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Defining Physiological Decompensation: An Expert Consensus and Retrospective Outcome Validation

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OBJECTIVES: Physiological decompensation of hospitalized patients is common and is associated with substantial morbidity and mortality. Research surrounding patient decompensation has been hampered by the absence of a robust definition of decompensation and lack of standardized clinical criteria with which to identify patients who have decompensated. We aimed to: 1) develop a consensus definition of physiological decompensation and 2) to develop clinical criteria to identify patients who have decompensated.

DESIGN: We utilized a three-phase, modified electronic Delphi (eDelphi) process, followed by a discussion round to generate consensus on the definition of physiological decompensation and on criteria to identify decompensation. We then validated the criteria using a retrospective cohort study of adult patients admitted to the Hospital of the University of Pennsylvania.

SETTING: Quaternary academic medical center.

PATIENTS: Adult patients admitted to the Hospital of the University of Pennsylvania who had triggered a rapid response team (RRT) response between January 1, 2019, and December 31, 2020.

INTERVENTIONS: None.

MEASUREMENTS AND MAIN RESULTS: Sixty-nine experts participated in the eDelphi. Participation was high across the three survey rounds (first round: 93%, second round: 94%, and third round: 98%). The expert panel arrived at a consensus definition of physiological decompensation, "An acute worsening of a patient's clinical status that poses a substantial increase to an individual's short-term risk of death or serious harm." Consensus was also reached on criteria for physiological decompensation. Invasive mechanical ventilation, severe hypoxemia, and use of vasopressor or inotrope medication were bundled as criteria for our novel decompensation metric: the adult inpatient decompensation event (AIDE). Patients who met greater than one AIDE criteria within 24 hours of an RRT call had increased adjusted odds of 7-day mortality (adjusted odds ratio [aOR], 4.1 [95% CI, 2.5–6.7]) and intensive care unit transfer (aOR, 20.6 [95% CI, 14.2–30.0]).

CONCLUSIONS: Through the eDelphi process, we have reached a consensus definition of physiological decompensation and proposed clinical criteria with which to identify patients who have decompensated using data easily available from the electronic medical record, the AIDE criteria.

KEY WORDS: cardiac arrest; Delphi study; mechanical ventilation; outcomes assessment; quality improvement; rapid response team

Physiological decompensation of hospitalized adult patients is common and remains a significant cause of morbidity and mortality (1–3). Recent studies have focused on identifying at-risk patients prior to significant events such as inhospital cardiac arrest (IHCA) to prompt earlier intervention and improve outcomes (4, 5). Several strategies have been proposed to identify and intervene upon

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patients prior to physiological decompensation, including Early Warning Scores and rapid response teams (RRTs) (6–9). Measuring the success of these approaches, however, remains a major challenge for health systems and researchers, in part, because there is no standard definition of what constitutes decompensation. Studies of in-hospital decompensation have typically used the clinical criteria of in-hospital mortality, IHCA, or the need for ICU transfer to define clinical decompensation (8, 10–13). Each of these has significant limitations. In-hospital mortality can occur weeks or even months after a deterioration event and can represent expected progression of disease or a subsequent decompensation event. IHCA, although well-defined and clinically relevant, is an uncommon event, limiting statistical power. Finally, decisions regarding ICU transfer are highly subjective, variable between providers and hospitals, and confounded by hospital-level factors such as bed availability (14).

Composite clinical criteria have been developed to capture patient decompensation for use in pediatric hospital-based care, for example, the composite outcomes of Critical Deterioration Event and the Emergency Transfer have both been shown to have face, criterion, and content validity (15, 16). However, these metrics have not been validated among adult patients and only apply to patients who were subsequently transferred to an ICU (15, 16).

Research into the etiology, prediction, and prevention of physiological decompensation has been hampered by an absence of both a descriptive definition of decompensation and standardized clinical criteria with which to identify patients who have decompensated. This has led to marked heterogeneity in decompensation criteria selection across studies and the nearly interchangeable use of "decompensation" and "deterioration," which causes further confusion.

We aimed to: 1) develop a consensus definition of physiological decompensation and 2) to develop clinical criteria to identify patients who have decompensated. Inviting participation from nearly 70 experts in Resuscitation Science, we used a sequential three-phase modified electronic Delphi (eDelphi) process to generate consensus around both a definition and criteria for physiological decompensation and subsequently validated the decompensation criteria in a retrospective cohort study.

MATERIALS AND METHODS

We utilized the modified eDelphi process to reach consensus on the definition of physiological decompensation and to generate a list of clinical criteria to identify decompensation. In contrast to other disease states, physiological decompensation can be caused by a range of acute insults. As such, we chose to make a distinction between the definition of decompensation and the selection of criteria that could be used to identify patient who had decompensated. Similar approaches have been taken to define the presence syndromes such as sepsis and acute respiratory failure (17, 18).

The modified eDelphi approach aims to reach consensus on a topic by harnessing the knowledge of experts through an iterative series of online questionnaires (19, 20). Survey responses from each round remain anonymous, but results from each round are reviewed, compiled, and presented to panel members prior to the next round. This allows for experts to update their opinions and encourages equity of opinion and avoidance of groupthink. This approach has been used successfully to develop other definitions and to identify a variety of critical care outcomes (21, 22). Consensus clinical criteria were then validated using a retrospective cohort of patients who had triggered an RRT response during their hospitalization. The study was exempted from review by the Institutional Review Board of the University of Pennsylvania.

Study Design

Establishment of Expert Panel. We chose to limit our panel to experts that were located within the United States given that RRT responses and outcomes may vary widely across different healthcare settings. We used purposive sampling to identify a multidisciplinary group of experts including patient advocates, physicians, nurses, respiratory therapists, pharmacists, and researchers. Experts were identified from professional contacts of the study team (O.J.L.M., M.D., H.A.W., K.J.R., S.N., G.L., M.G.S.S., B.S.A.), through review of published guidelines and manuscripts, through invitation of members of national and international professional societies, as well as through snowball sampling, whereby experts were asked to identify additional potential members of the panel (23). Expertise was defined as anyone with in-depth knowledge of inpatient clinical emergencies, through clinical practice, personal experience, or academic research. A list of participants in this process are included in **Supplemental Digital Content 1** (http://links.lww.com/CCX/A967).

Modified eDelphi. The modified eDelphi consisted of three sequential questionnaires that were collected and managed using Research Electronic Data Capture, a web-based software platform (24). For each round, up to two reminder emails were sent at weekly intervals. Panel members were asked to rate their level of agreement on a 6-point Forced Likert scale (strongly disagree, disagree, slightly disagree, slightly agree, agree, and strongly agree) and to provide free-text comments on the proposed definition and alternative clinical criteria for consideration in subsequent rounds. At the conclusion of each round, summary results were emailed to members of the expert panel, and the goals of the next round were outlined. Only experts who completed the prior round were invited to participate in the subsequent round. The fourth and final round consisted of a remote presentation and discussion of the study results. We defined consensus a priori as agreement or strong agreement among greater than or equal to 75% of experts for both the definition and for each of the individual clinical criteria. Each of the survey questionnaires is included in **Supplemental Digital Content 2** (http://links.lww.com/CCX/A967).

Round 1. The first round of the modified eDelphi took place from May 11, 2021, to May 25, 2021. Experts were presented a definition of physiological decompensation that was proposed by the study team based on local experience and literature review. They were additionally presented with six clinical events that could be included in the clinical criteria for decompensation. These included two commonly used criteria in the adult literature: ICU transfer and IHCA (8, 11), as well as administration of an intravenous fluid bolus, or initiation of invasive mechanical ventilation, noninvasive ventilation, or vasopressors; these were the constituents of the composite criteria developed by Bonafide and Hussain and used in pediatric critical care (15, 16). At the conclusion of round 1, the responses were compiled, and results were emailed to members of the expert panel.

Round 2. Feedback on the definition of physiological decompensation was reviewed by study team members (O.J.L.M., B.S.A.) and then incorporated into a revised definition. Criteria suggested by two or more of the expert panel were selected for inclusion in round 2 and were presented together with any criteria that had not reached consensus in round 1. Round 2 took place from June 8, 2021, to June 22, 2021. Again, panel members were asked to rate their level of agreement on a 6-point Likert scale and were also given an opportunity to provide free-text feedback. At the conclusion of round 2, the expert panel was again presented with the compiled results.

Round 3. In the third round, which ran from July 6, 2021, to July 20, 2021, experts were presented with criteria upon which greater than or equal to 70% of experts had agreed or strongly agreed in previous rounds. To establish criterion prioritization, experts were asked to rate the importance of each element from the most to the least important for inclusion in a composite definition of decompensation.

Remote Discussion. The final round of the modified eDelphi was a live presentation of results and subsequent discussion to highlight future directions. Due to the ongoing COVID-19 pandemic, this was held as two remote sessions using the videoconference software (Zoom Video Communications, San Jose, CA), which lasted 1 hour and were audio- and video-recorded with verbal permission of participants.

Validation

We performed a retrospective cohort study of all adult RRT activations at the Hospital of the University of Pennsylvania between January 1, 2019, and December 31, 2020. In hospitalizations with multiple RRT events, we only considered a patient's initial RRT encounter for analysis. We excluded patients who were admitted to a nonward bed and patients with any limitations on life-sustaining therapy at the time of the RRT call. RRT calls were identified from a prospectively collected quality improvement (QI) database and linked to patient data in the electronic medical record (EMR). Patients who received mechanical ventilation, vasopressors, and inotropes, or developed severe hypoxemia within 24 hours of the RRT call, or who died within 7 days of the RRT call were identified using from EMR data. Cases of IHCA, extracorporeal membrane oxygenation (ECMO) initiation, and emergent surgical airway occurring within 24 hours of RRT call were identified using the QI database. We were unable to identify unplanned surgery and emergency cardiac pacing using the approaches described above—these are not routinely captured in the QI database.

Invasive mechanical ventilation, severe hypoxemia, and use of vasopressor or inotrope medication

were bundled as criteria for our novel decompensation metric: the adult inpatient decompensation event (AIDE).

To determine the construct validity of the AIDE criteria, we established the odds of death within 7 days in patients who met any AIDE criteria within 24 hours of an RRT activation. To determine criterion validity, we established the odds of 7-day ICU transfer in patients who met any AIDE criteria within 24 hours of RRT activation. Though an imperfect measure, ICU transfer was chosen for comparison due to the frequency with which ICU transfer is used to denote decompensation in the published literature and otherwise absence of a gold standard definition. Both analyses used multivariable logistic regression and covariates included as potential confounders included age, gender, and chronic comorbidities present on hospital admission (measured by the Elixhauser comorbidity score) (25, 26). All statistical analyses were performed using standard statistical software (Stata version 17, Statacorp, College Station, TX).

RESULTS

Expert Panel

Sixty-nine experts were identified and invited to participate in the modified eDelphi process. Of these, 64 (93%) completed the first round, 60/64 (94%) first round participants completed the second round, and 59/60 (98%) second round participants completed the third round of questionnaires. Most experts worked in academic medical centers in the United States, with representation from 22 states (**Supplemental Digital Content 3**, http://links.lww.com/CCX/A967). Although physicians comprised the plurality of the experts (30/64; 47%), the expert cohort had a wide representation of specialties, areas of practice, and years of expertise, and included 10 patients or advocates. Full characteristics of the expert cohort are presented in **Table 1**.

Definition of Decompensation

During the first round of the modified eDelphi, 38/64 experts agreed (59%) and 18/64 strongly agreed (28%) (total 56/64, 88%) with the initially proposed definition of physiological decompensation: "An acute change in physiologic status that poses a new, substantial increase in an individual's short-term risk of death or disability." After review of the free-text responses received in round 1, a revised definition for physiological decompensation was proposed in round 2: "An acute worsening of a patient's clinical status that poses a substantial increase to an individual's short-term risk of death or serious harm." Fifty-five out of 60 experts (92%) either agreed or strongly agreed with this revised definition: 25/60 agreed (42%) and 30/60 (50%) strongly agreed. This reached the prespecified criterion for consensus.

Physiological Decompensation Criteria

The expert panel agreed upon three of the initial six criteria proposed in round 1: IHCA (100% agree/strongly agree), invasive mechanical ventilation (97% agree/strongly agree), and initiation of vasopressors (98% agree/strongly agree). Although 81% of respondents agreed or strongly agreed with inclusion of ICU transfer, numerous concerns were raised in the free-text responses surrounding the implications of including high variability in practice between providers and potential introduction of bias. As such, it was decided to rereview this in round 2 after these concerns were presented to the study team. An additional 15 criteria were proposed by the expert panel and included in round 2, for a total of 17 (Supplemental Digital Content 2, http://links.lww.com/CCX/A967). Consensus (≥75% agree/strongly agree) was reached on a total of 10 criteria (**Table 2**). In round 3, experts were asked to rank importance of any individual criteria with greater than or equal to 70% agreement or strong agreement in rounds 1 and 2. The purpose of this round was to assess the face validity and perceived importance of the consensus criteria. Results are displayed in **Supplemental Digital Content 4** (http://links.lww.com/CCX/A967).

Discussion Round

Remote discussion rounds were hosted via internet videoconference on August 25, 2021, and August 30, 2021, approximately 5 weeks after the conclusion of round 3. After presentation of the results, group discussion highlighted three key points for further investigation: 1) how best to account for limitations on interventions, for example, patients who did not wish to be intubated, in analyzing outcomes, 2) how to account for criteria such as ECMO initiation, which might only be

TABLE 1.
Baseline Characteristics of Modified eDelphi Experts Who Completed the First Round of Survey Questionnaire (*n* = 64)

Category	Variable	*n* (%)
Gender	Male	34 (53)
	Female	29 (45)
Ethnicity	Hispanic or Latino	2 (3)
	Not Hispanic or Latino	62 (97)
Race	Asian	9 (14)
	Black or African American	2 (3)
	White	53 (83)
Setting	Teaching hospital	56 (88)
	Nonteaching hospital	2 (3)
	Nonhospital	6 (9)
Clinical role	Physician	30 (47)
	Registered nurse	10 (16)
	Pharmacist	9 (14)
	Respiratory therapist	7 (11)
	Patient representative	4 (6)
	Other	4 (6)
Role in Cardiac Arrest Team or Rapid Response Team	Committee chair	17 (27)
	Member of committee	28 (44)
	Resuscitation researcher	28 (44)
	Respond to events	38 (59)
	Participate in guidelines	29 (45)
	Patient or advocate	10 (16)
Area of practice	Critical Care Medicine	49 (80)
	Emergency Department	17 (27)
	Internal Medicine	13 (20)
	Cardiology	9 (14)
	Pediatrics	11 (17)
Years in clinical practice	0–10	12 (19)
	11–20	28 (44)
	>20	19 (30)
	N/A	5 (8)

available in highly resourced centers, and 3) to ensure that patients who decompensated from a neurological etiology were also captured by the clinical criteria.

Validation

From January 1, 2019, to December 31, 2020, 1,441 inpatients experienced an RRT event and were included in the QI database. We were able to match patient details in the EMR for 1,379 patients (96%). Of these, we excluded 169 patients who had their RRT in a location other than the ward and a further 191 who had limitations on the use of cardiopulmonary resuscitation at the time of their RRT, leaving a total of 1,019 RRT activations (**Supplemental Digital Content 5**, http://links.lww.com/CCX/A967).

TABLE 2.
Survey Results From Rounds 1 and 2 of the Modified eDelphi Process

Criteria	Strongly Agree	Agree	Slightly Agree	Slightly Disagree	Disagree	Strongly Disagree	Not Applicable
Round 1 ($n = 64$)							
Inhospital cardiac arrest[a]	60 (94%)	4 (6%)					
Invasive mechanical ventilation[a]	50 (78%)	12 (19%)	1 (2%)	1 (2%)			
Vasopressor[a]	43 (67%)	20 (31%)		1 (2%)			
ICU transfer[a]	32 (50%)	20 (31%)	7 (11%)	2 (3%)	3 (5%)		
Noninvasive ventilation	26 (41%)	20 (31%)	14 (22%)	3 (5%)	1 (2%)		
>30 cc/kg fluid bolus	26 (41%)	17 (27%)	10 (16%)	7 (11%)	4 (6%)		
Round 2 ($n = 60$)							
Respiratory support							
Continuous positive-pressure ventilation	15 (25%)	19 (32%)	15 (25%)	9 (15%)	2 (3%)		
Bilevel positive pressure ventilation	19 (32%)	23 (38%)	14 (23%)	4 (7%)			
Heated high-flow nasal cannula	15 (25%)	21 (35%)	16 (27%)	3 (5%)	5 (8%)		
Severe hypoxemia[a]	24 (40%)	21 (35%)	7 (12%)	1 (2%)			1 (2%)
High O_2 requirement	22 (37%)	21 (35%)	12 (20%)	1 (2%)	3 (5%)		1 (2%)
Emergency interventions							
Dialysis	15 (25%)	21 (35%)	14 (23%)	5 (8%)	5 (8%)		
Extracorporeal membrane oxygenation[a]	48 (80%)	7 (12%)	2 (3%)	1 (2%)	1 (2%)		1 (2%)
Cardiac pacing[a]	32 (53%)	16 (27%)	8 (13%)	1 (2%)	2 (3%)		1 (2%)
Electrical cardioversion	30 (50%)	14 (23%)	10 (17%)	3 (5%)	2 (3%)		1 (2%)
Inotropes[a]	27 (45%)	21 (36%)	8 (14%)	2 (3%)			1 (2%)
Surgical airway[a]	50 (83%)	7 (12%)	1 (2%)	1 (2%)	1 (2%)		
High-risk medication	29 (48%)	15 (25%)	10 (17%)	3 (5%)	3 (5%)		
Transfusion of blood products	10 (17%)	18 (30%)	12 (20%)	9 (15%)	9 (15%)	2 (3%)	
Other criteria							
Inhospital death[a]	36 (60%)	11 (18%)	7 (12%)	3 (5%)		1 (2%)	2 (3%)
Unplanned surgery[a]	27 (45%)	21 (35%)	6 (10%)	3 (5%)	3 (5%)		
ICU transfer	8 (13%)	17(28%)	21 (35%)	3 (5%)	8 (13%)	3 (5%)	
Delirium	4 (7%)	15 (25%)	14 (23%)	16 (27%)	7 (12%)	3 (5%)	1 (2%)

[a]Criteria upon which consensus was agreed.

Experts were asked to select their degree of agreement on a 6-point Likert scale (strongly agree to strongly disagree). There was an option for "Not Applicable" if desired.

In the 24 hours following an index RRT event, 512 patients (50%) were transferred to the ICU, 292 patients required vasopressors or inotropes (29%), 229 patients received mechanical ventilation (22%), 103 patients (10%) developed severe hypoxemia, 41 patients suffered IHCA (4%), seven patients required ECMO (<1%), and two patients required an emergency surgical airway (<1%). In-hospital death occurred in 193 patients (19%), with 48 (5%) dying within 24 hours of an RRT call and 88 (9%) dying within 7 days of an RRT call. All of these were associated with substantially increased odds of in-hospital mortality within 7 days of the RRT activation (**Table 3**).

TABLE 3.
Association of Selected Consensus Outcomes Occurring Within 24 hr of Rapid Response Team Call With the Odds of 7-d Mortality

Outcome	Number of Outcomes in Cohort Within 24 h of RRT Call: *n* (%) of Total RRTs)	aOR for 7-d Mortality: aOR (95% CI)	Method of Identification	Definition
Vasopressors	292 (29)	4.4 (2.8–7.0)	EMR	Received any of epinephrine, norepinephrine, vasopressin, dobutamine, dopamine, or phenylephrine within 24 hr of RRT
Mechanical ventilation	229 (22)	3.4 (2.1–5.3)	EMR–intubations are also recorded in QI database	Received invasive mechanical ventilation within 24 hr of RRT
Severe hypoxemia	103 (10)	3.5 (2.0–5.9)	EMR	Peripheral oxygen saturation ≤85% within 24 hr of RRT
Inotropes	68 (7)	7.5 (4.2–13.4)	EMR	Received any of epinephrine, dobutamine, or dopamine within 24 hr of RRT
Inhospital death	48 (5)	Not applicable	EMR	Died during hospital admission within 24 hr of RRT
IHCA	41 (4)	8.5 (4.3–16.9)	QI database	Pulseless and received chest compressions within 24 hr of RRT
ECMO	7 (<1)	8.4 (1.7–41.6)	QI database	Cannulated for ECMO within 24 hr of RRT
Surgical airway	2 (<1)	10.5 (0.6–180.2)	QI database	Surgical airway performed within 24 hr of RRT

aOR = adjusted odds ratio, ECMO = extracorporeal membrane oxygenation, EMR = electronic medical record, IHCA = inhospital cardiac arrest, QI = quality improvement, RRT = rapid response team.
The total number of patients (*n*) and percentage (%) of patients from the cohort who met each outcome are presented, as are the results of multivariable logistic regression for each of the outcomes. Covariables included in the adjusted models included gender, Elixhauser comorbidity index on admission to hospital, and age.

Criteria agreed upon through the modified eDelphi process, which were also available through the EMR, were bundled as criteria for the novel AIDE metric. These were: invasive mechanical ventilation, severe hypoxemia, or receipt of either vasopressor or inotrope medication. For the purposes of validation, we chose a peripheral oxyhemoglobin saturation of less than or equal to 85% to define severe hypoxemia, as has been used in prior studies (18). A total of 405 patients (40%) met one or more of the AIDE criteria within 24 hours of RRT activation.

Patients who met one or more AIDE criteria within 24 hours of an RRT call had increased adjusted odds of 7-day mortality (adjusted odds ratio [aOR], 4.1 [95% CI, 2.5–6.7]). Adjusted odds of 7-day mortality were even higher when IHCA was included with the AIDE criteria (aOR, 8.2 [95% CI, 4.5–15.1]) (**Table 4**). Sensitivity analyses using alternative time-windows of 12 and 48 hours from RRT activation demonstrated similar findings (**Supplemental Digital Content 6**, http://links.lww.com/CCX/A967). Patients who met one or more AIDE criteria within 24 hours of RRT call had higher adjusted odds of being transferred to the ICU in the following 7 days than those who did not (OR, 20.6 [95% CI, 14.2–30.0]) and additionally had a length of stay 9.7 days longer than those who did not (95% CI, 5.4–14.1 d).

DISCUSSION

Through a modified eDelphi process, we have reached a consensus definition for physiological decompensation: "An acute worsening of a patient's clinical status that poses a substantial increase to an individual's short-term risk of death or serious harm." We have also proposed clinical criteria to identify patients who have

TABLE 4.
Association of Composite Outcomes Occurring Within 24 hr of Rapid Response Team Call With the Odds of 7-d Mortality

Outcome	Adjusted OR for 7-d Mortality	AUROC for Multivariable Model
	OR (95% CI)	AUROC (95% CI)
AIDE (mechanical ventilation or vasopressor or inotrope or hypoxemia)	4.1 (2.5–6.7)	0.73 (0.68–0.78)
AIDE or IHCA	8.2 (4.5–15.1)	0.78 (0.73–0.82)
ICU transfer	2.7 (1.6–4.5)	0.69 (0.64–0.75)
ICU transfer or IHCA	3.9 (2.5–6.1)	0.75 (0.70–0.80)

AIDE = adult inpatient decompensation event, AUROC = area under the receiver operating characteristic curve, IHCA = inhospital cardiac arrest, OR = odds ratio.
Multivariable logistic regression was performed for each of the outcomes. Covariables included in the adjusted models included gender, Elixhauser comorbidity index, and age. The AUROC is presented with 95% CIs.

decompensated using data easily obtained retrospectively from the EMR, which we have named "the AIDE criteria," consisting of mechanical ventilation, severe hypoxemia, and receipt of either vasopressor or inotrope medication. The AIDE criteria can be obtained retrospectively from the EMR, facilitating research and QI efforts. Fulfilling these criteria is strongly associated with both short-term mortality and ICU transfer. We propose that the AIDE criteria be used to identify physiological decompensation in future studies, replacing the currently used and highly flawed criterion of ICU transfer. This standard approach will allow for allow better comparison between studies.

The definition and criteria proposed here overcome an important obstacle in the study of decompensation. Studies of both the epidemiology of decompensation and of interventions designed to predict and prevent these events have been limited by a lack of standardization of both terminology and use of validated criteria for decompensation. Use of the AIDE criteria as standardized clinical metrics to define decompensation has the potential ability to increase the power of future interventional and observational studies without jeopardizing the generalizability of the results.

The ability to derive the outcome completely from the EMR in real time may be particularly advantageous to at hospitals with limited resources to collect data on IHCA. Although IHCA can theoretically be identified retrospectively using billing codes, such an approach may vary in accuracy between hospitals and would hinder real-time identification of events, limiting the utility of a composite metric (27).

Our study has several limitations. First, it must be recognized that physiological decompensation is a progressive phenomenon, and identifying a single moment at which decompensation has occurred creates an artificial distinction. Such a dichotomy is useful when studying patient outcomes and the AIDE are not intended to identify all potential instances that might be considered decompensation. However, we hope that our findings will allow researchers to use a definition that is validated and one that improves upon the flawed outcomes of ICU transfer or IHCA.

Additionally, the definition and criteria that were agreed upon by the expert panel do not consider the pathophysiology of physiological decompensation. An understanding of the stress response to acute illness is central to the question of whether an individual patient may progress to physiological decompensation. Although beyond the scope of our current work, these concepts have been elegantly described elsewhere (28). As our understanding of these concepts deepens and our ability to measure them evolves, we hope that our criteria and definition can be revised in the future.

Although we endeavored to include a broad range of experts, we focused on participants based in the United States and not in other countries, which may limit the applicability of our findings to those practicing outside the United States. Our validation of construct and criterion validity was limited by the single-center, retrospective, and observational nature of our cohort and by the fact that we limited our analysis to patients with full code status and who had an RRT activation. Patients who do not wish to receive cardiopulmonary resuscitation or

intubation also experience decompensation events for which successful intervention may include institution of comfort measures rather than prolongation of survival. Although critical to the management of decompensating patients, our study design was not configured to address this set of concerns. We were also not able to determine the performance and generalizability of the AIDE criteria in specific patient groups, such as those who suffer a neurological insult. This may limit the performance of these criteria in these subgroups and will be an important area of future study.

CONCLUSIONS

Using a modified eDelphi approach with a large multidisciplinary expert panel, including clinical and patient advocates, we have generated a consensus definition of physiological decompensation as well as clinical criteria to capture this construct. We propose clinical criteria for an AIDE, which has both criterion and construct validity on a retrospective analysis of single-center RRT data.

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Dr. Mitchell contributed to study design, data analysis, and interpretation and article drafting and writing. He had full access to study data and takes responsibility for the integrity of the data and the data analysis. Drs. Dewan, Wolfe, Roberts, Neefe, Lighthall, Sands, Weissman, Ginestra, Shashaty, Schweickert, and Abella contributed substantially to study conception and design, data interpretation, and drafting and revising of the article. Of note, membership of the expert panel was not considered to be sufficient contribution for authorship. Dr. Weissman was the only member of the expert panel also included as an author. He did not participate in the design of the eDelphi portion of the study but did contribute substantially to data gathering and analysis of the subsequent retrospective cohort study.

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