have found D50W to be more readily available in resuscitation situations. Emergency department staff may be more familiar with D50W than D10W or D25W. While several studies evaluate the use of D10W for patients of all ages in the prehospital setting [6,7], D50W continues to be the most common formulation used to treat hypoglycemia in adults in U.S. emergency departments. Unlike D50W and D25W, premixed syringes of D10W are not commercially produced, so D10W must be infused from a bag or withdrawn from the bag in order to be administered.

The following technique allows for the creation of any dextrose concentration lower than 50% from D50W, and the resulting mixture is ready for push infusion from a 60 mL syringe. Gather a D50W ampule or vial, a 60 mL luer-lock syringe, an 18 gauge needle or a transfer device, and enough sterile water to dilute the mixture. Draw up an amount of D50W in the 60 mL syringe that matches the desired concentration of dextrose. For example, draw up 10 mL to create D10W, and 25 mL to create D25W. The D50W may be drawn into the 60 mL syringe either directly with an 18 gauge needle, or by using a transfer device (Fig. 1). Dilute the mixture to 50 mL total volume with sterile water, label appropriately, and mix by inverting the syringe and then turning it upright several times. Some 60 mL syringe manufacturers place a circle around the 50 mL marker, which can serve as a memory aid. The operator can potentially make any concentration of dextrose lower than 50% using this technique. As an example, 12.5 mL of D50W diluted to 50 mL with 37.5 mL of sterile water would create D12.5W. The most useful dextrose concentrations to an EP, however, are D10W and D25W. The final volume of 50 mL will often allow for additional boluses as needed. Used in conjunction with the "rule of 50", this technique allows for treatment of hypoglycemia at any age (Fig. 2).

If sterile water is unavailable, normal saline can be used to dilute the D50. In the case of dilution to D10, this will be 1 part D50W (osmolarity 2552 mOsm/L) and 4 parts normal saline (osmolarity 308 mOsm/L). The osmolarity of this mixture will be 757 mOsm/L $[(4 \times 308 + 2552) / 5]$, which is higher than D10W (505 mOsm/L) but still lower than the recommended maximum osmolarity for a pediatric peripheral infusion. The additional sodium and chloride would also need to be considered in the context of the resuscitation.

We created a video demonstration of the technique and uploaded it to YouTube (https://youtu.be/CdArekqU2u4).

In the future, D10W may gain wide acceptance for hypoglycemia treatment at all ages in the United States, simplifying treatment. This transition occurred in the United Kingdom in the early 2000s and has been advocated for in Australia [6,7]. Until the United States adopts this practice, our technique offers a straightforward means to dilute dextrose by hand. For EPs working in emergency departments that do not have D25W and D10W readily available, this technique may be used to rapidly create these concentrations in order to treat pediatric hypoglycemia.

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Effects of videolaryngoscopes on cognitive workload during tracheal intubation performed by emergency residents

Tracheal intubation using direct laryngoscopy (DL) is the gold standard for airway management during resuscitation of severely ill patients [1]. The procedure may be challenging even for experienced physicians. In prehospital settings, tracheal intubation may be even more difficult considering unfavorable conditions such as poor or bright light, narrow space, and uncomfortable position of rescuers [2]. Lack of practice by emergency physicians due to the small number of procedures performed each year adds to the difficulty [3]. These two additional factors may be associated with lower success rates [4] and worse outcomes [5].

Videolaryngoscopes (VL) are devices developed to address the difficulties associated with tracheal intubation [6]. VLs provide indirect view of upper airway using optical or video camera technology, thereby improving glottis visualization compared to DL [7], but have not been associated with better first attempt success rate or shorter time for tracheal intubation when performed by experienced physicians [8]. Besides technical performance, usability is an important factor that may be associated with tracheal intubation failure [9] that can be assessed using cognitive workload. Cognitive workload is defined as the level of overall effort expended by individuals in response to a task and is closely related to the usability of devices having been developed to fulfill this task. High cognitive workload is associated with greater number of medical errors and worse outcomes [9]. We hypothesized that VL use could be helpful for emergency novices by reducing cognitive workload during challenging tracheal intubation.

In an experimental study, two VLs (APA [BD Carefusion, USA] and AT [Vygon, France]) were compared to DL in a randomized order through two consecutive simulated situations (easy and prehospital scenarios). Emergency residents with little experience in tracheal intubation were enrolled in the study. They attended theoretical and practical training courses prior to inclusion.

The easy scenario was conducted using fresh cadavers with good laryngeal visibility on DL installed in supine position on a dissection table in a room with sufficient luminosity. The prehospital

Table 1
Usability assessment according to situation and device used.

	Usability scales	Direct laryngoscopy	Airtraq	p-Value[a]	APA	p-Value[a]
Easy airway scenario	TLX	54 [38–71]	62 [48–75]	0.10	54 [43–65]	0.57
	Mental WL	8 [5–16]	13 [7–21]	0.31	11 [5–14]	0.47
	Physical WL	3 [0–7]	4 [2–9]	*<0.001*	2 [0–4]	0.39
	Temporal WL	13 [11–24]	16 [13–21]	0.83	13 [7–16]	0.30
	Performance	9 [5–13]	8 [5–13]	0.44	8 [3–16]	0.39
	Effort	3 [0–4.5]	6.3 [4–12]	*0.004*	3 [1–12]	0.073
	Frustration	6 [0–15]	0 [0–20]	0.94	1 [0–7]	0.061
	Perceived difficulty	3 [2–5]	5 [4–7]	*0.005*	5 [3–7]	0.076
Prehospital scenario	TLX	81 [62–87]	33 [30–45]	*0.005*	48 [31–66]	*0.008*
	Mental WL	5 [0–9]	5 [2–10]	0.94	4 [3–14]	0.43
	Physical WL	15 [5–25]	2 [1–5]	*0.005*	1 [0–4]	*0.003*
	Temporal WL	13 [7–17]	12 [8–16]	0.64	16 [9–21]	0.43
	Performance	9 [6–13]	6 [4–10]	0.21	9 [5–17]	1
	Effort	18 [12–23]	3 [2–8]	*0.004*	5 [2–10]	*0.007*
	Frustration	11 [0–20]	1 [0–9]	0.28	1 [0–5]	*0.037*
	Perceived difficulty	8 [6–10]	4 [3–6]	*0.011*	5 [2–7]	*0.012*

Data are expressed as median and first and third interquartile or in population and proportion. Perceived difficulty was assessed according to a Likert-scale ranging from 0 (no difficulty) to 10 (high difficulty). NASA-TLX dimensions were rated using a Likert-type scale ranging from 0 (low level) to 100 (high level) except for performance ranging from 0 (high performance) to 100 (low performance) and secondly weighting by letting the subjects compare them pairwise, based on their perceived importance. The sum of the weighted ratings is used to obtain the TLX. APA – Carefusion APA videolaryngoscope; TLX – Task Load Index; WL – Workload. Data in italics shown the significative p-value.
[a] Comparison against direct laryngoscopy.

scenario was conducted using one high-fidelity manikin (Simman3G, Laërdal, Stavanger, Norway), installed in supine position on the floor, in a small room with poor ambient light.

We used tracheal tubes with 7.5-mm internal diameter, size 4 Macintoch Blade and size 4 difficult intubation blade for APA and AT. Students had 180 s to succeed in each tracheal intubation. The main endpoint was cognitive workload measured using NASA-TLX previously described [10,11]. Secondary endpoints were glottis visualization using the Cormack-Lehane scale [12], success rate and time to successful intubation split into three sequences (vocal cord exposure, tracheal tube insertion, cuff inflation).

A total of 73 sequences were recorded in easy scenario (LD, n = 25; AT, n = 23; APA, n = 25) and 78 in prehospital scenario (LD, n = 26; AT, n = 26; APA, n = 26) for a total of 151 tracheal intubations.

In Easy scenario, TLX were similar between DL and AT or APA use (Table 1). Cormack-Lehane scale was similar between DL and both VLs (Table 2). Tracheal intubation success rate was comparable and time to successful tracheal intubation was shorter with DL than AT or APA use. With VLs, participants mentioned difficulties in advancing tracheal tube due to a hitch against arythenoids and removing the blade after tracheal intubation.

In Prehospital scenario, TLX values were higher with DL than Airtraq or APA. Glottis visualization was better with both VLs compared to DL (Table 2). Tracheal intubation success rate was similar between DL and each VL and time to successful intubation was higher with DL than AT but similar with APA.

In this simulation trial, VLs neither reduced cognitive workload nor improved intubation success rate in the easy scenario. Partici-

Table 2
Time necessary to perform successful intubation and glottis visualization according to the devices.

		Direct laryngoscopy	Airtraq	p-Value[a]	APA	p-Value[a]
Easy airway scenario	Intubation step N; time in s					
	Vocal cords exposure	25; 12 [6–14]	23; 12 [6–22]	0.36	25; 12 [6–24]	0.48
	Tube insertion	25; 7 [5–17]	22; 9 [7–54]	*0.13*	21; 13 [6–35]	*0.13*
	Cuff inflation	25; 9 [6–10]	22; 12 [6–16]	0.18	21; 12 [8–15]	*0.036*
	Total time for success	25; 32 [20–41]	22; 43 [30–96]	*0.019*	21; 46 [42–57]	*0.002*
	Cormack class	N = 25	N = 23		N = 25	
	I	19 (79)	17 (75)	1	13 (54)	0.19
	II	5 (21)	5 (21)		8 (33)	
	III	0 (0)	1 (4)		2 (8)	
	IV	0 (0)	0 (0)		1 (4)	
Prehospital scenario	Intubation step N; time in sec					
	Vocal cords exposure	26; 16 [10–30]	26; 7 [3–17]	0.002	26; 5 [3–12]	*<0.001*
	Tube insertion	18; 14 [10–36]	24; 7 [4–12]	*<0.001*	20; 5 [3–10]	*<0.001*
	Cuff inflation	18; 6 [5–12]	24; 8 [6–12]	0.09	20; 8 [4–13]	0.71
	Total time for success, in s	18; 31 [60–112]	24; 24 [18–35]	*0.001*	20; 26 [14–37]	0.11
	Cormack class	N = 24	N = 24		N = 24	
	I	6 (25)	18 (75)	*<0.001*	8 (33.3)	*0.009*
	II	4 (16.7)	6 (25)		12 (50)	
	III	8 (33.3)	0 (0)		4 (16.7)	
	IV	6 (25)	0 (0)		0 (0)	

Data are expressed as number of values, median [interquartile range] or number (proportion). Vocal cord exposure, tube insertion, cuff inflation represented data of participants who succeeded in performing the step. Total time represented data of all participants. In case of failure, total time was set at 180 s. The Cormack class was assessed for only 24 of the participants in the prehospital scenario.
APA – Carefusion APA videolaryngoscope; TLX – Task Load Index; WL – Workload; PH – Prehospital; EA – Easy Airway. Data in italics shown the significative p-value.
[a] Comparison with direct laryngoscopy.

pants mentioned difficulties in advancing tracheal tube due to a hitch against arytenoids, as previously reported [13].

By contrast, VLs reduced cognitive workload in the prehospital scenario. Although the use of VLs was not associated with better success rate or a lower tracheal intubation time, cognitive workload assessment suggested easier conditions for tracheal intubation performed by novices. VLs can be useful because the acute angle of a VL blade allows direct visualization of the glottis regardless of the position of the rescuers or of the patient's head [7]. A difficult intubation in prehospital settings differed from anesthesia definition [2]. Patient on the floor is an independent predictor of difficult intubation, because this position requires changes in rescuers position and patients' head, both impeding vision of the glottis [14].

Our main limit is that we used simulated models instead of real patients. However, fresh cadavers and high-fidelity manikins are known to closely simulate real conditions and are considered as good alternatives [15]. Moreover, it would not be ethical to conduct this study in living patients.

To conclude, VLs may be helpful for novices during tracheal intubation in difficult prehospital settings.

Authors contribution statements

NM conceived the study. NM, JGue, JGui and MD recorded data. OM and JPR supervised the study. NM performed statistical analysis. NM and JGue wrote the manuscript with support from OM. All authors discussed the results and contributed to the final manuscript. All authors approved the final manuscript.

Ethics approval statements

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Clinical trial registration

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