



HAL
open science

Prognostic Value of the Intensive Care Respiratory Distress Observation Scale on ICU Admission

Maxens Decavèle, Isabelle Rivals, Romain Persichini, Julien Mayaux, Laure Serresse, Capucine Morélot-Panzini, Martin Dres, Alexandre Demoule, Thomas Similowski

► To cite this version:

Maxens Decavèle, Isabelle Rivals, Romain Persichini, Julien Mayaux, Laure Serresse, et al.. Prognostic Value of the Intensive Care Respiratory Distress Observation Scale on ICU Admission. *Respiratory Care*, 2022, 67 (7), pp.823-832. 10.4187/respcare.09601 . hal-04018500

HAL Id: hal-04018500

<https://hal.science/hal-04018500>

Submitted on 7 Mar 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

RESPIRATORY CARE

**Prognostic value of the Intensive Care Respiratory Distress
Observation Scale (IC-RDOS) on intensive care unit
admission:
an exploratory prospective single-center cohort study**

Journal:	<i>Respiratory Care</i>
Manuscript ID	RC-09601
Manuscript Type:	Original Research
Date Submitted by the Author:	03-Sep-2021
Complete List of Authors:	Decavele, Maxens; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S) Rivals, Isabelle; Sorbonne Université, Sorbonne Université, INSERM, UMRS1158 Neurophysiologie Respiratoire Expérimentale et Clinique Persichini, Romain; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S) Mayaux, Julien; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S) Serresse, Laure; AP-HP, Unité de soins palliatifs, hôpital Pitié-Salpêtrière Morelot, Capucine; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S) Dres, Martin; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S) Demoule, Alexandre; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S) Similowski, Thomas; AP-HP, Service de Pneumologie, Médecine Intensive et Réanimation (Département R3S)
Categories:	Critical Care, Dyspnea, Patient assessment/physical diagnosis

Prognostic value of the Intensive Care Respiratory Distress Observation

Scale (IC-RDOS) on intensive care unit admission: an exploratory prospective single-center cohort study

Maxens Decavèle M.D.^{1,2}, Isabelle Rivals Ph.D.³, Romain Persichini M.D.²,
Julien Mayaux, M.D.², Laure Serresse, M.D.^{1,4}, Capucine Morélot-Panzini M.D., Ph.D.^{1,5},
Martin Dres M.D., Ph.D.^{1,2}, Alexandre Demoule M.D., Ph.D.^{1,2*},
Thomas Similowski M.D., Ph.D.^{1,6*} (* co-last authors)

⁽¹⁾ Sorbonne Université, INSERM, UMRS1158 Neurophysiologie Respiratoire Expérimentale et Clinique, F-75005 Paris, France

⁽²⁾ Groupe Hospitalier Universitaire APHP-Sorbonne Université, site Pitié-Salpêtrière, Service Médecine Intensive et Réanimation (Département R3S), F-75013 Paris, France

⁽³⁾ Equipe de Statistique Appliquée, ESPCI Paris, PSL Research University, Paris, France

⁽⁴⁾ Groupe Hospitalier Universitaire APHP-Sorbonne Université, site Pitié-Salpêtrière, Unité Mobile d'Accompagnement et de Soins Palliatifs, Paris, France

⁽⁵⁾ Groupe Hospitalier Universitaire APHP-Sorbonne Université, site Pitié-Salpêtrière, Service de Pneumologie (Département R3S), F-75013 Paris, France

⁽⁶⁾ Groupe Hospitalier Universitaire APHP-Sorbonne Université, site Pitié-Salpêtrière, Département R3S, F-75013 Paris, France

Institution where the study was performed

Groupe Hospitalier Universitaire APHP-Sorbonne Université, site Pitié-Salpêtrière, Service Médecine Intensive et Réanimation (Département R3S), F-75013 Paris, France

Corresponding author

Dr Maxens Decavèle

Department of Respiratory and Critical Care Medicine - Groupe Hospitalier Pitié-Salpêtrière

47-83 Boulevard de l'Hôpital, 75013 Paris, France

Phone: 33 1 42 16 77 61; Fax: 33 1 42 16 78 43

e-mail: maxens.decavele @aphp.fr

Statement of Ethics

This study was approved by the “*Comité de protection des personnes Ile-de-France VI*,” Paris, France and all subjects provided their consent to participate

Conflict or Interests Statement

MDe reports personal fees (for congress registration) from ISIS Medical.

TS reports personal fees from AstraZeneca France, personal fees from Boehringer Ingelheim France, personal fees and non-financial support from Novartis France, personal fees from TEVA France, personal fees from Chiesi France, personal fees from Lungpacer Inc, personal fees from ADEP Assistance, grants from Air Liquide Medical Systems, outside the submitted work.

AD reports grants, personal fees and non-financial support from Philips, personal fees from Baxter, personal fees and non-financial support from Fisher & Paykel, grants from French Ministry of Health, personal fees from Getinge, grants, personal fees and non-financial support from Respinor, grants, personal fees and non-financial support from Lungpacer, personal fees from Lowenstein, personal fees from Gilead, outside the submitted work.

MDr reports expertise fees, travel expenses, research contract from Lungpacer, research contract from Bioserenity, outside the submitted work.

CMP reports personal fees from Astra-Zeneca, GSK, SOS Oxygène, ADEP, ISIS, Resmed, Chiesi, Menarini, Vivisol, Air Liquide, Lowenstein, Fisher & Paykel, outside the submitted work

JM reports personal fees (for congress registration) from Gilead France.

IR, RP and LS have no conflicts of interests to declare.

Authors' contributions

A : Conceptualization/Methodology

B : Analysis/Statistics-software

C : Data acquisition/curation

D : Data interpretation

E : Writing original draft

F : Approval original draft

Maxens Decavèle: A,B,C,D,E,F

Isabelle Rivals: A,B,D,F

Romain Persichini, A,B,C,F

Julien Mayaux: C,D,F

Laure Serresse: D,E,F

Capucine Morélot-Panzini:

Martin Dres: C,D,F

Alexandre Demoule: A,B,D,E,F

Thomas Similowski:A,B,D,E,F

Previous presentation

No previous presentation

Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Funding Sources

This study was supported by the program “Investissement d’Avenir ANR-10-AIHU 06” of the French Government (Agence Nationale pour la Recherche) and allows R.P. salary.

Number of Tables: 3

Number of Figures: 3

Word count: 2959 words

Abstract

Background: The association between dyspnea and mortality has not been demonstrated in the intensive care unit (ICU) setting. We tested the hypothesis that dyspnea (self-reported respiratory discomfort) or its observational surrogates (5-item intensive care respiratory distress observation scale, IC-RDOS) assessed on ICU admission would be associated with ICU mortality.

Methods: Ancillary analysis of single-center data prospectively collected from 220 communicative ICU subjects allocated to a derivation cohort of 120 subjects and a separate validation cohort of 100 subjects. Dyspnea was assessed dichotomously (yes/no), with a visual analog scale (D-VAS), and IC-RDOS was calculated. Multivariate logistic regression was used to identify factors associated with ICU and hospital mortality.

Results: Dyspnea was reported by 69 (58%; median 45 mm, [interquartile interval 32–60]) and 47 (47%; 38 [26–48] mm) subjects in the derivation and validation cohorts, respectively. IC-RDOS was 2.3 (1.2–3.1) and 2.4 (1.3–2.8), respectively. IC-RDOS values were higher in dyspneic subjects than in non-dyspneic subjects in both the derivation cohort (2.6 [2.2–4.6] vs. 1.4 [0.9–2.4], $p < 0.001$) and the validation cohort (2.6 [2.3–4.4] vs. 2.2 [1.0–2.8], $p < 0.001$). On multivariate analysis of the derivation cohort, admission for hemorrhagic shock (OR 13.98), IC-RDOS (OR 1.77) and SAPS II (OR 1.10) was associated with ICU mortality. Areas under the receiving operating curve of IC-RDOS to predict ICU mortality were 0.785 and 0.794 in the derivation and validation cohorts, respectively.

Conclusion: IC-RDOS, an observational surrogate of dyspnea, but not dyspnea itself, is associated with higher mortality in ICU subjects.

Key words list

Dyspnea

Dyspnea observation scale

Intensive care unit

Multidimensional dyspnea profile

Prognosis

For Peer Review

Introduction

Dyspnea, namely the patient's complaint of difficult breathing, which is a distressing and frightening experience, should prompt caregivers to undertake diagnostic procedures and provide relief of this symptom [1, 2]. Dyspnea is also an independent prognostic indicator in numerous clinical settings [3-7]. For example, Stevens *et al.* [4] recently observed that dyspnea on hospital admission was associated with mortality, particularly in the absence of underlying chronic cardiorespiratory disease. In contrast, few data are available concerning the prognostic impact of dyspnea in the ICU [8-10] and apparently no data are available about the impact of being dyspneic at the time of ICU admission. We designed the present study to test the hypothesis that dyspnea on ICU admission constitutes a predictor of mortality.

We evaluated dyspnea using a traditional unidimensional assessment, namely a dyspnea visual analog scale, D-VAS. Because dyspnea is a multidimensional experience [11], we also evaluated dyspnea using a simplified version of a validated multidimensional tool, the Multidimensional Dyspnea Profile (sMDP) [12]. Finally, with non-communicative subjects (i.e. subjects unable to reliably report their dyspnea) in mind, we also assessed the prognostic value of the intensive care respiratory distress observation scale (IC-RDOS) [13, 14]. IC-RDOS is a five-item dyspnea surrogate considering the need for supplemental oxygen, heart rate, use of neck muscles and abdominal paradox during inspiration, and facial expression of fear [13, 14]. This scale has been devised to identify "occult respiratory suffering" [15] in intensive care unit (ICU) subjects, who often cannot self-report their breathing difficulties [16] and in whom caregivers have trouble identifying such difficulties [8, 17, 18].

Methods

Subjects and settings

This is an ancillary analysis of a previous single-center prospective study conducted in a 16-bed intensive care unit (ICU) of a 1600-bed tertiary university hospital, which described the IC-RDOS and its performance in two cohorts of critically ill subjects: a derivation cohort that comprised 120 subjects and a validation cohort that comprised 100 subjects [13]. This study was approved by the “Comité de protection des personnes Ile-de-France VI,” Paris, France and all subjects provided their consent to participate. Guidelines for reporting this retrospective study were from the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement. All consecutive subjects admitted to the ICU were included except when they refused to participate or were unable to reliably self-report (non-communicative subjects). The inability to self-report was defined by the presence of at least one of the following criteria: Richmond RASS < -2 or $> +2$, presence of delirium according to the Confusion Assessment Method for the ICU (CAM-ICU), ongoing sedative drugs, language barrier, deafness or dyspnea visual analog scale (D-VAS) variation > 10 mm between three successive measures.

Dyspnea assessment in the derivation cohort (n = 120)

Dyspnea assessment and clinical data were collected during the first 24 hours of the ICU stay (on week days only), between 8 and 10 am, by a single investigator (R.P.):

1) Unidimensional self-reported assessment:

- the presence of dyspnea was detected by the subject's answers to questions such as “is your breathing difficult?”, “is breathing a problem?”, “is your breathing bothering you”. At least two different phrasings were used and the answers had to be consistent in order to define the patient as “dyspneic”.

- dyspneic subjects were then asked to rate the intensity of their breathing difficulties using a 0-100-mm visual analog scale (D-VAS, from "absent" to "maximal difficulty").

2) Multidimensional self-reported assessment (sensory and emotional descriptors):

Dyspneic subjects were asked to:

- rate dyspnea unpleasantness on a 0-100 mm VAS (from "no discomfort" to "maximal imaginable discomfort"; analogous to the A1 scale of the MDP) [12];
- choose one or several sensory descriptors from a list of five descriptors taken from the sensory descriptors of the MDP [12] (sensory dimension);
- choose one or several emotional descriptors from a list of five descriptors taken from the emotional descriptors of the MDP [12] (emotional dimension) .

Subjects unable to choose descriptors were labelled: "unable to report sensations" and/or "unable to report emotions". Each subject was therefore characterized by 12 "yes/no" answers.

3) Surrogate observational approach: the components of the IC-RDOS were collected at the same time and the IC-RDOS score was calculated. The IC-RDOS is a 5-item multidimensional dyspnea observation scale validated for the ICU setting that takes into account the need for oxygen supplementation, the use of neck muscles for inspiration, the paradoxical abdominal motion during inspiration (abdominal paradox), heart rate, and facial expression of fear [13, 14] (e-Table 1).

Dyspnea assessment in the validation cohort (n = 100)

Only D-VAS and IC-RDOS were collected in this cohort.

Statistical analysis

Continuous variables were expressed as median (interquartile interval) and categorical variables were expressed as absolute and relative frequencies. Continuous variables were

compared between two groups using a Mann–Whitney test and categorical variables were analyzed by Chi-square or Fisher's exact tests, as appropriate.

To incorporate the results of multidimensional self-reporting in the multivariate analysis, we created an "awareness" variable by means of hierarchical cluster analysis (HCA) taking into account the 12 "yes/no" answers collected during the multidimensional assessment (see methods) and using the Euclidean distance and Ward's minimum variance method for merging. The number of clusters was determined using the pseudo-F [19] and pseudo-T [20] heuristics.

Multivariate logistic regression was used to identify factors associated with ICU and hospital mortality. Univariate analysis of factors associated with ICU or 90-day mortality was first performed. Factors yielding p values ≤ 0.20 or considered clinically relevant were then considered for logistic regression. The "awareness" variable determined by the cluster analysis was entered in the dyspneic subject mortality prediction models, as well as the two additional synthetic variables: "at least one sensation reported" or "at least one emotion reported". Continuous variables were not dichotomized. Prior to multivariate analysis, missing data (3.8%) were imputed using the nearest neighbour method. The final models were determined using additive stepwise logistic regression. All tests were two-tailed and p values < 0.05 were considered statistically significant. The Hosmer-Lemeshow Chi-square test was used to check the goodness-of-fit of the final model. Odds ratios (ORs) and their 95% confidence intervals were calculated for factors identified as being significant. The performance of the IC-RDOS to discriminate ICU and hospital survivors and non-survivors was tested in the derivation and validation cohorts by generating receiver operating curves (ROC), which were compared to the ROC of the SAPS II using bootstrap (2000 bootstrap samples). Analyses were performed using Matlab™ (Natick, MA, USA) 9.7.0.1261785

(R2019b) and its Statistics and Machine Learning Toolbox version 11.6, as well as R version 3.6.1 (2019-07-05) and its ROCR package.

Results

Derivation cohort

Subject characteristics

During the study period, 456 subjects were admitted to the ICU and 193 subjects were evaluated. Seventy-three (37%) were non-communicative (sedation, $n = 49$; delirium, $n = 9$; unable to understand the questions, $n = 6$; and other reasons, $n = 9$) [4]. Among the remaining 120 subjects, 69 (57%) were dyspneic and 51 (43%) were not dyspneic (Table 2). Dyspneic subjects were more likely to present pneumonia, visible signs of laboured breathing and other distressing symptoms, such as pain and anxiety (Table 2). Fourteen subjects were receiving mechanical ventilation at the time of dyspnea assessment, but 54 (45%) subjects received mechanical ventilation at some time during their ICU stay. Mechanical ventilation was more frequently required in dyspneic patient than in non-dyspneic subjects (43 [62%] vs. 21 [51%], $p=0.022$), especially noninvasive ventilation (NIV) (29 [42%] vs. 9 [18%], $p=0.017$). The ICU stay was significantly longer in dyspneic subjects (3 [2-7] vs. 2 [1-3], $p=0.001$), but the hospital stay was not significantly longer (13 [7-32] vs. 8 [5-18], $p=0.076$).

Characteristics of dyspnea

Dyspneic subjects reported dyspnea intensity of 45 [32-60] mm on D-VAS and dyspnea unpleasantness of 52 [31-77] mm. IC-RDOS scores were higher among the 69 dyspneic subjects (Table 2) and all 5 items, except for abdominal paradox, were significantly more frequent or more intense in dyspneic subjects (Table 2). Figure 1 depicts the frequency of each sensory and emotional descriptor in these subjects. Fifty-nine (86%) subjects were able to choose at least one sensory descriptor ($n=49$; two or more descriptors in 42 cases) or

state that none of the descriptors was appropriate (n=10). Ten (14%) subjects were unable to express themselves on this aspect. Fifty-one (74%) Subjects were able to choose at least one emotional descriptor (n= 44; two or more descriptors in 41 cases) or state that none of the descriptors was appropriate (n = 7). Eighteen (26%) subjects were unable to express themselves on this aspect.

Hierarchical cluster analysis

Analysis of the 69 dyspneic subjects identified two clusters composed of: 1) 37 (54%) subjects who were able to choose at least one sensory or one affective descriptor ("self-aware"), and 2) 32 subjects (46%) who were unable to choose any descriptor ("non-self-aware"). The characteristics of these two clusters are compared in Table 3. Self-aware subjects reported more intense dyspnea and were more likely to exhibit visible signs of laboured breathing. They were also less frequently treated with morphine than "non-self-aware" Subjects.

Mortality and associated factors

ICU and hospital mortality rates in the derivation cohort (n = 120) were 9% and 21%, respectively. ICU and hospital mortality rates were 12% and 25% in dyspneic subjects versus 6% and 16% in non-dyspneic subjects (p=0.351 and 0.232, respectively). Factors associated with ICU and hospital mortality, identified by univariate analyses, are depicted in e-Table 2 and 3, respectively. On multivariate analysis, two factors were independently associated with ICU mortality: the need for vasopressors (odds ratio [OR] 20.79, 95% confidence interval [95%CI] 1.57–258.71, p<0.001) and IC-RDOS (OR 2.01, 95%CI 1.34–3.00, p<0.001). Multivariate analysis identified three factors independently associated with hospital mortality: admission for hemorrhagic shock (OR 13.98, 95%CI 2.26–86.96, p=0.004), IC-RDOS (OR 1.77, 95%CI 1.27–2.51, p<0.001) and SAPS II (OR 1.10, 95%CI 1.01–1.08, p=0.014). Higher

IC-RDOS scores were associated with higher mortality in both the ICU and hospital mortality prediction models.

When mortality analysis was restricted to the 69 dyspneic subjects (e-Table 4 and 5), multivariate analysis showed that IC-RDOS was independently associated with ICU mortality (OR 5.26, 95%CI 1.69–16.67, $p=0.003$). Of note, a significant inverse relationship was also observed between the ability to report at least one emotion and ICU mortality (OR 0.01, 95%CI 0.00–0.25, $p=0.006$). Only one factor was identified as an independent predictor of hospital mortality, namely IC-RDOS (OR 2.19, 95%CI 1.42–3.34, $p<0.001$).

On univariate analysis, being “self-aware” according to the HCA analysis was not associated with increased ICU ($p=0.457$) or hospital mortality ($p=0.620$).

IC-RDOS performance to predict mortality in the derivation and validation cohorts

Figure 2 depicts the area under the receiver operating curve (ROC) of IC-RDOS compared to SAPS II to predict mortality. In the derivation cohort, an IC-RDOS of 2.8 predicted ICU mortality with a sensitivity of 76% and a specificity of 72%.

The characteristics of the subjects included in the validation cohort ($n = 100$) are described in e-Table 6. Although the hospital mortality rate was significantly lower in the validation cohort (7% vs. 21%, $p=0.004$), the performance of the IC-RDOS to predict mortality in this cohort was similar to that observed in the derivation cohort, as, in the validation cohort ($n = 100$), an IC-RDOS of 2.7 predicted hospital mortality with a sensitivity of 100% and a specificity of 70%.

Discussion

This study, conducted in two independent patient cohorts, shows that dyspnea evaluated on ICU admission is not associated with increased ICU or hospital mortality. In

contrast, IC-RDOS, a surrogate of dyspnea derived from physical examination, is independently associated with both ICU and hospital mortality.

Data linking dyspnea with mortality in the ICU setting are scarce. Schmidt *et al.* found that dyspnea was associated with prolonged weaning from mechanical ventilation, but not with mortality [9]. Haugdahl *et al.* observed similar results when dyspnea was assessed at the end of a spontaneous breathing trial [8]. Dangers *et al.* observed a significant association between mortality and persistent dyspnea after a first NIV session in subjects admitted for acute respiratory failure, but not between mortality and dyspnea on admission [10]. In these studies, dyspnea was assessed unidimensionally using VAS or numerical rating scales. Our D-VAS data are in line with these observations.

In contrast with D-VAS, IC-RDOS was independently associated with ICU mortality and hospital mortality in both cohorts. The association was even stronger when the analysis was restricted to the subset of dyspneic subjects. The difference in prognostic value between D-VAS and IC-RDOS may stem from the integrative nature of IC-RDOS that captures elements related to gas exchange (need for oxygen supplementation), respiratory drive (use of neck muscles for inspiration), respiratory muscle function (abdominal paradox), and neurovegetative (heart rate) and emotional responses (facial expression of fear) to stress. The contrast in terms of the respective prognostic value of D-VAS and IC-RDOS is reminiscent of dyspnea-targeted interventional studies that failed to modify unidimensional dyspnea ratings, but successfully improved other patient-related outcomes. Likewise, Messika *et al.* [21] studied the effects of musical intervention in subjects undergoing NIV. They did not observe any relief of dyspnea, but reported a statistically significant reduction in blood pressure and the peritraumatic distress inventory, a measure of acute stress that is predictive of post-traumatic stress disorders [21]. These findings have led to the hypothesis that dyspnea-targeted intervention should be evaluated by means of multidimensional rather than

unidimensional indicators [22, 23]. Our observations suggest that IC-RDOS could provide a multidimensional assessment of dyspnea, but this remains to be demonstrated by specifically designed studies.

The absence of association between dyspnea and prognosis observed in previous studies [8-10] could result from a bias due to high proportions of noncommunicative subjects in the corresponding populations (up to 50% [13, 16]). However, this was not the case in our study, which only included communicative subjects and which also concluded on the absence of an D-VAS / mortality association. Of note, it is unlikely that the prognostic value of IC-RDOS is simply due to an overlap of its constituent variables with variables of the Simplified Acute Physiology Score 2 (SAPS2). Only one variable is common to IC-RDOS and SAPS2 (heart rate) and, in our study, IC-RDOS performed as well or better than SAPS2 to predict ICU and hospital mortalities.

In line with previous MDP clinical studies, air hunger and anxiety dominate the description of dyspnea on ICU admission [24-26], confirming the interplay between anxiety and dyspnea [27, 28]. Subjects in the "non-self-aware" subgroup had lower IC-RDOS scores and reported twofold lower dyspnea intensity and dyspnea unpleasantness than "self-aware" subjects. However, "non-self-aware" subjects more frequently received morphine than "self-aware" Subjects at the time of dyspnea assessment. Morphine, regardless of its indication, may therefore have blunted dyspnea in "non-self-aware" subjects [29]. The inability to report at least one emotion was associated with higher mortality, in line with recent data showing that hospitalized subjects unable to self-report their symptoms (dyspnea, pain or anxiety) are at increased risk of mortality than subjects who are able to self-report [4].

This study has a number of limitations. Firstly, the verbal multidimensional assessment of dyspnea was based on a non-validated rough simplification of the MDP. Secondly, this assessment was only performed in the derivation cohort and not in the

validation cohort. Thirdly, because of the study design requiring subjects be communicative in order to participate, only 14 subjects (12%) of the derivation cohort were intubated, and the overall mortality was low in line with this moderate disease severity, limiting the generalizability of the results. A corroborative study of the prognostic value of IC-RDOS in unselected ICU subjects is therefore needed. Finally, the study was not powered to identify the components of the IC-RDOS that drive its prognostic value. However, some of these items taken independently have been associated with prognosis (e.g. alterations in breathing pattern [30] and modifications of facial expression [31]).

Conclusion

With all due caution in view of the above limitations, our results support the idea that measuring IC-RDOS in communicative subjects on ICU admission can provide valuable prognostic information and therefore complements the clinically actionable information provided by unidimensional or multidimensional assessment of dyspnea. Our results also support further evaluation of the prognostic value of IC-RDOS in noncommunicative subjects, corresponding to the population for which this scale was developed in order to alleviate "unrecognized respiratory suffering" [32].

Acknowledgments

Not applicable

Quick look

Current Knowledge

Dyspnea is a ubiquitous symptom associated with negative emotional response and mortality in various clinical settings. In the intensive care unit setting (ICU) self-reported dyspnea is frequent, severe, distressing but its emotional response and its association with mortality has not been demonstrated.

What this paper contributes to our knowledge

Measuring the IC-RDOS, a 5-item observational surrogate of dyspnea, on ICU admission reveals the prognostic influence of dyspnea in critically ill subjects. Assessing the negative emotional response to dyspnea allows identifying subjects that may suffer the most from being dyspneic during their ICU stay.

References

- [1] Chanques G, Nelson J, Puntillo K. Five patient symptoms that you should evaluate every day. *Intensive Care Med.* 2015;41:1347-50.
- [2] Demoule A, Similowski T. Respiratory Suffering in the ICU: Time for Our Next Great Cause. *Am J Respir Crit Care Med.* 2019;199:1302-1304.
- [3] Nishimura K, Izumi T, Tsukino M, Oga T. Dyspnea is a better predictor of 5-year survival than airway obstruction in patients with COPD. *Chest.* 2002;121:1434-40.
- [4] Stevens JP, Dechen T, Schwartzstein RM, O'Donnell C, Baker K, Banzett RB. Association of dyspnea, mortality, and resource use in hospitalised patients. *Eur Respir J.* 2021 Mar 2:1902107 [Online ahead of print].
- [5] Steer J, Norman EM, Afolabi OA, Gibson GJ, Bourke SC. Dyspnoea severity and pneumonia as predictors of in-hospital mortality and early readmission in acute exacerbations of COPD. *Thorax.* 2012;67:117-21.
- [6] Kirchberger I, Heier M, Kuch B, von Scheidt W, Meisinger C. Presenting symptoms of myocardial infarction predict short- and long-term mortality: the MONICA/KORA Myocardial Infarction Registry. *Am Heart J.* 2012;164:856-61.

- [7] Smith AK, Currow DC, Abernethy AP, et al. Prevalence and Outcomes of Breathlessness in Older Adults: A National Population Study. *J Am Geriatr Soc.* 2016;64:2035-2041.
- [8] Haugdahl HS, Storli SL, Meland B, Dybwik K, Romild U, Klepstad P. Underestimation of Patient Breathlessness by Nurses and Physicians during a Spontaneous Breathing Trial. *Am J Respir Crit Care Med.* 2015;192:1440-48.
- [9] Schmidt M, Demoule A, Polito A, et al. Dyspnea in mechanically ventilated critically ill patients. *Crit Care Med.* 2011; 39:2059–2065.
- [10] Dangers L, Montlahuc C, Kouatchet A, et al. Dyspnoea in patients receiving noninvasive ventilation for acute respiratory failure: prevalence, risk factors and prognostic impact: A prospective observational study. *Eur Respir J.* 2018;52(2).
- [11] Lansing RW, Gracely RH, Banzett RB. The multiple dimensions of dyspnea: review and hypotheses. *Respir Physiol Neurobiol.* 2009;167:53-60.
- [12] Banzett RB, O'Donnell CR, Guilfoyle TE, et al. Multidimensional Dyspnea Profile: an instrument for clinical and laboratory research. *Eur Respir J.* 2015;45:1681-91.
- [13] Persichini R, Gay F, Schmidt M, et al. Diagnostic Accuracy of Respiratory Distress Observation Scales as Surrogates of Dyspnea Self-report in Intensive Care Unit Patients. *Anesthesiology.* 2015;123:830-7.
- [14] Demoule A, Persichini R, Decavèle M, Morelot-Panzini C, Gay F, Similowski T. Observation scales to suspect dyspnea in non-communicative intensive care unit patients. *Intensive Care Med.* 2018;44:118-120
- [15] Carel H, Macnaughton J, Dodd J. Invisible suffering: breathlessness in and beyond the clinic. *Lancet Respir Med* 2015;3:278-279.
- [16] Nelson JE, Meier DE, Oei EJ, et al. Self-reported symptom experience of critically ill cancer patients receiving intensive care. *Crit Care Med* 2001;29:277-282.
- [17] Binks AP, Desjardin S, Riker R. ICU Clinicians Underestimate Breathing Discomfort in Ventilated Subjects. *Respir Care.* 2017;62:150-155.
- [18] Gentzler ER, Derry H, Ouyang DJ, et al. Underdetection and Undertreatment of Dyspnea in Critically Ill Patients. *Am J Respir Crit Care Med.* 2019;199:1377-1384.
- [19] Caliński T, Harabasz J. A dendrite method for cluster analysis. *Commun Statist.* 1974;3:1-27.
- [20] Duda RO, Hart PE. *Pattern Classification and Scene Analysis.* John Wiley & Sons, New York, 1973.

- [21] Messika J, Martin Y, Maquigneau N, et al; MUS-IRA team; MUS-IRA Investigators: A musical intervention for respiratory comfort during noninvasive ventilation in the ICU. *Eur Respir J*. 2019;53:1801873.
- [22] Similowski T, Serresse L. Lessons from negative dyspnoea studies: arguments for the multidimensional evaluation of multidirectional therapeutic approaches. *Eur Respir J*. 2019;53(1).
- [23] Similowski T. Treat the lungs, fool the brain and appease the mind: towards holistic care of patients who suffer from chronic respiratory diseases. *Eur Respir J* 2018; 51: 1800316.
- [24] Stevens JP, Sheridan AR, Bernstein HB, et al. A Multidimensional Profile of Dyspnea in Hospitalized Patients. *Chest*. 2019;156:507-517
- [25] Morélot-Panzini C, Perez T, Sedkaoui K, et al. The multidimensional nature of dyspnoea in amyotrophic lateral sclerosis patients with chronic respiratory failure: Air hunger, anxiety and fear. *Respir Med*. 2018;145:1-7.
- [26] Morélot-Panzini C, Gilet H, Aguilaniu B, et al. Real-life assessment of the multidimensional nature of dyspnoea in COPD outpatients. *Eur Respir J*. 2016;47:1668-79.
- [27] Livermore N, Butler JE, Sharpe L, McBain RA, Gandevia SC, McKenzie DK. Panic attacks and perception of inspiratory resistive loads in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 2008;178:7-12.
- [28] Smoller JW, Pollack MH, Otto MW, Rosenbaum JF, Kradin RL. Panic anxiety, dyspnea, and respiratory disease. Theoretical and clinical considerations. *Am J Respir Crit Care Med*. 1996;154:6-17.
- [29] Verberkt CA, van den Beuken-van Everdingen MHJ, Schols JMGA, Hameleers N, Wouters EFM, Janssen DJA. Effect of Sustained-Release Morphine for Refractory Breathlessness in Chronic Obstructive Pulmonary Disease on Health Status: A Randomized Clinical Trial. *JAMA Intern Med*. 2020;17:e203134.
- [30] Churpek MM, Yuen TC, Huber MT, Park SY, Hall JB, Edelson DP. Predicting cardiac arrest on the wards: a nested case-control study. *Chest*. 2012;141:1170-6.
- [31] Madrigal-Garcia MI, Rodrigues M, Shenfield A, Singer M, Moreno-Cuesta J. What Faces Reveal: A Novel Method to Identify Patients at Risk of Deterioration Using Facial Expressions. *Crit Care Med*. 2018;46:1057-1062.
- [32] Başoğlu M. Effective management of breathlessness: a review of potential human rights issues. *Eur Respir J*. 2017;49. pii: 1602099.

Figure legends

Figure 1. Sensory and emotional descriptors reported by the 69 dyspneic subjects on intensive care unit admission

Figure 2. Hierarchical cluster analysis of dyspneic subjects according to sensory and emotional descriptors in the derivation cohort.

Figure 3. Comparisons of the area under the receiver operating curve (AUC) of the Simplified Acute Physiology Score (SAPS) II and the Intensive Care–Respiratory Distress Observation Scale (IC-RDOS) to predict intensive care unit (ICU) and hospital mortality in the derivation (n = 120) and validation (n = 100) cohorts

Table 1. Multidimensional assessment of dyspnea used in the validation cohort (n = 120), from a simplified version of the Multidimensional Dyspnea Profile (MDP)¹².

Sentence	Coded variables
Unpleasantness or discomfort of your breathing sensations, how bad your breathing feels	Intensity of the unpleasantness related to dyspnea (if dyspneic), VAS
	Breathing-related sensations
My breathing requires muscle work or effort	Labored breathing
I am not getting enough air or I am smothering, or I feel hunger for air	Air hunger
My chest and lungs feel tight or constricted	Constricted chest,
My breath requires mental effort or concentration	Concentrated breathing
I am breathing a lot (rapidly, deeply, heavily)	Heavy/hard breathing,
	Breathing-related emotions
My breathing makes me feel depressed	Depression
My breathing makes me feel anxious	Anxiety
My breathing makes me feel frustrated	Frustration
My breathing makes me feel angry	Anger
My breathing makes me feel afraid	Fear

Patients were asked whether or not each of the breathing-related sensations or emotions applied to them. They were informed that they could choose several descriptors in each category.

VAS, visual analog scale

Table 2. Characteristics, at the time of evaluation, of dyspneic and non-dyspneic patients in the derivation cohort (n = 120)

Variables	All patients n = 120	Dyspneic patients n = 69	Non-dyspneic patients n = 51	p
General characteristics				
Age, years	61 [46-70]	62 [48-70]	57 [39-72]	0.326
Male gender, n (%)	72 (60)	38 (55)	34 (67)	0.258
Admission for ARF, n (%)	78 (65)	49 (71)	29 (57)	0.077
Admission for hemorrhagic shock, n (%)	9 (8)	3 (4)	6 (12)	0.167
Acute infectious pneumonia, n (%)	18 (15)	15 (22)	3 (6)	0.020
Physiological variables and severity				
Heart rate, beats/min	95 [80-120]	99 [85-109]	88 [75-99]	0.008
SAPS II	33[21-43]	35 [26-43]	29 [19-43]	0.108
Laboratory variables				
PaCO ₂ , mmHg	38 [33-46]	39 [32-46]	37 [34-46]	0.651
Bicarbonate, mMol/L	25 [21-29]	26 [23-29]	23 [19-28]	0.106
Hemoglobin, g/dL	12.0 [9.9-13.4]	11.8 [9.9-13.2]	11.5 [9.6-13.9]	0.975
Respiratory clinical features				
Respiratory rate, breaths/min	22 [18-26]	23 [19-27]	20 [17-25]	0.043
Paradoxical breathing, n (%)	4 (3)	4 (6)	0 (0)	0.136
Use of inspiratory neck muscles, n (%)	26 (22)	24 (35)	2 (4)	<0.001
Facial expression of fear, n (%)	7 (6)	7 (10)	0 (0)	0.020
Non-purposeful movements, n (%)	2 (2)	1 (1)	1 (2)	0.737
Nasal flaring, n (%)	4 (3)	4 (6)	0 (0)	0.136
Need for oxygen therapy, n (%)	80 (67)	57 (83)	23 (45)	<0.001
IC-RDOS	2.3 [1.1-3.0]	2.56 [2.18-4.62]	1.40 [0.88-2.35]	<0.001
Associated symptoms				
Pain, n (%)	41 (34)	29 (60)	12 (26)	<0.001
Pain intensity on VAS, mm	43 [23-60]	45 [30-60]	35 [20-50]	0.195
Anxiety, n (%)	61 (51)	50 (74)	11 (22)	<0.001
Anxiety intensity on VAS	54 [40-80]	58 [41-80]	45 [29-50]	0.027
Medication at the time of evaluation				
Anxiolytics, n (%)	35 (29)	20 (29)	15 (29)	0.959
Morphine, n (%)	28 (23)	13 (21)	15 (29)	0.176
Bronchodilators, n (%)	32 (27)	19 (28)	13 (25)	0.802

Continuous variables are expressed as median (interquartile range) and categorical data are expressed as number (%).

ARF, acute respiratory failure; IC-RDOS, Intensive Care Respiratory Distress Observation Scale; SAPS II, Simplified Acute Physiology Score II; VAS, Visual Analog Scale.

Table 3. Characteristics, at the time of evaluation, of self-aware and non-self-aware dyspneic patients (n=69), as defined by hierarchical cluster analysis on the 10 sensory and emotional descriptors.

Variables	Self-aware patients n = 37	Non-self-aware patients n = 32	p
General characteristics			
Age, years	61 [45-70]	63 [51-72]	0.400
Male gender, n (%)	19 (51)	19 (59)	0.504
Admission for ARF, n (%)	29 (78)	22 (69)	0.364
Admission for hemorrhagic shock, n (%)	2 (5)	1 (3)	0.765
Acute infectious pneumonia, n (%)	8 (22)	7 (22)	0.941
Physiological variables and severity			
Heart rate, beats/min	102 [86-109]	94 [80-110]	0.277
SAPS II	35 [22-43]	37 [26-47]	0.772
Respiratory clinical features			
Respiratory rate, breaths/min	24 [21-30]	22 [16-25]	0.005
Paradoxical breathing, n (%)	3 (8)	1 (3)	0.776
Use of inspiratory neck muscles, n (%)	16 (43)	8 (25)	0.112
Facial expression of fear, n (%)	6 (16)	1 (3)	0.113
Non-purposeful movements, n (%)	1 (3)	0 (0)	1.000
Nasal flaring, n (%)	4 (11)	0 (0)	0.118
Need for oxygen therapy, n (%)	33 (89)	24 (75)	0.121
IC-RDOS	3.2 [2.4-4.7]	2.4 [1.7-4.1]	0.011
Associated symptoms			
Pain intensity on VAS, mm	42 [21-62]	45 [33-60]	0.803
Anxiety intensity on VAS, mm	72 [42-82]	52 [36-66]	0.142
Dyspnea sensory and emotional descriptors			
VAS Dyspnea intensity, mm	55 [42-64]	39 [22-50]	0.003
VAS Dyspnea unpleasantness intensity, mm	56 [32-81]	31 [11-59]	0.009
At least one sensation reported, n (%)	34 (92)	15 (46)	<0.001
Labored breath, n (%)	23 (62)	5 (16)	<0.001
Air hunger, n (%)	28 (76)	9 (28)	<0.001
Constricted chest, n (%)	21 (57)	2 (6)	<0.001
Concentrated breathing, n (%)	17 (46)	3 (9)	<0.001
Heavy/hard breathing, n (%)	22 (59)	5 (16)	<0.001
At least one emotion reported, n (%)	36 (97)	8 (25)	<0.001
Depression, n (%)	23 (62)	0 (0)	<0.001
Anxiety, n (%)	29 (78)	5 (16)	<0.001
Frustration, n (%)	21 (66)	3 (9)	<0.001
Anger, n (%)	19 (51)	0 (0)	<0.001
Fear, n (%)	20 (54)	1 (3)	<0.001
Medication at the time of evaluation			
Anxiolytics, n (%)	10 (27)	10 (31)	0.807
Morphine, n (%)	3 (8)	10 (32)	0.014
Bronchodilators, n (%)	10 (27)	9 (28)	0.891

Continuous variables are expressed as median (interquartile range) and categorical data are expressed as number (%).

ARF, acute respiratory failure; IC-RDOS, Intensive Care Respiratory Distress Observation Scale; SAPS II, Simplified Acute Physiology Score II; VAS, Visual Analog Scale.

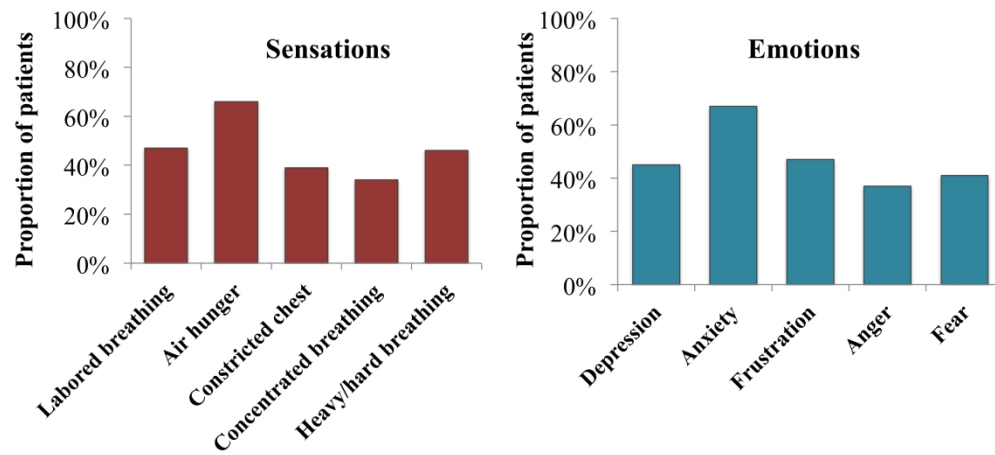


Figure 1

1057x793mm (72 x 72 DPI)

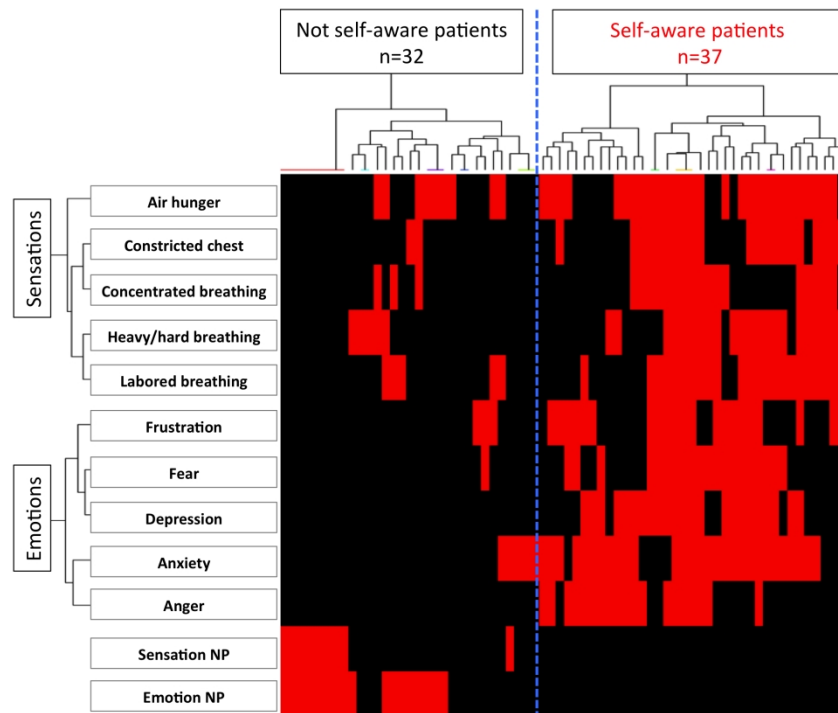


Figure 2

1057x793mm (72 x 72 DPI)

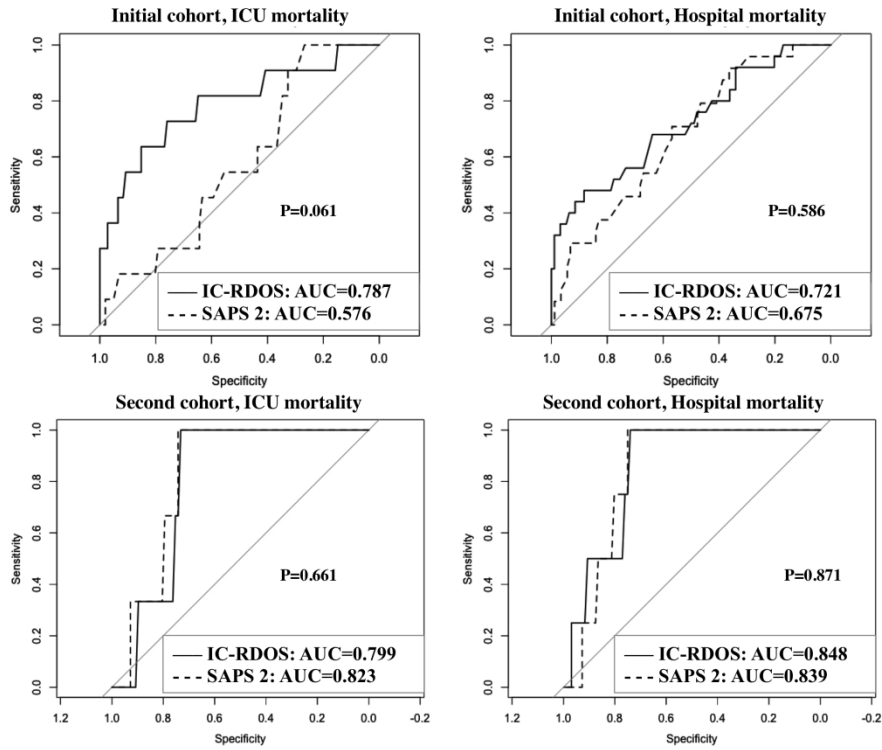


Figure 3

1057x793mm (72 x 72 DPI)