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A COMPARATIVE STUDY REGARDING THE PERFORMANCE OF CORPULS 3 AND ZOLL DEFIBRILLATORS

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ABSTRACT

The purpose of this paper is to provide a detailed and accessible overview of the Corpuls 3 and Zoll defibrillators, highlighting their features, functionalities and advantages in the monitoring and treatment of patients in emergency and intensive care settings. The comparison was based on seven main criteria: modularity, design, CPR capacity, performance, vital parameters monitoring, monitoring screens and maintenance costs.

KEYWORDS: defibrillator, Corpuls 3, Zoll, performance

1. Introduction

The circulatory system's blood pumping function is carried out by the heart, an essential organ of the human body. There are four chambers in the heart: two ventricles and two atria. The heart's left side pumps oxygenated blood from the lungs to the rest of the body, while the right side takes in deoxygenated blood from the body and delivers it to the lungs for oxygenation [1-3]. The blood supply to the heart is provided by the coronary arteries. Heart attacks and coronary heart disease can result from blockages in these arteries. The heart also has an electrical conduction system that coordinates the heartbeat. The sinoatrial node, also known as the "natural pacemaker", initiates the electrical impulses that regulate the heart rate. A cardiac arrhythmia is an irregular heartbeat that occurs when the electrical signals that coordinate the heartbeat don't work properly [4-6]. The heart can beat too fast (tachycardia), too slowly (bradycardia) or irregularly [7-10]. While some arrhythmias are not dangerous, some can be harmful and need medical attention. For example, tachycardia includes types such as atrial fibrillation [11-14], atrial flutter [15-16], supraventricular tachycardia [17-18], and ventricular fibrillation [19-20].

Various health conditions can affect heart health, including heart disease, heart failure, arrhythmias, and congenital heart defects. Lifestyle factors such as diet, exercise and stress management play a crucial role in maintaining heart health.

Defibrillation is a medical procedure that involves delivering electric shocks to the heart to restore normal heart rhythm in the event of cardiac arrest or severe arrhythmias. Defibrillation is essential in treating ventricular tachycardia and ventricular fibrillation, which can lead to death if not treated fast. It is a crucial step in cardiopulmonary resuscitation (CPR) and must be performed as soon as possible after the onset of ventricular fibrillation to be effective. Correct use of defibrillators and proper electrode placement are critical to successful procedures and prevention of arrhythmias.

A vital component of equipment for resuscitation in a scenario of cardiac arrest is a manual defibrillator. A defibrillator operating improperly or slowly might have a negative impact on acute treatment [21]. A self-explanatory interface reduces the possibility of operational faults while also rendering handling easier.

Continuous monitoring from the scene of the incident to the hospital is essential to ensure effective and rapid medical intervention in emergency situations. Modern monitoring devices, such as the Corpuls 3 or Zoll, allow emergency teams to constantly monitor the patient's condition and provide appropriate treatment throughout transport or at the scene of the incident.

An ergonomic approach in transporting the patient is important to ensure his comfort and safety during the medical intervention. By dividing the modules, modern monitoring devices facilitate handling and transport of the patient, allowing medical staff to focus on treatment and continuous monitoring. Improving patient safety by recording and saving parameters directly on the patient is an innovative feature of modern monitoring devices. This allows quick access to the patient's vital data and

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provides accurate recording of the evolution of his clinical condition throughout.

2. Experimental research

For this case study, we used images of the monitoring screens of the Corpuls 3 (Figure 1) and Zoll (Figure 2) defibrillators. The analysis focuses on the displayed parameters, including heart rate, oxygen saturation (SpO_2), blood pressure, modularity, design, CPR capability, performance, vital signs monitoring and maintenance costs between Corpuls 3 and Zoll.

Fig. 1. *Zoll defibrillator display results*

Fig. 2. *Corpuls 3 defibrillator display results*

3. Results

Modularity of defibrillators include aspects such as configurability, compatibility with accessories, portability and flexibility of use. In Figure 3 presented is the radar chart comparing the modularity between Corpuls 3 and Zoll based on five key criteria: module configurability, accessory compatibility, portability, flexibility of use, and integration with other medical systems.

The chart above provides a clear view of the strengths and weaknesses of each device according to the modularity criteria analysed. Corpuls 3 stands out with superior modularity in almost all criteria compared to Zoll, which makes it more suitable for uses that require high configurability and portability.

Regarding the design between Corpuls and Zoll, we analyse several criteria relevant to the design of medical devices. These criteria could include: ergonomics, accessibility, ease of use, durability and aesthetics. In Figure 4 the major design difference between the two devices is clearly highlighted. Corpuls 3 stands out through a superior design in all the analysed criteria: ergonomics excellent, high accessibility, maximum ease of use, durability and modern and attractive aesthetics. Zoll's performance is good in all criteria, but inferior to Corpuls in terms of ergonomics, accessibility, ease of use, durability and aesthetics.

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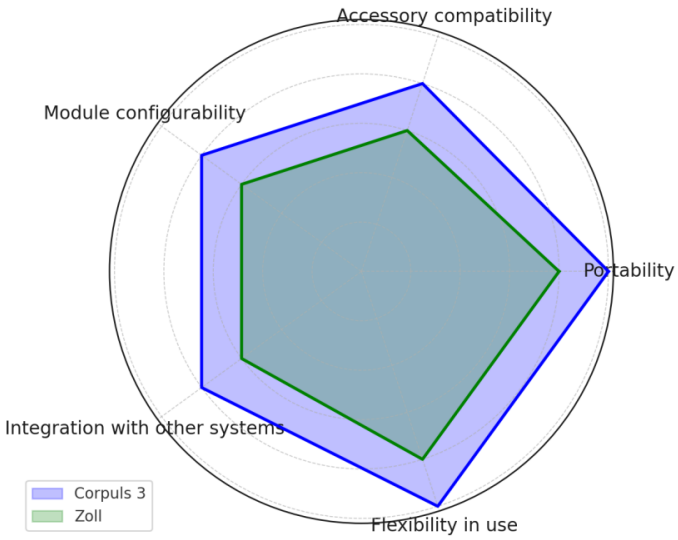

Fig. 3. *Comparison of modularity between Corpuls 3 and Zoll*

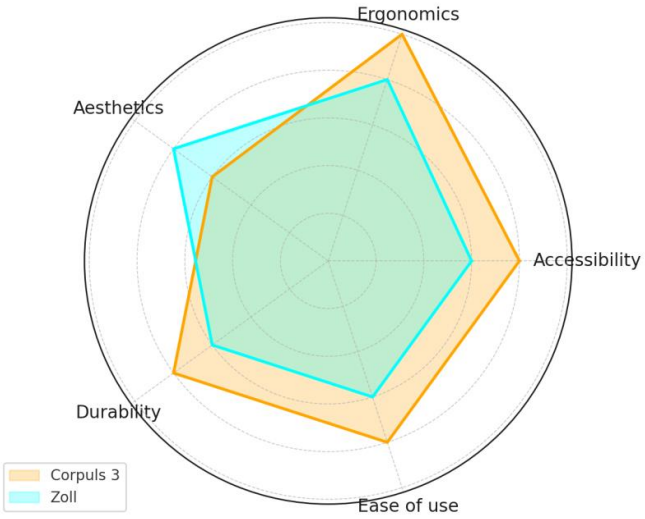

Fig. 4. *Comparison of design between Corpuls 3 and Zoll*

To conduct a comparative study on cardiopulmonary resuscitation (CPR) capability between the Corpuls 3 and Zoll devices, we analysed several key criteria such as: CPR efficiency, real-time feedback capabilities, ease of use, compatibility with other equipment, innovations and additional technologies. Figure 5 shows the comparative graph regarding the PCR capacity between Corpuls 3 and Zoll.

As seen in Figure 5, regarding the CPR efficiency, Corpuls 3 is well supported by the advanced technologies included, the device provides accurate feedback and helps maintain appropriate compressions. Zoll is known for its efficiency in CPR, thanks to patented technologies, the device ensures an optimal depth and frequency of compressions. As for the real-time feedback capabilities of the two devices, the Corpuls 3 provides real-time feedback for the depth and rate of compressions, as well as for ventilation, and includes a metronome to help maintain the correct rhythm. Zoll is famous for its Real CPR Help technology, which provides real-time visual and auditory feedback. Monitors compressions and suggests adjustments to optimize CPR performance.

Figure 6 shows a comparison between the performances of the medical devices, Corpuls 3 and Zoll, represented in a radar plot. Each axis of the graph represents a different performance category: user Interface, design and portability, core functionality, cost, durability and reliability, connectivity and integration, battery and power, defibrillation, monitoring capabilities.

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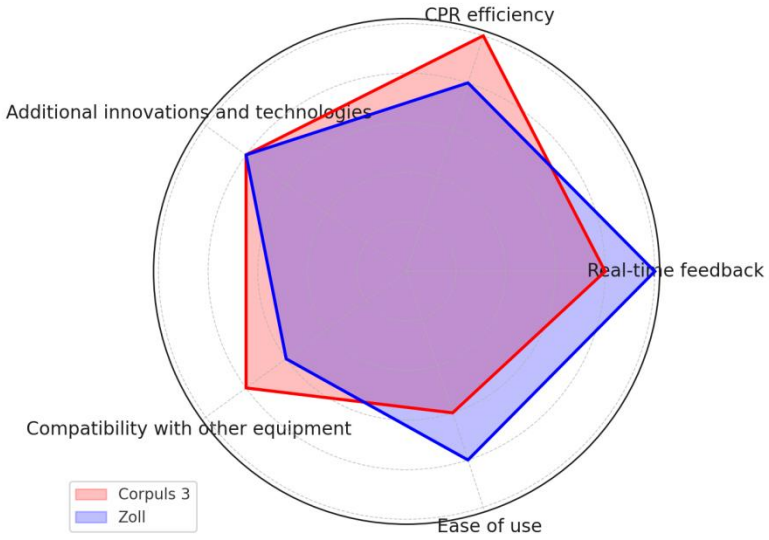

Fig. 5. *Comparison of CPR capacity between Corpuls 3 and Zoll*

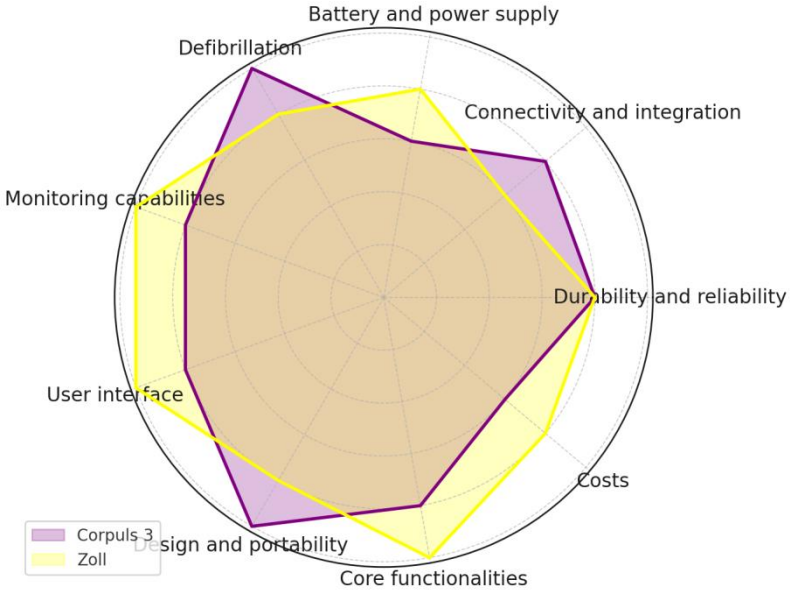

Fig. 6. *Performance comparison Corpuls 3 vs. Zoll*

Looking at the graph, it can see that Corpuls 3 has superior performance in the "User Interface" and "Main Features" categories. Zoll excels in "Design and Portability" and "Durability and Reliability". In the categories "Cost", "Connectivity and Integration", "Battery and Power" and "Defibrillation", the performances of the two devices are very similar, with a slight advantage for Zoll in "Connectivity and Integration". In "Monitoring Capabilities", both devices perform similarly, with a slight edge for the Corpuls 3. The Corpuls 3 excels in most criteria, with an excellent user interface, superior design and portability, and advanced monitoring capabilities. The costs are moderate, being the only criterion where the Corpuls 3 has a lower value than the Zoll. Zoll stands out for lower costs compared to Corpuls 3 and excellent performance in most of the analyzed criteria. It is also easy to use, reliable and offers advanced defibrillation and monitoring capabilities.

In Figure 7 the radar graph is presented that compares how two medical devices, Corpuls 3 and Zoll, perform in monitoring essential vital parameters: ECG (electrocardiography), SpO_2 (blood oxygen saturation), NIBP (non-invasive blood pressure), Temperature and CO_2 (carbon dioxide). The Corpuls 3 excels in ECG, SpO_2 and NIBP

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monitoring, while also performing very well in temperature and CO_2 monitoring, although slightly inferior to the Zoll in these two areas. The Zoll performs excellently in ECG, temperature and CO_2 monitoring, being slightly weaker in SpO_2 and NIBP monitoring compared to the Corpuls 3.

The Corpuls 3 excels in ECG, SpO_2 and NIBP monitoring, while also performing very well in temperature and CO_2 monitoring, although slightly inferior to the Zoll in these two areas. The Zoll performs excellently in ECG, temperature and CO_2 monitoring, being slightly weaker in SpO_2 and NIBP monitoring compared to the Corpuls 3.

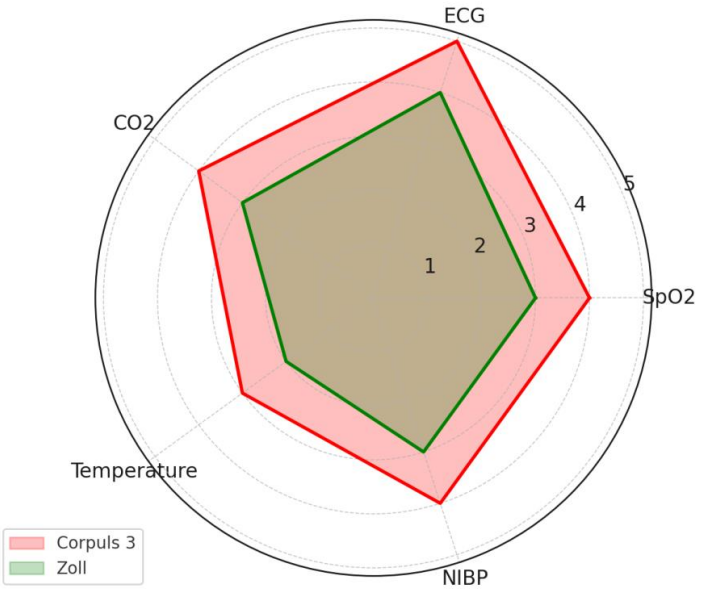

Fig. 7. *Comparison of vital parameters monitoring between Corpuls 3 and Zoll*

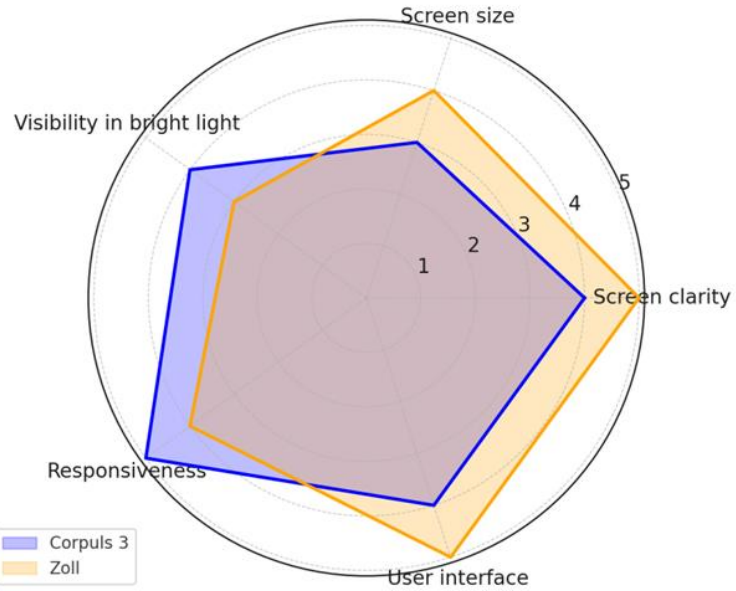

Fig. 8. *Comparison regarding the analysis of monitoring screens between Corpuls 3 and Zoll*

In Figure 8 is presented the radar chart that comparatively illustrates how two medical devices, Corpuls 3 and Zoll, perform on several criteria related to monitoring screens: screen size, screen clarity, user interface, responsiveness, and visibility in bright light.

The Corpuls 3 excels in screen size, user interface, and responsiveness, performing very well in

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screen clarity and bright light visibility as well, though slightly inferior to the Zoll in these two areas. The Zoll performs excellently in screen clarity and visibility in bright light, falling slightly short in screen size, user interface, and responsiveness compared to the Corpuls 3.

Figure 9 shows the radar graph that provides a clear visualization of the maintenance costs for each device according to the analysed criteria.

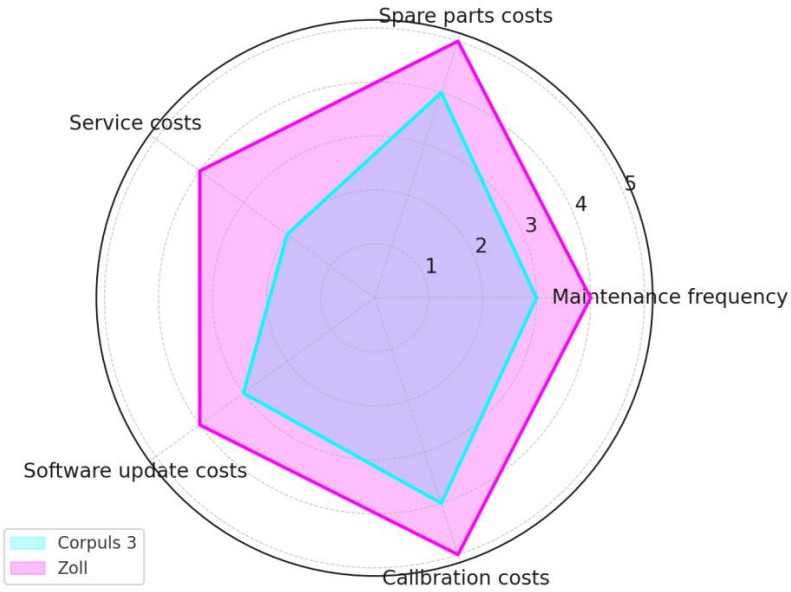

Fig. 9. *Comparison of maintenance costs Corpuls 3 vs. Zoll*

Corpuls 3 stands out with more moderate costs in all compared aspects, while Zoll presents higher costs, especially in terms of maintenance frequency and service costs. Corpuls 3 has more moderate costs for spare parts, calibration and service due to its modular design and component accessibility. Costs for software updates are lower compared to Zoll.

Zoll has higher costs for spare parts, calibration and service due to its complexity. Maintenance frequency is higher compared to Corpuls 3 and software update costs are moderate. This can be an important factor to consider when deciding whether to invest in one of these pieces of equipment.

4. Conclusions

Corpuls 3 is distinguished by its modular design, which allows increased flexibility in use and customization according to the specific needs of medical interventions. This aspect is crucial in emergency situations, where quick adaptability can mean the difference between life and death. The device is not just a defibrillator, but a complete patient monitoring system, offering advanced vital sign monitoring features including ECG, pulse oximetry, blood pressure and capnography. This allows medical staff to get an overview of the patient's condition and get informed decisions in real time.

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