The clinical practice of small animal CPR and compliance with RECOVER guidelines in Switzerland: an internet-based survey

A. P. Kruppert[1], K. N. Adamik[2], S. N. Hoehne[2]

[1]Division of Anesthesiology and Pain Therapy, Department of Clinical Veterinary Science, Vetsuisse Faculty, University of Bern, Switzerland; [2]Division of Small Animal Emergency and Critical Care, Department of Clinical Veterinary Science, Vetsuisse Faculty, University of Bern, Switzerland

Die Kardiopulmonale Wiederbelebung (CPR) beim Kleintier unter Einhaltung der RECOVER Wiederbelebungsrichtlinien in der Schweiz: Eine internetbasierte Umfrage

Ziel: Im Jahr 2012 veröffentlichte die «Reassessment Campaign on Veterinary Resuscitation» (RECOVER) die ersten evidenzbasierten Herz-Lungen-Wiederbelebungsrichtlinien für Kleintiere. Obwohl sich gezeigt hat, dass ein RECOVER-basierter CPR-Ansatz den Wiederbelebungserfolg am Patienten verbessert, sind das Kennen der Richtlinien und deren Einhaltung erforderlich, um diese Erfolge zu erzielen. Das Ziel der vorliegenden Studie war es, die CPR Praxis in Schweizer Kleintierkliniken unter Einhaltung der RECOVER-Richtlinien zu bewerten.

Methoden: Eine landesweite, internetbasierte Umfrage wurde durchgeführt, dazu wurden Einladungen über die Mailinglisten der Gesellschaft Schweizer Tierärztinnen und Tierärzte (GST) versendet. Die Fragen betrafen die Demografie der Befragten, die CPR-Vorbereitung, die Basismassnahmen (BLS) und die erweiterten Massnahmen (ALS) der Reanimation sowie die Kenntnis der RECOVER-Richtlinien. Für die Einschätzung des Datensatzes der 95% -Konfidenzintervall berechnet.

Ergebnisse: Einhundertfünfzig Befragte wurden nach Fachwissen in Fachtierärzte (BCS, n=19), Tierärzte mit zusätzlicher postgradualer Ausbildung (PGT, n=27) und Allgemeintiermediziner mit (GPE, n=30) und ohne Notdienst (GPG, n=74) unterteilt. Von den BCS-Befragten waren 58% (36–77%) mit den RECOVER-Richtlinien vertraut, verglichen mit 8% (4–17%) der GPG. Bei den Fachkenntnissen zeigten sich grosse Unterschiede bei der CPR Vorbereitungs-, BLS- und ALS-Techniken. Die Nichteinhaltung der Vorbereitungsmassnahmen variier-

Abstract

Objective: In 2012, the Reassessment Campaign on Veterinary Resuscitation (RECOVER) published the first evidence-based small animal CPR guidelines. Even though a RECOVER-based CPR approach has been shown to improve patient outcomes, guideline awareness and compliance is necessary to see such benefits. Our study aimed to characterize Swiss small animal veterinary CPR practices and assess their compliance with RECOVER guidelines.

Methods: A nationwide, internet-based survey was conducted, and invitations distributed via Swiss veterinary society mailing lists. Questions covered respondents' demographics, CPR preparedness, Basic Life Support (BLS) and Advanced Life Support (ALS) techniques, and awareness of RECOVER guidelines. Percentages of group total (95% confidence interval) were calculated.

Results: One-hundred and fifty respondents were grouped by level of expertise into board-certified specialists (BCS, n=19), veterinarians with additional post-graduate training (PGT, n=27), and general practitioners with (GPE, n=30), and without emergency duties (GPG, n=74). Of BCS respondents, 58% (36–77%) were familiar with the RECOVER guidelines, compared to 8% (4–17%) of GPG. Large disparities in preparedness, BLS, and ALS techniques emerged among the levels of expertise. Incompliance with preparedness measures varied from 89% (69–98%) in BCS to 100% (95–100%) in GPG and was predominantly due to failure to attend regular CPR training. BLS compliance ranged from 26% (12–49%) in BCS to 5% (2–13%) in GPG, and incompliance was mostly characterized by targeting lower than recommended chest compression rates. ALS compliance varied from 21% (9–43%) in BCS to 0% (0–5%) in GPG and was compromised by limitations in the resuscitation environment such as lacking access to a defibrillator, monitoring equipment, and rescue drugs.

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te von 89% (69–98%) bei BCS bis 100% (95–100%) bei GPG und war hauptsächlich auf die Nichtteilnahme an regelmässigen CPR-Schulungen zurückzuführen. Die BLS-Befolgung lag zwischen 26% (12–49%) bei BCS und 5% (2–13%) bei GPG, die Nichtbeachtung war durch zu tiefe Thoraxkompressionsraten verursacht. Die ALS-Compliance variierte von 21% (9–43%) bei BCS bis 0% (0–5%) bei GPG und wurde durch Einschränkungen in der Notfallumgebung beeinträchtigt, z. B. fehlender Defibrillator, Überwachungsgeräte und Notfallmedikamente.

Schlussfolgerung: Bei Fachtierärzten in der Schweiz ist die Kenntnis der RECOVER-Richtlinien akzeptabel, bei Allgemeintierärzten jedoch unzureichend. Die ungenügende Kenntnis der RECOVER-Richtlinien führt zu nicht übereinstimmenden CPR-Praktiken. Für die Verbesserung des CPR-Wissens und Massnahmen in der Schweiz ist eine Bildungsstrategie in der Kleintiermedizin notwendig.

Schlüsselwörter: Herzstillstand, kardiopulmonale Wiederbelebung, Katze, Compliance, Hund, RECOVER-Richtlinien

Conclusion: Awareness of RECOVER guidelines in Switzerland is acceptable in specialists, but inadequate among general practitioners and CPR practices are largely not in agreement with RECOVER guidelines. An educational strategy is needed to improve Swiss small animal CPR knowledge and performance.

Key words: cardiac arrest, cardiopulmonary resuscitation, cat, compliance, dog, RECOVER guidelines

Abbreviations

ALS: Advanced life support
BCS: Board-certified specialists
BLS: Basic life support
BPM: Breaths per minute
CE: Continuing education
CI: Confidence Interval
CPA: Cardiopulmonary arrest
CPM: Compressions per minute
CPR: Cardiopulmonary resuscitation
ECG: Electrocardiogram
$EtCO_2$: End-tidal carbon dioxide
GPE: General practitioners in an emergency setting
GPG: General practitioners in a non-emergency setting
GST: Gesellschaft Schweizer Tierärztinnen und Tierärzte
IQR: Interquartile range
PGT: Veterinarians with additional post-graduate training
RECOVER: Reassessment Campaign on Veterinary Resuscitation
ROSC: Return of spontaneous circulation
SVK: Schweizerische Vereinigung für Kleintiermedizin

Introduction

The importance of veterinary cardiopulmonary resuscitation (CPR) has only relatively recently gained growing recognition, and less than ten years ago, evidence-based guidelines for small animal CPR execution were not available. Correspondingly, an internet-based survey evaluating the clinical practice of CPR published in 2010 found that CPR performance among small animal practitioners was very variable.[7] The Reassessment Campaign on Veterinary Resuscitation (RECOVER) initiative responded to this lack of standardization by evaluating the scientific evidence relevant to veterinary CPR and composed the first evidence-based, clinical consensus guidelines for small animal CPR practice in 2012.[12] Eight years later, these guidelines have been adopted by emergency and critical care specialists as the standard of care during CPR and are widely used in CPR training and certification of veterinary professionals.

Return of spontaneous circulation (ROSC) and survival to hospital discharge rates between human and veterinary medicine differ widely. Prior to the publication of the RECOVER guidelines, ROSC rates in small animals reportedly ranged from 28–58% and survival to hospital discharge rates from 3–10%, compared to ROSC rates of up to 53% and survival to hospital discharge rates of up to 34% in people suffering an in-hospital cardiopulmonary arrest (CPA).[25,28,34,41,42] To achieve better CPR outcomes in veterinary medicine, we need to improve the early recognition of CPA, basic life support (BLS) and advanced life support (ALS) strategies, and enhance post-resuscitative phase care.[6] In people, incompliance with resuscitation guidelines leads to worse patient outcomes, and the publication of the RECOVER clinical guidelines was a first step towards improving the outcomes of veterinary patients.[32] A recent Japanese study was able to demon-

strate that the implementation of the RECOVER guidelines improved ROSC and survival to hospital discharge rates in dogs compared to a traditional, non-standardized CPR approach.[26]

Even though a RECOVER-based approach to veterinary CPR has been shown to improve patient outcomes, such benefit can only be expected if the veterinary community is widely aware of guideline existence and if the compliance with guideline recommendations is high. A recent international, internet-based survey evaluating the compliance of current small animal CPR practice with RECOVER guidelines confirmed that guideline awareness positively impacts compliance, but showed that awareness of RECOVER guidelines remains incomplete among general practitioners.[13] Furthermore, it showed that limited resources in general practice could additionally negatively impact guideline compliance.[13] This improved understanding of incompliance factors could now be used to help develop more widely accessible educational strategies in the area of small animal CPR.

To date, no data exist regarding the awareness of the RECOVER guidelines or current small animal CPR practices in Switzerland. We therefore conducted a nationwide, internet-based survey that examined the clinical practice of small animal CPR in Switzerland. Our study aimed to assess the awareness of RECOVER guidelines among actively practicing Swiss small animal veterinarians, to evaluate if awareness varies between different levels of expertise, and to determine if current CPR practices in Switzerland comply with RECOVER guideline recommendations.

Materials and methods

Data collection

A commercial, internet-based survey development tool was used to create the survey and anonymously collect participant responses (Survey Monkey®, www.surveymonkey.com). The internal ethics review board at the Vetsuisse Faculty, University of Bern, waived the need for ethical approval for the survey procedure. Survey invitations were distributed via electronic media of two Swiss professional veterinary organizations; the Society of Swiss Veterinarians (GST, Gesellschaft Schweizer Tierärztinnen und Tierärzte) and the Swiss Association for Small Animal Medicine (SVK-ASMPA, Schweizerische Vereinigung für Kleintiermedizin). The initial invitations were included in the July 2019 GST and SVK newsletters. A reminder was distributed via the GST mailing list in August 2019. The survey closed on September 30th, 2019. Survey links were also made available on social media outlets of the Vetsuisse Faculty at the Universities of Bern and Zurich over the same time period. Neither the e-mail invitations nor the text introducing the survey purpose mentioned the term RECOVER.

Survey and classification of respondents' level of expertise

The distributed survey was adapted from a previously conducted international survey on small animal CPR practice and made available to Swiss veterinarians in German, French, and Italian [13]. It included 49 questions regarding respondents' demographics; opinions on CPR; CPR training; preparedness, BLS, and ALS equipment and techniques; familiarity with and use of the RECOVER guidelines **(supplemental data)**. Question formats included single- and multiple-answer multiple-choice, Likert's and slider scales, and categorical and numerical ranking questions. Most questions were closed-ended, but for selected questions, a free-text field was provided for elaboration. Respondents were expected to complete the survey in approximately 10 minutes based on pre-release pilot evaluations.

The initial 20 questions surveyed population characteristics, such as gender, age, post-graduate specialty training, current career status, and clinical environment. We used these questions to apply inclusion and exclusion criteria and to subdivide respondents into groups based on level of expertise. Responses from veterinary students or non-practicing veterinarians (e. g., public health officials) were excluded from the analysis, as were surveys that were terminated prematurely.

Participants were then divided into four groups based on their qualifications, namely board-certified specialists (BCS), veterinarians with additional post-graduate training (PGT), general practitioners working at a practice that provides 24 hours emergency services or at an emergency and critical care center (GPE), and general practitioners working in practices with emergency service available only during business hours with or without an after-hours on-call service (GPG). Individuals holding a Swiss national companion animal specialist qualification (FVH), residents in training to obtain board certification for any clinical veterinary medical subspecialty, and assistant doctors following completion of a rotating internship but not enrolled in a formal post-graduate training program were included in the group PGT. Interns were allocated to either GPE or GPG, depending on their training mandated coverage of emergency services, using the same criteria as for general practitioners.

The subsequent seven questions covered participants' practice in offering and frequency of conducting CPR, and their potential reasoning for not doing so. Eighteen questions inquired information about CPR performance in the areas of preparedness, BLS, and ALS techniques.

The final four questions asked respondents' opinions about CPR importance, their CPR capability, awareness of the 2012 RECOVER consensus guidelines, and opinions regarding the usefulness of the guidelines to improve CPR practice.

Compliance with CPR guidelines

To evaluate if respondents' CPR practices were in agreement with the RECOVER guidelines, compliance composite variables were created for the three areas of CPR preparedness, BLS, and ALS techniques, as previously published.[13] Preparedness compliance was defined as having participated in CPR training within the last six months, displaying CPR cognitive aids in the practice (CPR algorithm and drug dosing chart), and maintaining a crash cart.[12] BLS compliance was defined as knowledge of the RECOVER recommended chest compression rate (100–120 compressions per minute (cpm)) and ventilation rate (6–15 breaths per minute (bpm)) for both dogs and cats.[12,13] Lastly, respondents were considered ALS compliant if they have access to a defibrillator, use electrocardiogram (ECG) and end-tidal carbon dioxide ($EtCO_2$) monitoring regularly, do not use intravascular volume expansion routinely, and have access to epinephrine and/or vasopressin, atropine, amiodarone and/or lidocaine, and sodium bicarbonate.[12,13]

Statistical analyses

Survey responses from the collector were downloaded into a commercial computer program spreadsheet (Microsoft Excel®), reviewed, and edited to exclude cases that met exclusion criteria. Data was subsequently imported into a commercially available statistical program for analysis (Prism 8.0, GraphPad Software, La Jolla, CA, U.S.A). For categorical data, percentages of group total and 95% confidence intervals (CI) were calculated and results are presented as percentage (95% CI) unless stated otherwise. Categorical population characteristics and response frequencies of binary answers were compared between two groups using Fisher's exact test and among multiple groups using Chi-Square tests. Normality testing on continuous data, including Likert-scale responses, was performed using the Shapiro-Wilk test and by examining normal plots. Normally distributed data are presented as mean +/- SD, and non-normally distributed data is presented as median (interquartile range, IQR). Non-normally distributed data were compared among multiple groups using the Kruskal-Wallis Test. Post-hoc analyses were performed using Dunn's multiple comparisons test, and Bonferroni corrections were applied to adjust for multiple comparisons where appropriate. P-values and adjusted P-values of <0.05 were considered statistically significant.

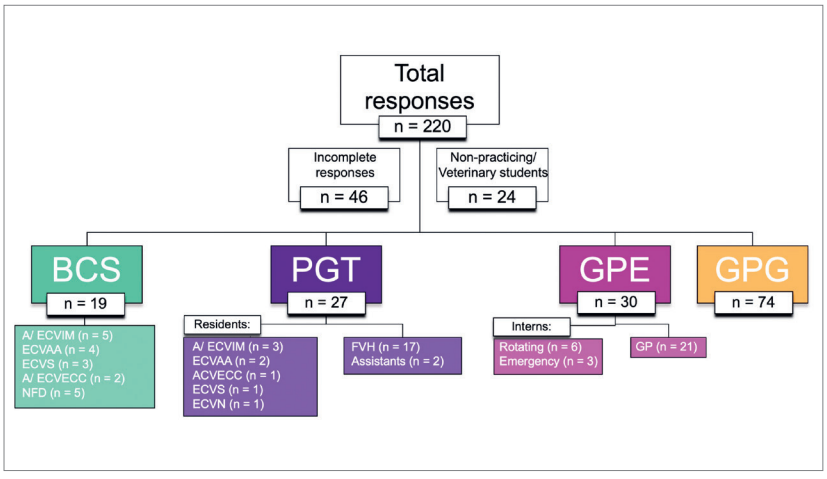


Figure 1: Flow diagram of survey responses and identification of respondents of Swiss veterinarians (n=150) included in the final analysis of an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines.
BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting; ECVAA, European College of Veterinary Anesthesia and Analgesia; A/ECVIM, American/ European College of Veterinary Internal Medicine; ECVS, European College of Veterinary Surgeons; A/ECVECC, American/ European College of Veterinary Emergency & Critical Care; ECVN, European College of Veterinary Neurology; NFD, not further defined; FVH, Veterinary specialist for small animals/ Fachtierarzt für Kleintiere.

Results

Respondent characteristics

Two hundred and twenty veterinary professionals participated in the survey. Thereof, 70 responses were excluded from data analysis due to incompleteness or stemming from non-target respondents. Responses from 150 practicing Swiss veterinarians were analyzed further and included 19 BCS (13%), 27 PGT (18%), 30 GPE (20%) and 74 GPG (49%) **(Figure 1)**. Population and clinical environment characteristics of the respondent groups can be found in **Table 1**. The emergency setting of respondents' practices is summarized in **Table 2**.

There was no statistically significant gender difference between the four groups. GPG were significantly older than both PGT and GPE ($P<0{,}0001$ and $P=0{,}03$, respectively). Sixty-eight percent of BCS and all residents worked in an academic setting. Nine interns were all included in GPE. Board-certified specialists (42% (23–64%)) and PGT (33% (19–52%)) more commonly worked in practices with more than 50 employed veterinarians. All study participants treated small animals, 95% (75–100%) of BCS, 85% (66–94%) of PGT, 59% (41–74%) of GPE, and 74% (63–83%) of GPG treated small animals exclusively. There was no statistically significant difference in daily caseload among groups. However, there was a significant difference in the proportion of animals presented on an emergency basis per day **(Table 1)**. There were statistically significant differences between the number of times individuals per-

Table 1: Population and clinical environment characteristics by groups of Swiss veterinarians (n=150) responding to an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines.

BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting; IQR, interquartile range. Data are expressed as the percentage of group total (95% confidence interval) unless stated otherwise. P-values refer to comparisons among all groups.

	BCS	PGT	GPE	GPG	P-value
Respondents per group	n=19	n=27	n=30	n=74	
Age (years, median (IQR range))	42,5 (36–50)	33 (30–41)	31 (28–56)	48 (37–56)	<0,0001
Female respondents	68 (46–85)	85 (68–94)	70 (52–83)	72 (60–81)	0,48
Graduation from veterinary school ≤10 years ago	37 (19–59)	59 (41–75)	60 (42–75)	20 (13–31)	<0,0001
Respondents with >5 veterinarians in practice	90 (69–98)	70 (52–84)	57 (39–73)	11 (1–20)	<0,0001
Number of treated patients per day >10 patients	50 (29–71)	59 (41–75)	63 (46–78)	76 (65–84)	0,12
Respondents with caseload ≥50% emergencies per day	24 (10–47)	12 (4–29)	14 (6–31)	0 (0–5)	0,0024
Respondents performing CPR ≥6 times per year	53 (32–73)	26 (13–45)	23 (12–41)	7 (3–15)	<0,0001
Respondents with resuscitation team of ≥4 people	74 (51–88)	42 (26–61)	30 (17–48)	5 (2–13)	<0,0001

formed CPR per year and the resuscitation team size among the four groups **(Table 1)**.

CPR perception and awareness of RECOVER guidelines

The majority of respondents in all groups agreed that good CPR is a crucial skill for the small animal practitioner (BCS (median (IQR)) 89% (48–100%); PGT 75% (40–93%); GPE 90% (55–100%); GPG 71% (50–99%); P=0,41). When asked to judge their CPR skills, 68% (46–85%) of BCS assessed them to be good to excellent; whereas 74% (55–87%) of PGT, 77% (59–88%) of GPE, and 84% (74–90%) of GPG described their ability as sufficient to inadequate (P<0,0001). The minority of BCS (26% (12–49%)) and GPG (32% (22–43%)) stated that they were lectured on CPR in veterinary school, compared to PGT (58% (39-74%)) and GPE (53% (36-70%)) (P=0.03). Fifty-eight percent (36-77%) of BCS, 37% (22–56%) of PGT, 33% (19–51%) GPE, and 8% (4–17%) of GPG were familiar with RECOVER guidelines, and 53% (32–73%) of BCS, 35% (19–54%) of PGT, 33% (19–51%) of GPE, and 4% (1–11%) of GPG stated that they apply them in daily practice (P<0,0001).

All (83–100%) BCS and PGT (100% (88–100%)), 97% (83–100%) of GPE, and 89% (80–94%) of GPG offered CPR at their practice. Of respondents who do not offer CPR, 40% (17–69%) of GPE and 21% (10–38%) of GPG responded to be unsure of how to perform CPR; 50% (9–91%) of PGT, 60% (31–83%) of GPE, and 66% (47–80%) of GPG stated they lack equipment; 25% (1–70%) of PGT, 10% (1–40%) of GPE, and 31% (17%–49%) of GPG had no demand; 50% (9–91%) of PGT, 10% (1–40%) of GPE, and 10% (4–26%) of GPG stated lack of indication; 25% (1–70%) of PGT, 10% (1–40%) of GPE, and 7% (1–22%) of GPG stated lack of success; while only 25% (1–70%) of PGT stated high cost as a reason. If respondents only offered CPR in specific circumstances, these included peri-anesthetic CPA (n=42), trauma cases (n=14), in neonates after cesarean section (n=5), respiratory complications (n=7), and cases of collapse or intoxication (n=2).

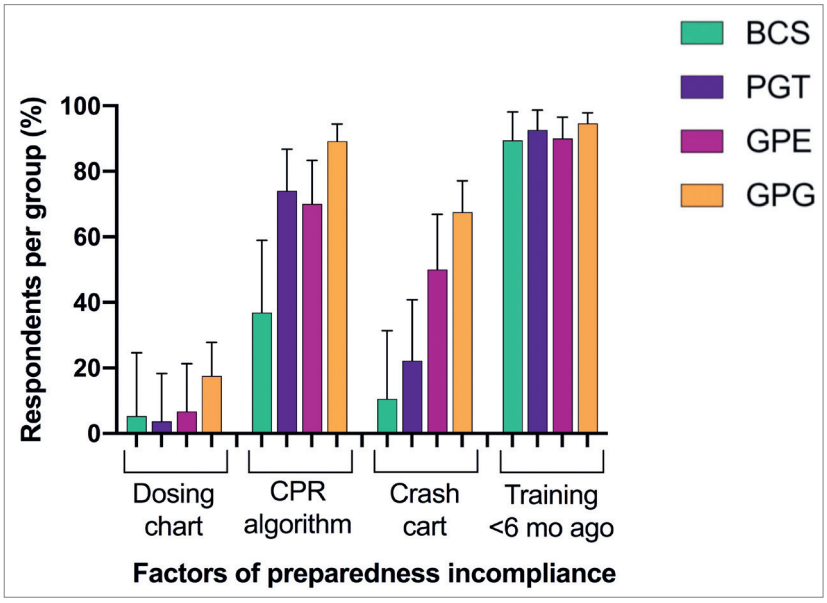
A higher proportion of BCS (47% (27–68%)) routinely conducted CPR for more than 20 minutes, whereas PGT (85% (66–94%)), GPE (73% (56–86%)), and GPG (92% (83–96%)) consider CPR efforts futile prior to expiry of 20 minutes.

Table 2: Emergency setting of respondents' practices by group

BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting. Data are expressed as the percentage of group total (95% confidence interval).

	BCS	PGT	GPE	GPG
Emergency service during regular business hours only	0 (0–17)	4 (2–18)	0 (0–11)	18 (11–28)
Emergency service during regular business hours and on call after hours	0 (0–17)	33 (19–52)	0 (0–11)	82 (72–89)
Emergency service or clinic open after regular business hours only	0 (0–17)	0 (0–12)	0 (0–11)	0 (0–5)
Emergency service or clinic open 24h and able to hospitalize patients	21 (9–43)	30 (16–48)	67 (49–81)	0 (0–5)
Emergency and critical care or referral center	79 (57–91)	33 (19–52)	33 (19–51)	0 (0–5)

Figure 2: Factors of incompliance with recommended preparedness guidelines of Swiss veterinarians (n=150) responding to an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.



Clinical practice of CPR and compliance with RECOVER guidelines

Preparedness

Available preparedness measures in the respondents' practices are listed in **Table 3**.

The vast majority of respondents in all groups stated that their last CPR training was more than six months ago (BCS 89% (69–98%), PGT 93% (77–99%), GPE 90% (74–97%) and GPG 95% (87–98%)). On a scale from 1 (not important) to 10 (very important), the majority of respondents in all groups perceived regular continuing education on CPR to be important (BCS (median (IQR) 10 (8–10), PGT 10 (8–10), GPE 9 (7–10), GPG 8 (6–10); P>0,05). The majority of respondents in all groups furthermore perceived the display of a CPR algorithm (BCS 9 (7–10), PGT 10 (7–10), GPE 8 (5–9), GPG 8 (5–10); P>0,05) and availability of a regularly stocked crash cart to be important (BCS 10 (7–10), PGT 10 (8–10), GPE 9 (5–10), GPG 8 (5–10); PGT vs. GPG P=0,03).

The largest proportion of respondents in all groups were incompliant with CPR preparedness according to RECOVER guidelines (BCS 89% (69–98%), PGT 93% (77–99%), GPE 90% (74–97%) and GPG 100% (95–100%)). The main factors leading to preparedness incompliance are illustrated in **Figure 2**. Taken all groups together, participants who were aware of the RECOVER guidelines were compliant with all preparedness measures significantly more frequently (P=0,01).

Basic life support (BLS)

Targeted chest compression rates in dogs are summarized in **Figure 3**. Fifty-three percent (32–73%) of BCS, 44% (28–63%) of PGT, 33% (19–51%) of GPE, and 15% (9–25%) of GPG targeted the RECOVER recommended chest compression rate of 100–120 cpm (P=0,001). Compared to dogs, participants tended to select higher chest compression rates in cats, with 74% (51–88%) of BCS, 30% (16–48%) of PGT, 50% (33–67%) of GPE, and 19% (12–29%) of GPG aiming for the RECOVER recommended 100–120 cpm (P<0,0001), see **Figure 4**.

Targeted ventilatory rates for dogs and cats are shown in **Figures 5 and 6**. The recommended ventilation rate of 6–15 bpm in dogs was targeted by most BCS respondents (84% (62–94%)), followed by PGT (81% (63–92%)), GPE (57% (39–73%)), and GPG (52% (41–63%); P=0,008). In cats, significantly different proportions of 84% (62–94%) of BCS, 67% (48–81%) of PGT, 57% (39–73%) of GPE, and 49% (38–61%) of GPG targeted the RECOVER recommended ventilation rate of 6–15 bpm (P=0,037).

The majority of respondents routinely used oxygen for patient ventilation during CPR (BCS 95% (75–100%),

Table 3: Small animal cardiopulmonary resuscitation (CPR) preparedness measures available to Swiss veterinarians (n=150) responding to an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines by group

BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting; CPR, cardiopulmonary resuscitation. Data are expressed as the percentage of group total (95% confidence interval).

	BCS	PGT	GPE	GPG
In-house continuing education on veterinary CPR	58 (36–77)	19 (8–37)	40 (25–58)	26 (17–37)
Regular mock codes for staff likely to be involved in CPR	53 (32–73)	30 (16–48)	30 (17–48)	11 (6–20)
Regularly maintained crash cart or crash station	89 (69–98)	78 (59–89)	50 (33–67)	32 (23–44)
Emergency drug dosing chart displayed	95 (75–100)	96 (82–100)	93 (79–99)	82 (72–89)
CPR algorithm displayed	63 (41–81)	26 (13–45)	30 (17–48)	11 (6–20)
CPR recording sheet to document CPR events	58 (36–77)	30 (16–48)	23 (12–41)	5 (2–13)
No preparedness measures available	5 (0–25)	0 (0–12)	7 (1–21)	12 (7–22)

PGT 92% (76–99%), GPE 96% (82–100%), GPG 82% (72–89%)), while fewer participants used room air (BCS 11% (2–31%), PGT 19% (9–38%), GPE 23% (12–41%), GPG 22% (14–32%)) and exhaled breaths (BCS 0% (0–17%), PGT 12% (4–29%), GPE 7% (1–21%), GPG 15% (9–25%)). Ventilatory support was delivered most frequently via endotracheal intubation (BCS 68% (49–82%), PGT 100% (88–100%), GPE 90% (74–97%), GPG 82% (72–89%)), while mouth-to-snout (BCS 5%, (0–25%) PGT 11% (4–28%), GPE 17% (7–34%), GPG 36% (26–48%)) or facemask ventilation (BCS 16% (6–38%), PGT 11% (4–28%), GPE 10% (3–26%), GPG 45% (34–56%)) was most commonly employed by GPG.

Taking the above factors together, the largest proportion of BCS (74% (51–88%)), PGT (93% (77–99%)), GPE (87% (70–95%)), and GPG (95% (87–98%)) were incompliant with recommended BLS guidelines and factors of incompliance are summarized in **Figure 7**. When combining all survey participants, those aware of the RECOVER guidelines were compliant with all BLS recommendations significantly more frequently (P=0,0003).

Advanced life support (ALS)

Almost every participant indicated having performed closed-chest CPR (95% (75–100%) of BCS, 100% (88–100%) of PGT, 100% (89–100%) of GPE, and 97% (91–100%) of GPG). In contrast, open chest CPR had mostly been performed by 68% (46–85%) of BCS and infrequently by other groups (PGT 15% (6–32%), GPE 26% (13–45), GPG 4% (1–11%)).

Monitoring equipment available and regularly used during CPR is listed in **Table 4**. A significant difference was found in use of a defibrillator among groups, with 79% (57–91%) of BCS having defibrillated patients compared to only 4% (1–11%) of GPG (P<0,0001). The use of a precordial thump was most common in GPG (P=0,038).

Frequency of employed routes for drug administration and the availability and use of medications during CPR are summarized in **Tables 5 and 6**. Board-certified specialists overall had more medications available for the use during CPR than PGT, GPE, and GPG. Of medications that were not listed in the multiple-choice question, participants mentioned the use of noradrenaline (n=3), dopamine or dobutamine (n=3), «respiratory drops» (n=3), and glucose, hydroxyethyl starch, esmolol, glycopyrrolate, furosemide, pimobendan, and RevivoVet® (essential oils, and 64% vol. ethanol) (n=1 each), during CPR.

The majority of respondents in all groups indicated that they routinely use intravenous fluid therapy during CPR (BCS 79% (57–91%), PGT 78% (59–89%), GPE 73% (56–86%), GPG 70% (59–79%); P=0,79).

Seventy-nine percent (57–91%) of BCS, 93% (77–99%) of PGT, 93% (79–99%) of GPE, and 100% (95–100%) of GPG did not comply with ALS guidelines, and factors of incompliance are shown in **Figure 8**. Taken all groups together, participants who were aware of the RECOVER guidelines were compliant with all ALS recommendations significantly more frequently (P=0,03).

Figure 3: Targeted chest compression rates in dogs during cardiopulmonary resuscitation (CPR) performed by Swiss veterinarians (n=150) responding to an internet-based survey on small animal CPR and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.

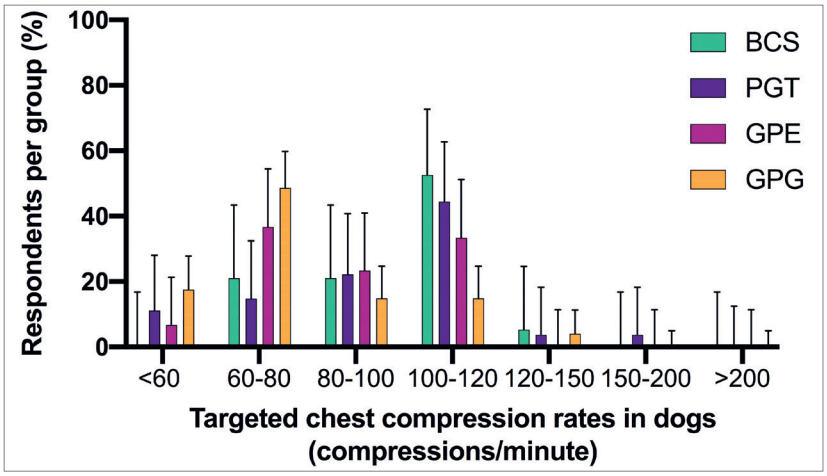


Figure 4: Targeted chest compression rates in cats during cardiopulmonary resuscitation (CPR) performed by Swiss veterinarians (n=150) responding to an internet-based survey on small animal CPR and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.

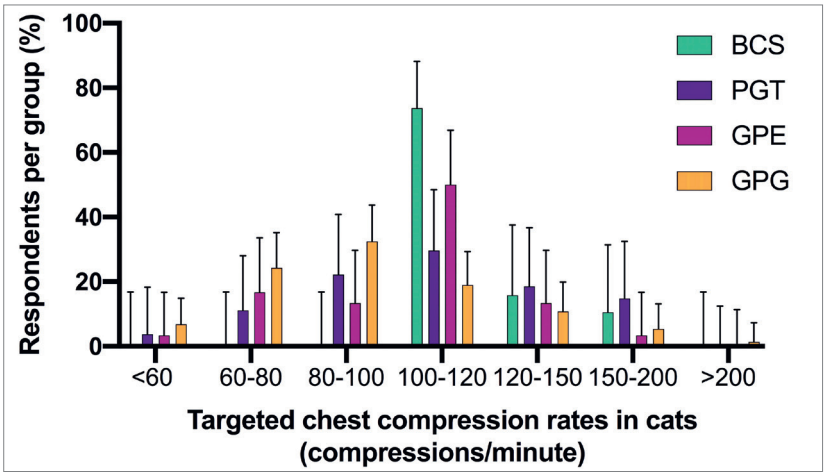


Figure 5: Targeted ventilation rates in dogs during cardiopulmonary resuscitation (CPR) performed by Swiss veterinarians (n=150) responding to an internet-based survey on small animal CPR and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.

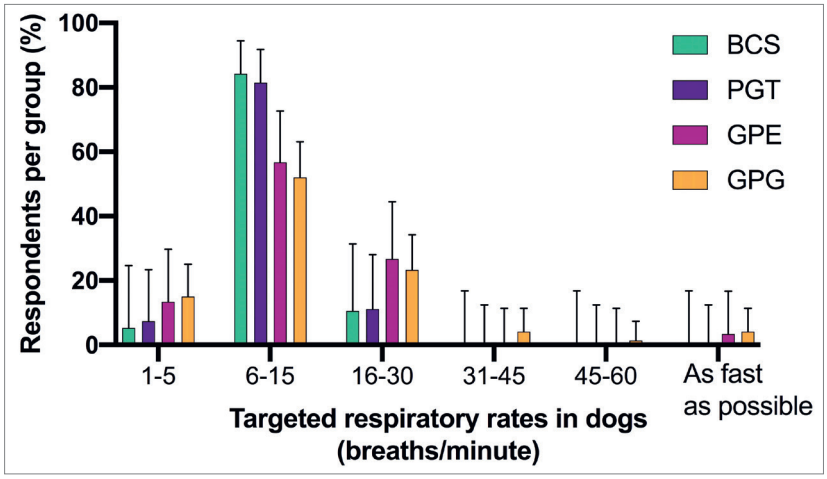
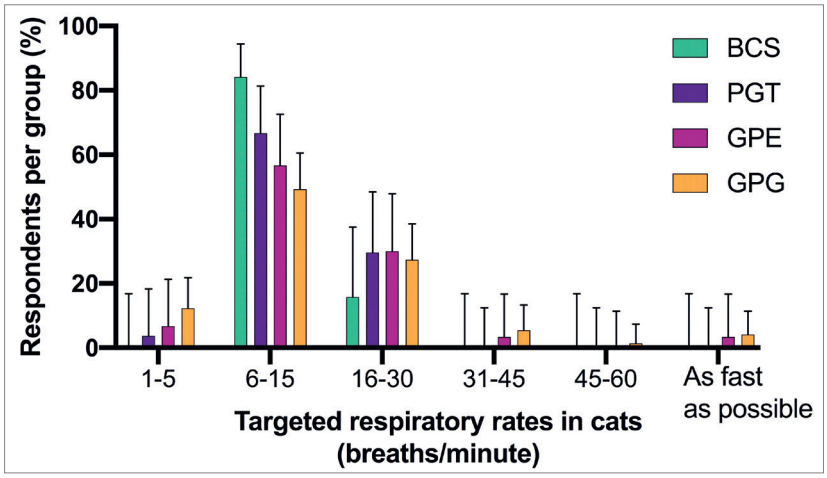


Figure 6: Targeted ventilation rates in cats during cardiopulmonary resuscitation (CPR) performed by Swiss veterinarians (n=150) responding to an internet-based survey on small animal CPR and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.



Discussion

Our study describes the attitude of veterinarians towards, and the self-reported clinical practice of small animal CPR in Switzerland. It shows that most Swiss veterinarians offer CPR in their daily practice and perceive it to be an important skill. Reported BLS and ALS techniques were highly variable and differed by respondents' level of expertise and their available equipment. Awareness of the 2012 RECOVER clinical CPR guidelines[12] in the Swiss veterinary population was insufficient, but increased with level of post-graduate training. CPR performance was frequently incompliant with RECOVER guideline recommendations, but significantly improved if practitioners were familiar with guideline existence.

According to the Swiss Federal Office of Public Health, 2949 veterinarians were licensed to practice in 2019. The Swiss veterinary population is characterized by a female to male ratio of 70 to 30% and a median age of 50 years.[4] Age and gender distribution of participants in our study were mostly in line with these reports, and the results of our study therefore appear to represent the Swiss veterinary population adequately. PGT and GPE were significantly younger than GPG, which likely stems from the fact that most individuals complete post-graduate training soon after veterinary school and that emergency practice tends to attract and retain more junior medical professionals.[16] Even though GPG treated the highest average number of patients per day, only 25% of their caseload consisted of emergencies, which could explain their infrequent involvement in CPR and the assessment of their own CPR skills as inadequate. Dogs and cats suffering CPA in the peri-anesthetic period have repeatedly been shown to have the highest chance of ROSC and survival to hospital discharge and this is thought to be due to patients undergoing anesthesia being more systemically healthy.[17,19,25,34] It is likely that the patient population seen and anesthetized by GPG on an elective basis is less severely ill than that of other groups. This would make good CPR skills especially important in the GPG veterinary population attending to the patient population with the best chance of successful recovery from CPA. More efforts should therefore be made to increase GPG exposure to CPR-themed continuing education (CE) events and to improve their comfort level. BCS, PGT, and GPE worked in larger teams of veterinarians than GPG, so it is plausible that GPG operate in smaller rescuer teams during CPR. Even though the optimal team size in veterinary CPR remains undetermined, a minimum number of rescuers is likely needed to provide high-quality resuscitative efforts.[17,19] The presence of a veterinarian as a CPR team leader has not conclusively been shown to be associated with better patient outcomes, so especially for GPG, veterinary technicians and support staff should be recruited to streamline CPR efforts.[17,34]

Improved patient survival is dependent on early CPA recognition, and fast institution of high-quality CPR efforts.[17,34] Preparedness measures to facilitate timely CPR initiation and structured resuscitation are therefore of utmost importance. The most commonly employed preparedness measures by Swiss veterinarians were emergency drug dosing charts, whereas the lack of a displayed

Table 4: Equipment available and used during Advanced Life Support by Swiss veterinarians (n=150) responding to an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines.

BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting; ECG: Electrocardiogram, MM: Mucous membrane color, CRT: capillary refill time. Data are expressed as the percentage of group total (95% confidence interval).

Equipment/ Monitoring technique	available				used			
	BCS	PGT	GPE	GPG	BCS	PGT	GPE	GPG
ECG	100 (83–100)	89 (72–96)	83 (66–93)	45 (34–56)	84 (62–94)	70 (52–84)	70 (52–83)	31 (22–42)
Capnograph/ Capnometer	100 (83–100)	93 (77–99)	80 (63–90)	46 (35–57)	84 (62–94)	67 (48–81)	60 (42–75)	32 (23–44)
Pulse oximeter	100 (83–100)	93 (77–99)	90 (74–97)	76 (65–84)	84 (62–94)	85 (68–94)	80 (63–90)	66 (55–76)
Oscillometric blood pressure	84 (62–94)	70 (52–84)	53 (36–70)	28 (19–40)	42 (23–64)	37 (22–56)	23 (12–41)	11 (6–20)
Doppler blood pressure	68 (46–85)	52 (34–69)	37 (22–54)	8 (4–17)	42 (23–64)	11 (4–28)	13 (5–30)	5 (2–13)
Ultrasound	79 (57–91)	78 (59–89)	73 (56–86)	36 (26–48)	47 (27–68)	22 (11–41)	17 (7–34)	14 (8–23)
Stethoscope	100 (83–100)	100 (88–100)	97 (83–100)	99 (93–100)	100 (83–100)	100 (88–100)	93 (79–99)	99 (93–100)
Direct pulse palpation					89 (69–98)	100 (88–100)	93 (79–99)	89 (80–94)
Palpation of apex beat					79 (57–91)	93 (77–99)	80 (63–90)	88 (78–93)
MM color and CRT					84 (62–94)	89 (72–96)	100 (89–100)	93 (85–97)
Defibrillator	79 (57–91)	41 (25–59)	27 (14–44)	1 (0–7)				
External defibrillation					79 (57–91)	41 (25–59)	20 (10–37)	4 (1–11)
Internal defibrillation					47 (27–68)	7 (1–23)	3 (0–17)	1 (0–7)
Precordial thumb					68 (46–85)	37 (22–56)	37 (22–54)	32 (23–44)

CPR algorithm, access to a crash cart, and regular CPR training were leading factors of preparedness incompliance across all study groups. Interestingly, despite not being readily available, these emergency preparedness measures were recognized as important by all study groups. The use of an organized arrest station that includes a regularly maintained crash cart and displays cognitive aids is indeed essential for efficient CPR because insufficient stocking of materials or the inability to locate drugs and functional equipment can lead to potentially detrimental delays in resuscitation.[29,33,35] Several studies in human medicine show that both, the display of cognitive aids and hands-on training to improve psychomotor skills are required for improved adherence to CPR guidelines.[1,9,30] Due to rapid decay of psychomotor skills, CPR refresher training is currently recommended at least every 6 months, but more frequent courses might be even more beneficial.[2,12] The implementation of a few changes, including shortened CPR refresher training intervals, acquiring and regularly maintaining a crash cart, and displaying a CPR algorithm, would largely abolish CPR preparedness incompliances in Swiss veterinary practice.

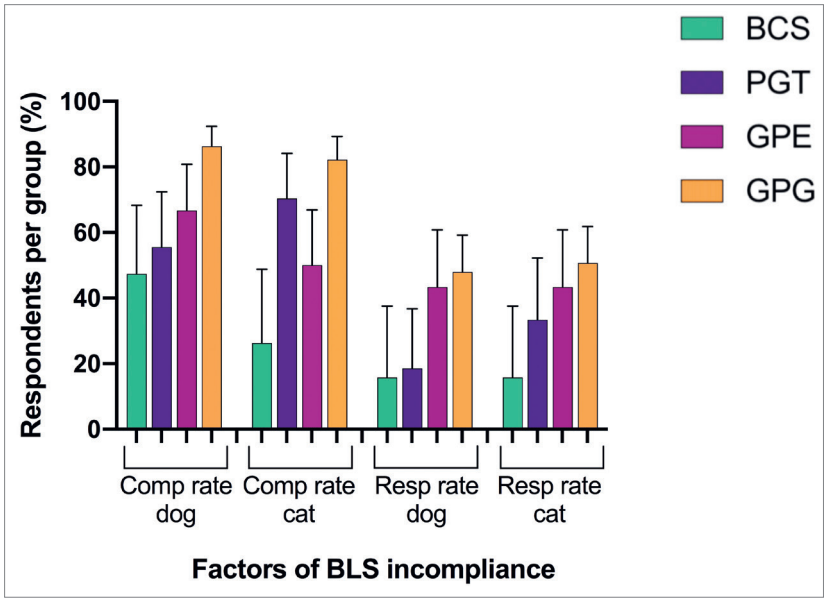
Even well-executed chest compressions only generate 25–30% of normal cardiac output during CPR and it is

Table 5: Frequency of drug administration routes on a scale from 1 (never) to 10 (always) used during small animal cardiopulmonary resuscitation (CPR) by Swiss veterinarians (n=150) responding to an internet-based survey on small animal CPR and RECOVER guidelines.

BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting. Data are expressed as median and IQR (interquartile range).

	BCS	PGT	GPE	GPG
Intravenous	10 (9–10)	10 (9–10)	10 (9–10)	10 (8–10)
Intraosseous in juvenile animals	4 (2–7)	2 (1–4)	1 (1–5)	1 (1–2)
Intraosseous in adult animals	1 (1–3)	1 (1)	1 (1)	1 (1)
Intracardiac	1 (1–3)	1 (1–5)	2 (1–5)	4 (1–7)
Via endotracheal tube	7 (5–8)	6 (3–8)	5 (1–7)	2 (1–6)

Figure 7: Factors of incompliance with recommended basic life support (BLS) guidelines of Swiss veterinarians (n = 150) responding to an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.



therefore essential to optimize them for maximal vital organ blood flow.[21] Although the ideal chest compression rate in veterinary CPR is unknown, available studies and current CPR guidelines support rates of 100–120 cpm.[11,21,43] Overly high rates can lead to incomplete chest recoil during the decompression phase, impede venous return, and decrease mean arterial, coronary, and cerebral perfusion pressures.[43] In contrast, compression rates of 60 cpm or lower do not maintain coronary perfusion pressure sufficiently and decrease the likelihood of ROSC.[11] Almost half of GPG selected chest compression rates between 60–80 cpm in dogs. A higher proportion of respondents in all groups targeted higher rates in cats, with a higher overall intragroup variability. As previously suggested, this might indicate that some veterinarians believe that BLS is executed differently for dogs and cats but are unsure of where the differences should lie.[7] In the past 50 years, the CPR guideline-recommended chest compression rate for people has steadily increased from 60–100 cpm.[31,40] Considering the higher median age of the GPG group and the fact that almost no GPG had CPR lectures during veterinary school, this group may be aware of outdated BLS guideline recommendations.

The majority of respondents targeted a ventilatory rate of 6–15 bpm for both dogs and cats, which includes the RECOVER-recommended rate of 10 bpm.[12,21] Intragroup variabilities were smaller than for chest compression rates and respondents who chose ventilatory rates other than the currently recommended rates, more commonly tended to overventilate patients. This was observed irrespective of experience level and more frequently reported in cats. Excessive ventilation rates should be avoided whenever possible because overven-

Table 6: Drugs available and used during cardiopulmonary resuscitation (CPR) by Swiss veterinarians (n = 150) responding to an internet-based survey on small animal CPR and RECOVER guidelines.

BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting. Data are expressed as the percentage of group total (95% confidence interval).

Drugs	available				used			
	BCS	PGT	GPE	GPG	BCS	PGT	GPE	GPG
Atropine	100 (83–100)	100 (88–100)	97 (83–100)	92 (83–96)	76 (55–89)	77 (58–89)	73 (56–86)	49 (37–60)
Epinephrine	100 (83–100)	100 (88–100)	97 (83–100)	91 (82–95)	94 (74–100)	100 (87–100)	87 (70–95)	78 (67–86)
Vasopressin	37 (19–59)	33 (19–52)	27 (14–44)	5 (2–13)	0 (0–18)	4 (0–19)	7 (1–21)	1 (0–7)
Lidocaine	100 (83–100)	100 (88–100)	100 (89–100)	97 (91–100)	39 (20–61)	31 (17–50)	23 (12–41)	18 (11–28)
Amiodarone	42 (23–64)	19 (8–37)	10 (3–26)	3 (0–9)	11 (2–33)	4 (0–19)	3 (0–17)	0 (0–5)
Sodium bicarbonate	84 (62–94)	63 (44–78)	70 (52–83)	41 (30–52)	39 (20–61)	12 (4–29)	23 (12–41)	10 (5–19)
Calcium gluconate	95 (75–100)	89 (72–96)	70 (52–83)	50 (39–61)	44 (25–66)	31 (17–50)	17 (7–34)	3 (0–19)
Doxapram	68 (46–85)	63 (44–78)	63 (46–78)	58 (47–69)	11 (2–33)	23 (11–42)	33 (19–51)	43 (32–55)
Mannitol	100 (83–100)	96 (82–100)	73 (56–86)	65 (54–75)	33 (16–56)	15 (6–34)	23 (12–41)	11 (6–20)
Steroids	100 (83–100)	100 (88–100)	100 (89–100)	99 (93–100)	33 (16–56)	19 (9–38)	23 (12–41)	35 (25–46)
Opioids	100 (83–100)	100 (88–100)	97 (83–100)	92 (83–96)	6 (0–26)	4 (0–19)	3 (0–17)	13 (7–22)
Naloxone	95 (75–100)	74 (55–87)	73 (56–86)	54 (43–65)	61 (39–80)	31 (17–50)	40 (25–58)	25 (16–36)
Flumazenil	79 (57–91)	59 (41–75)	33 (19–51)	14 (8–23)	33 (16–56)	15 (6–34)	3 (0–17)	7 (3–15)
Atipamezole	100 (83–100)	96 (82–100)	97 (83–100)	92 (83–96)	56 (34–75)	42 (26–61)	60 (42–75)	64 (52–74)

tilation significantly decrease coronary perfusion pressure and negatively impacts patient survival.[3,37] The causes for hyperventilation during CPR are likely multifactorial. A commonly cited reason includes resuscitator inexperience and every effort should be made to more widely disseminate knowledge of the currently recommended ventilatory rate of 10 bpm [12,37]. Hypoxemia and hypercapnia reduce the likelihood of ROSC and securing the airway to provide oxygenation and ventilation during CPR is therefore recommended.[12,21,24,46] Most respondents in all groups reported that they orotracheally intubate patients during CPR, while facemask and mouth-to-snout ventilation were frequently reported alternative approaches. Both techniques have recently been shown to be reasonable alternatives and they should continue to be applied in situation where orotracheal intubation is not possible.[22]

Only 8% of GPG replied to be aware of the RECOVER guidelines, and guideline awareness significantly improved BLS compliance in this study. In light of this finding, it seems essential to derive strategies for a broader dissemination of the RECOVER BLS recommendations among non-BCS practitioners, such as the translation of the guidelines into Swiss national languages or through local CE events.

In comparison, BCS, PGT, and GPE had more patient monitoring equipment available and utilized this more frequently, while GPG predominantly relied on physical examination parameters during CPR. Surprisingly, participants of all groups tended to use pulse oximetry more frequently than capnometry. Several studies describe that the measurement of $EtCO_2$ serves a non-invasive surrogate measurement of cardiac output and predictor of ROSC, while pulse oximetry and pulse palpation are of limited use to assess CPR efficacy.[8,10,14,15,18,20,27] Whenever available, $EtCO_2$ monitoring during CPR is therefore recommended to evaluate chest compression quality.[12]

Only 1% of GPG had access to a defibrillator and accordingly almost none had experience in external or internal defibrillation. In contrast to people, non-shockable rhythms are common in dogs and cats and account for more than 70% of initial arrest rhythms.[18,19,34] A minority of patients is therefore likely to require electrical defibrillation throughout the course of CPR. Depending on their caseload, it is possible that many veterinarians practice several years without encountering a CPA patient with an indication for defibrillation. Despite their rarity, it is important to note that shockable rhythms in dogs are associated with higher chances of ROSC if defibrillated appropriately.[18] The acquisition of an ECG and electrical defibrillator to enable cardiac rhythm diagnosis and defibrillation where indicated could therefore still make an important difference in patient outcomes, especially in practices with a high caseload performing frequent anesthetic procedures. Due to their inferiority in terminating arrhythmias, precordial thumps should only be considered if no defibrillator is available.[12]

Intravenous fluid administration during CPR was commonly performed by all respondent groups. Experimental animal studies and CPR guidelines suggest that the routine administration of intravenous fluids to euvolemic patients is associated with decreased coronary perfusion pressure and should be avoided.[12,44] Patients with preexisting hypovolemia, on the other hand, might benefit from an increased circulating volume and fluid administration is reasonable.[12]

Medications during CPR were predominantly administered intravenously in all groups, followed by the intratracheal and intracardiac route. The continued use of intracardiac injections was unexpected and might stem from unawareness of alternative vascular access techniques. Due to the potential risks of intracardiac injections, venous cutdown techniques or intraosseous access should be preferred and are well described.[23] If neither of these drug administration routes are available, intratracheal vasopressor and anticholinergic administration should be considered.[12]

Similar to monitoring equipment, the number of available medications during CPR is more limited for GPG and GPE than for PGT or BCS. To maximize cardiac

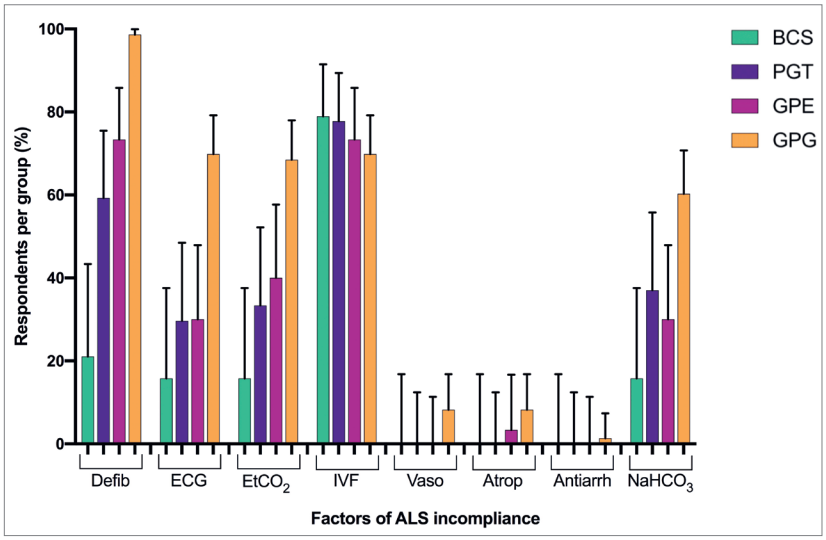


Figure 8: Factors of incompliance with recommended advanced life support (ALS) guidelines of Swiss veterinarians (n = 150) responding to an internet-based survey on small animal cardiopulmonary resuscitation (CPR) and RECOVER guidelines.
Data are expressed as proportions of total responses in each group and error bars indicate 95% confidence interval. BCS, board-certified specialists; PGT, veterinarians with post-graduate training; GPE, general practitioners in emergency setting; GPG, general practitioners in non-emergency setting.

output during CPR, it is crucial to redistribute blood flow from the periphery to the vital organs. Vasopressors achieve this by peripheral vasoconstriction and increasing coronary and cerebral blood flow, and the majority of respondents in this study complied with the recommendation to use epinephrine during CPR.[36] While a similar number of respondents had atropine available, all groups used it less frequently during CPR than epinephrine. Indeed, the evidence supporting the use of atropine during CPR is more limited.[5,45] While only few studies demonstrate a positive effect of atropine therapy, most show no detrimental effect. Atropine is likely to be of use in animals with a non-shockable arrest rhythm suspected of having an increased vagal tone and its use is therefore considered reasonable.[12,38] Antiarrhythmics were used by a minority of all groups during CPR. Having these agents available could be a benefit in practice environments without a defibrillator but it should be acknowledged that they are mostly considered adjunct treatments in shockable rhythms refractory to electrical defibrillation and that their benefit as a sole therapy is unclear.[12,38] Sodium bicarbonate was widely available to all groups except GPG. Cardiopulmonary arrest is commonly associated with the development of acidemia, and sodium bicarbonate therapy may be considered in prolonged CPA and should be kept on hand.[38]

The majority of respondents in all groups were overall incompliant with ALS guideline recommendations. While GPG displayed the highest proportion of ALS incompliance, this was predominantly due to lack of a defibrillator and monitoring equipment. According to our results, the ALS compliance for all groups could be improved by some easily implemented changes, such as stocking sodium bicarbonate in the crash cart and restricting resuscitative fluid therapy to hypovolemic patients. Equipment limitations of the resuscitative environment will be harder to rectify and even competent GPG might not become able to fully comply with all ALS guidelines.

The delivery of evidence-based CPR with the goal to improve patient outcomes requires awareness of guideline recommendations and guideline adherence in daily practice. A Japanese study recently demonstrated that a RECOVER-based CPR approach significantly improves patient outcomes [26]. In our study, awareness of the RECOVER guidelines significantly improved self-reported compliance with guideline recommendations, but further studies are needed to determine if this translates into clinical CPR practice and improved patient outcomes. With regards to reported preparedness, BLS and ALS techniques, BCS and GPG were frequently positioned at opposite ends of the response spectrum in this study. It is important to keep in mind that differences in CPR practice can occur regardless of the resuscitators' expertise and due to limitations in resuscitation infrastructure and personnel. Such inherent characteristics of a practice environment cannot be easily changed, and this will need to be taken into consideration when formulating CPR recommendations to be implemented by small and medium-sized veterinarian practices. Multilingual translations of future RECOVER guidelines might additionally attract more veterinarians' attention and could help improve CPR techniques in Swiss veterinary professionals by minimizing potential language-barriers.

This study has several limitations. First, the number of participants is small with only 150 complete survey records, limiting statistical comparisons between respondent groups. While it is more cost-effective and easier to distribute internet-based surveys, low response rates to electronic surveys have previously been reported in human medicine and have posed challenges to international veterinary CPR surveys and this likely also played a role in the present study.[7,13,39] Despite this low response rate, the number of Swiss survey participants reached approximately 20% of previous international veterinary CPR surveys, which, for a comparably small country and veterinary community is considerable.[7,13] Our study is furthermore likely limited by a selection bias. We expect that veterinarians with a greater interest in CPR were more likely to participate in the survey, while its length may have dissuaded less interested recipients. Third, responses from residents and diplomates in specialties other than anesthesia or emergency and critical care were not excluded from our study. This decision was made, because in Swiss veterinary practice, these individuals remain likely to provide primary emergency services and CPR. However, the heterogeneity in their training could have skewed the results of our BCS and PGT populations. Lastly, it is important to realize that a discrepancy likely exists between self-reported and actual CPR practice, and our results should therefore not be interpreted as a definitive representation of CPR execution in daily practice. In addition to this discrepancy, our survey did not query all 101 RECOVER CPR recommendations and can therefore only assess the compliance with the investigated subset of guidelines.

In conclusion, CPR performance among Swiss veterinarians is variable and commonly not in line with RECOVER guideline recommendations. Awareness of the RECOVER guidelines is highest in specialists and veterinarians with additional post-graduate training, and positively influenced self-reported compliance with guideline recommendations. In order to disseminate up-to-date knowledge and ensure the application of evidence-based recommendations in small animal CPR, strategies are required to make the RECOVER guidelines and hands-on CPR training courses more widely accessible across Switzerland. Furthermore, additional

studies are needed to evaluate clinical instead of self-reported CPR practice and to better understand Swiss small animal CPR outcomes and their determining factors.

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Conflicts of interest

Author SNH is a member of the RECOVER CPR registry committee and certified CPR instructor. These are volunteer responsibilities and the author declares no conflicts of interest.

La pratique clinique de la RCP chez les petits animaux dans le respect des lignes directrices de RECOVER en Suisse: une enquête basée sur l'internet

Objectif: En 2012, la campagne de réévaluation de la réanimation vétérinaire(«Reassessment Campaign on Veterinary Resuscitation», RECOVER) a publié les premières lignes directrices sur la RCP fondées sur des preuves chez les petits animaux. Même s'il a été démontré qu'une approche de RCP basée sur le RECOVER améliore les résultats pour les patients, la connaissance de ces lignes directrices et leur respect sont nécessaires pour constater ces avantages. Notre étude visait à caractériser les pratiques de RCP dans les cliniques suisses pour petits animaux et à évaluer leur conformité aux directives RECOVER.

Méthodes: Une enquête nationale sur Internet a été menée et des invitations ont été envoyées via les listes de diffusion de la Société des Vétérinaire Suisses (SVS). Les questions portaient sur les données démographiques des répondants, la préparation à la RCP, les techniques de Basic Life Support (BLS) et Advanced Life Support (ALS) et la connaissance des directives RECOVER. Les pourcentages du total du groupe (intervalle de confiance à 95%) ont été calculés.

Résultats: Cent cinquante répondants ont été regroupés par niveau d'expertise en spécialistes certifiés (BCS, n=19), vétérinaires ayant une formation post-universitaire supplémentaire (PGT, n=27) et généralistes avec (GPE, n=30) et sans service d'urgence (GPG, n=74). Parmi les répondants BCS, 58% (36–77%) connaissaient les directives RECOVER, contre 8% (4–17%) des GPG. De grandes disparités dans les techniques de préparation, BLS et ALS sont apparues entre les niveaux d'expertise. Le non-respect des mesures de préparation va-

La pratica clinica della RCP dei piccoli animali e il rispetto delle linee guida per il recupero in Svizzera: un sondaggio via internet

Obiettivo: Nel 2012, la campagna di rivalutazione sulla rianimazione in veterinaria (Reassessment Campaign on Veterinary Resuscitation (RECOVER)) ha pubblicato le prime linee guida per la RCP nei piccoli animali basate su prove di efficacia. Sebbene il metodo di RCP basato su RECOVER ha dimostrato un incremento dei benefici per i pazienti, per ottenere tali benefici è necessario la conoscenza delle linee guida e la loro messa in atto conforme. L'obiettivo del nostro studio era di caratterizzare le pratiche di RCP usate negli studi veterinari di piccoli animali in Svizzera e di valutarne la conformità con le linee guida RECOVER.

Metodologia: È stata condotto su base nazionale un sondaggio via internet e gli inviti a questo sono stati distribuiti utilizzando la lista di diffusione della Società dei Veterinari Svizzeri. Le domande portavano sulla demografia degli intervistati, la loro preparazione alla RCP, le tecniche di sostegno di base (BLS) e di sostegno avanzato (ALS) delle funzioni vitali, e infine le conoscenze delle linee guida RECOVER. Sono state calcolate le percentuali del totale del gruppo (intervallo di confidenza 95%).

Risultati: Abbiamo raggruppato i centocinquanta rispondenti a secondo del loro livello di competenza: specialisti certificati (BCS, n=19), veterinari con formazione supplementare post diploma (PGT, n=27), veterinari generici con compiti di emergenza (GPE, n=30) e senza compiti di emergenza (GPG, n=74). Tra gli intervistati del gruppo BCS, 58% (36–77%) conosceva le linee guida RECOVER, rispetto all'8% (4–17%) del gruppo GPG. Grandi differenze di competenza si sono riscontrate a livello delle tecniche di preparazione alle BLS e ALS. La non conformità delle misure di preparazione variava dall'89% (69–98%) nel gruppo BCS

riait de 89% (69–98%) chez les BCS à 100% (95–100%) chez les GPG et était principalement dû au fait de ne pas suivre une formation régulière en RCP. L'observance du BLS variait de 26% (12–49%) chez les BCS à 5% (2–13%) chez les GPG et la non-conformité était principalement caractérisée par des taux de compression thoracique inférieurs aux recommandations. L'observance de la SLA variait de 21% (9–43%) chez les BCS à 0% (0–5%) chez les GPG et était compromise par des limitations dans l'environnement de réanimation telles que le manque d'accès à un défibrillateur, à l'équipement de surveillance et aux médicaments d'urgence.

Conclusion: La connaissance des directives RECOVER en Suisse est acceptable chez les spécialistes, mais insuffisante parmi les vétérinaires généralistes et les pratiques de RCP ne sont en grande partie pas en accord avec les directives RECOVER. Une stratégie pédagogique est nécessaire pour améliorer les connaissances et les performances de la RCP chez les petits animaux en Suisse.

Mots clés: arrêt cardiaque, réanimation cardio-pulmonaire, chat, compliance, chien, directives RECOVER

al 100% (95–100%) nel gruppo GPG ed era dovuta in particolare alla mancata partecipazione a corsi regolari sulla RCP. La conformità alle tecniche di BLS era del 26% (12–49%) per il gruppo BCS e del 5% (2–13%) per il gruppo GPG, e la non conformità era dovuta in particolare a tassi di compressione toracica inferiori a quelli raccomandati. La conformità alle tecniche ALS variava dal 21% (9–43%) per il gruppo BCS allo 0% (0–5%) per il gruppo GPG ed era così compromessa da limitazioni dell'ambiente di rianimazione come la mancanza di accesso ad un defibrillatore, all'attrezzatura di monitoraggio e ai farmaci di supporto.

Conclusione: La conoscenza delle linee guida RECOVER in Svizzera è accettabile per gli specialisti ma inadeguata per i veterinari di medicina generale. Inoltre, le procedure di RCP sono in larga misura non conformi alle linee guida RECOVER. Bisogna instaurare una strategia educativa per migliorare le conoscenze e le prestazioni di RCP per i piccoli animali in Svizzera.

Parole chiave: arresto cardiaco, rianimazione cardiopolmonare, gatto, conformità, cane, linee guida RECOVER

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A. P. Kruppert et al.

Corresponding author

Sabrina N. Hoehne
Länggassstrasse 128
CH-3012 Bern
Telefon: 031 631 23 15
E-Mail: sabrina.hoehne@vetsuisse.unibe.ch