature has now been adequately saturated with DSD case studies and case series. Researchers should focus their efforts on study designs which will yield higher levels of evidence in order to better define the true benefit, if any, of DSD.

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Brian M. Clemency*
Benjamin Pastwik
Dennison Gillen
Department of Emergency Medicine, Jacobs School of Medicine and Biomedical Sciences at the University at Buffalo, 955 Main St, Buffalo, NY 14203, USA
*Corresponding author at: Erie County Medical Center, Department of Emergency Medicine, 462 Grider St, Buffalo, NY 14215, USA.
E-mail addressess: bc34@buffalo.edu (B.M. Clemency), benpastw@buffalo.edu (B. Pastwik), dgillen@buffalo.edu (D. Gillen).

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