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SHORT REPORT

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# Rehabilitation complexity scale and reimbursement of in-hospital pulmonary rehabilitation

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ABSTRACT

**Background:** The use of case-based reimbursement for medical rehabilitation is greatly discussed. The investigators explored the relationship between disability and reimbursement opportunities in individuals with respiratory diseases undergoing in-hospital pulmonary rehabilitation (PR), considering the correlation (if any) between the Rehabilitation Complexity Scale (RCS-E v13) scores used at admission and the actual reimbursement.

**Methods:** This study is part of a larger prospective multicenter study conducted by eight Pulmonary Rehabilitation Units in Italy. Here, investigators considered only data from the Lombardy Region. On January 30th or February 28th, 2023, participants were allocated according to the main DRG into 4 groups [tracheostomized/ventilated (TX/V), chronic respiratory failure (CRF), COPD, and miscellaneous group]. We recorded anthropometrics, diagnosis, international outcome measures, and calculated admission and discharge RCS-E v13 scores and hospital stay reimbursement according to the healthcare system (HS).

**Results:** Three hundred and sixteen participants were evaluated. Patients were elderly, in the majority of cases with CRF, presenting comorbidities, disability, dyspnea, and reduced effort tolerance. At admission, RCS-E v13 showed an average moderate value of complexity. The median (IQR) HS reimbursement/stay was different among groups. RCS-E v13 evaluated at admission was weakly ($r=0.3471$), but significantly related to the HS reimbursement/stay ($p<0.0001$) mainly due to TX/V and miscellaneous subgroups, while no relationship was found for COPD and CRF patients. After PR, all outcome measures improved significantly in all groups ($p<0.001$ for all). Higher RCS-E v13 scores at admission did not correspond to a proper amount of reimbursement, being this latter under- or over-estimated if compared to needs assessed by RCS-E v13. RCS-E v13 at discharge decreased for all subgroups (range from -6 to -11) reaching a low value of complexity.

**Conclusions:** The RCS-E v13 disability score does not fully mirror the HS reimbursement for patients undergoing in-hospital PR.

**Key words:** COPD; chronic respiratory diseases; disability; outcomes; costs.

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**Ethics approval:** This study is part of a larger prospective multicenter study conducted in Italy and approved by the Ethical Committee of the Istituti Clinici Scientifici (ICS) Maugeri, IRCCS (Protocol ID: ICS Maugeri 2713 EC, December 16th, 2022).

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## Introduction

After the introduction of Diagnosis-Related Groups (DRGs) into the prospective payment system, there is discussion about using case-based reimbursement for medical rehabilitation as well. Specific guidance has been previously proposed on billing and coding for rehabilitation services, impacting reimbursement for qualified providers [1].

In particular, at the international level, two systems of reimbursement have already been tested: the FIM-FRG has been developed specifically for a prospective payment system for inpatient rehabilitation facilities, while the RUG-III is used for long-term care reimbursement in nursing homes and is based on a daily payment [2].

The feasibility of a reimbursement system matching costs to functional recovery by linking reimbursement to actual in-hospital stay, adjusted for trends of functional recovery performance, has been proposed to improve efficiency in the Italian Health System [3]. The addition of specific information on functioning in case-mix systems improves predictive ability and fosters the homogeneity of case-mix groups predicting resource use and capturing outcomes for frail elderly patients or those with severe functioning difficulties [4]. Unfortunately, the major fault in existing reimbursement systems lies in their inability to discriminate for the real complexity and needs of patients, both when paying per day and when paying per treatment episode. In particular, patients with respiratory diagnoses admitted for rehabilitation programs have been poorly studied and no information is available on the relation between their disability and reimbursement opportunities.

In previous studies (*under submission*), we recorded the Rehabilitation Complexity Scale (RCS-E v13) in subjects undergoing in-hospital pulmonary rehabilitation (PR). This simple tool has been recently proposed by different authors to measure patients' care and rehabilitation needs and interventions across rehabilitation services being useful for determining the cost of the programs, as well [5-10]. RCS-E v13 varies in different chronic respiratory diseases (CRD), is responsive to PR, and correlates significantly with several outcome measures of PR in different ways (*under submission*). The current study aimed to evaluate the correlation (if any) of RCS-E v13 with the current DRG reimbursement in individuals with CRD undergoing in-hospital PR in Italy.

## Methods

This study is part of a larger prospective multicenter study conducted in Italy and approved by the Ethical Committee of the Istituti Clinici Scientifici (ICS) Maugeri, IRCCS (Protocol ID: ICS Maugeri 2713 EC, December 16th, 2022). For the aim of the present study, the investigators considered data from the Lombardy Region only. All individuals, irrespective of admission diagnosis and provenience (acute hospital or primary care), attending eight Pulmonary Rehabilitation (PR) Units in the Lombardy Region, Italy, were evaluated in one of two days (January 30th and February 28th, 2023). We excluded data from people who died during the stay, with a hospital length of stay (LoS) lower than 7 days or transferred to acute hospitals. All specific diagnoses were obtained from the acute hospital discharge records, from the outpatient records completed at the time of the visit for rehabilitative admission, and/or from our rehabilitative centers at the time of hospital discharge. Data from these participants have been part of the data collected for a previous study (*under submission).*

Participants were divided into 4 groups according to the main DRGs: i- tracheostomized/ventilated individuals treated for difficult weaning from mechanical ventilation (TX/V); ii. individuals with chronic respiratory failure (CRF) (as defined by arterial oxygen tension to inspiratory oxygen fraction ratio ($PaO_2/FiO_2$) <300, from various causes; iii- individuals with chronic obstructive pulmonary disease without CRF (COPD); iv. individuals with diseases other than COPD, without CRF (miscellaneous group).

We recorded age, sex, LoS, and Cumulative Illness Rating Scale (CIRS) at admission as well as RCS-E v13 and outcome measures [Barthel index (BI), Barthel dyspnea index (BiD), Medical Research Council scale for dyspnoea (MRC), COPD assessment test (CAT), short physical performance battery (SPPB)], before and after in-hospital PR.

Daily reimbursement was collected according to the Healthcare System (HS) of the Lombardy region. The value of reimbursement for each individual (HS Reimbursement/stay) was calculated by multiplying the daily reimbursement by the LoS. Actual reimbursement is based on a similar fare/day for COPD and CRF (irrespective of diagnosis) of 283.3€/day, with higher reimbursement for TX/V individuals (332.3€/day) and lower reimbursement for the miscellaneous group (220€/day).

The association between RCS-E v-13 at admission and HS reimbursement was assessed by Spearman correlation. Data were analyzed using STATA 11.2 (STATA software, USA). A $p<0.05$ was defined as statistically significant.

## Results

Three hundred and twenty-seven participants were considered. Two participants died, one was transferred to acute care hospitals and 8 had a LoS less than 7 days. Therefore 316 participants were

**Table 1. Demographic and clinical characteristics of the population in the study.**

| | |
|---|---|
| Patients, n | 316 |
| Age, years | 73 (58-79) |
| Males, n (%) | 181 (57.3) |
| LoS, days | 30 (21-41) |
| COPD, % | 13.9 |
| COPD CRF, % | 55.1 |
| TX/V, % | 8.2 |
| Miscellaneous, % | 22.8 |
| CIRS, score | 1.8 (1.5-2.1) |
| 6MWT, meters | 167 (0.0-304.0) |
| CAT, score | 22.0 (16.8-25.0) |
| MRC, score | 3.0 (2.0-4.0) |
| BI, score | 81.0 (38.8-100.0) |
| BiD, score | 33.0 (19.8-52.0) |
| SPPB, score | 6.0 (2.0-9.0) |
| Acute care hospitals provenience, % | 57.0 |

Data are expressed as median values, interquartile range, or percentage. COPD, chronic obstructive pulmonary disease; CRF, chronic respiratory failure; TX/V, tracheostomized/ventilated; CIRS, cumulative illness rating scale; 6MWT, six-minute walking test; CAT, COPD assessment test; MRC, Medical Research Council; BI, Barthel index; BiD, Barthel dyspnea index; SPPB, short physical performance battery.

evaluated (Table 1). Patients were elderly, in the majority of cases with CRF, presenting comorbidities, disability, dyspnea, and reduced effort tolerance. At admission, the RCS-E v13 evaluated in the whole group showed an average moderate value of care burden and complexity; the TX/V group showed the most severe value, while other groups showed less severe and similar values (p<0.0001) (Table 2). RCS-E v13 at discharge decreased in all subgroups (range from -6 to -11) reaching a low value of complexity. Median (IQR) HS Reimbursement/stay was different among groups; miscellaneous and Tx/V groups showed the lowest and the highest amount, respectively (Table 2). After PR, all outcome measures improved significantly in all groups (p<0.001 for all) (Table 3). Figure 1 shows the relationship between RCS-E v13 evaluated at admission and HS Reimbursement/stay in the whole group of patients. The graph displays the distribution and percentage of participants according to 4 quadrants obtained from the median values of the two variables. As shown in Figure 1, RCS-E v13 at admission was significantly (p<0.0001) related to the HS Reimbursement/stay, but with a weak correlation (r=0.3471). Indeed, higher RCS-E v13 scores did not always correspond to a proper amount of reimbursement, being this latter sometimes under or over-estimated as compared to needs assessed by RCS-E v13.

**Table 2.** **RCS-E v13 and healthcare system reimbursement/stay.**

| | Overall (n=316) | TX/V (n=26) | CRF (n=174) | COPD (n=44) | Miscellaneous (n=72) | p |
|---|---|---|---|---|---|---|
| RCS-E v13 adm | 11.0 (8.0-12.0) | 16.0 (14.5-17.0) | 11.0 (9.0-12.0) | 8.0 (7.0-11.0) | 8.0 (8.0-11.0) | <0.0001 |
| RCS-E v13 dis | 3.5 (1.0-6.0) | 5.0 (4.0-11.5) | 4.0 (2.0-6.0) | 2.0 (1.0-4.5) | 1.0 (1.0-4.0) | <0.0001 |
| Healthcare system reimbursement/stay, € | 7674.3 (5437.6-11047.9) | 12557.2 (11263.5-15443.0) | 8781.7 (6232.2-11331.2) | 8356.8 (6232.2-10552.2) | 4730.0 (4070.0-5885.0) | <0.0001 |

TXV, tracheostomized/ventilated; CRF, chronic respiratory failure; COPD, chronic obstructive pulmonary disease; RCS-E v13, rehabilitation complexity scale – extended version; adm, admission; dis, discharge.

**Table 3.** **Outcome variations.**

| | 6MWT, meters | CAT, score | MRC, score | BI, score | BiD, score | SPPB, score |
|---|---|---|---|---|---|---|
| Admission | 167.0 (0.0-304.0) | 22.0 (16.8-25.0) | 3.0 (2.0-4.0) | 81.0 (38.8-100.0) | 33.0 (19.8-52.0) | 6.0 (2.0-9.0) |
| Discharge | 265.0 (142.0-376.0) | 13.0 (8.0-18.0) | 2.0 (1.0-3.0) | 94.0 (78.0-100.5) | 18.0 (8.0-32.0) | 8.9 (5.0-11.0) |
| p | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

Data are expressed as median values, interquartile range; 6MWT, six-minute walking test; CAT, COPD assessment test; MRC, Medical Research Council; BI, Barthel index; BiD, Barthel dyspnea index; SPPB, short physical performance battery.

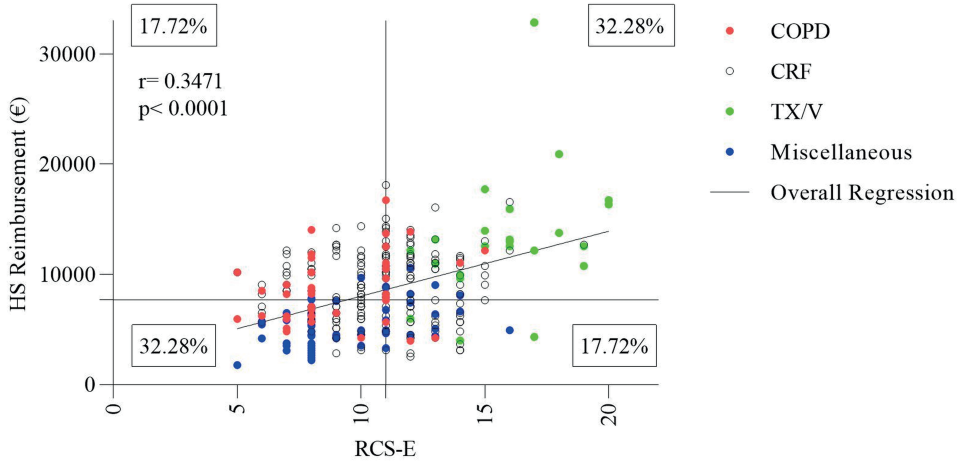


**Figure 1.** **Relation between admission RCS-E v13 and healthcare system reimbursement/stay. Each quadrant presents distribution according to different diseases (red COPD, white CRF, green TX/V, and blue miscellaneous) and the percentage of participants for each quadrant. The whole group has been divided according to 4 quadrants obtained with median values of the two parameters. RCS-E v13, rehabilitation complexity scale-extended version; COPD, chronic obstructive lung disease; CRF, chronic respiratory failure.**

Table 4 shows details on the relationship between RCS-E v13 evaluated within each group and HS Reimbursement/stay: interestingly only TX/V and miscellaneous groups (the most and the minor severe condition, respectively) presented statistical relationships, while for COPD and CRF subgroups no relationships were observed with a huge dispersion of cases.

## Discussion

The present findings highlight how hospital reimbursements for PR programs are not entirely consistent with the level of complexity of many individuals with CRD who require PR. In eight Pulmonary Rehabilitation Units in Lombardy, we collected prospective data on a large sample useful for comparison with other rehabilitation settings in different countries exploring the utility of applying RCS-E v13 to individuals consecutively admitted to PR.

Rehabilitation, and in particular PR, is a complex area of health care that has a huge variation in costs. Individuals with CRD present a wide range of complexity and LoS for PR which can vary from three to several weeks. At present in Italy, especially at the level of intensive rehabilitation, the supply of services is not homogeneous and this is a well-known problem illustrated in an analysis of information flows released by the Italian Ministry of Health concerning the years 2010-2012, as well [11]. To improve appropriateness and efficiency, the report underlines the need to use appropriate criteria and parameters in planning rehabilitation actions. The recent radical reform of rehabilitation needs for healthcare services in Italy [12], issued by the Italian Ministry of Health, has changed the previous philosophy of hospitalizations based only on disease-related groups (DRGs) toward the need for a clear measure of care burden and disability leading to hospitalization. In this respect, the RCS-E v13 has been proposed nationwide as a simple and practical tool to identify complex patients admitted to a rehabilitation program. The tool, based on the intensity and level of burden and skills required in terms of nursing, medical, therapeutic, and appropriate care, allows the measurement of individual needs to be matched with resources.

To the best of our knowledge, no RCS-E v13 data have been never tested in patients admitted to PR programs. Otherwise, in a respiratory-specialized setting, individuals with the same high or very high complexity of needs as measured by the RCS-E v13, have completely different barriers, needs, or prognostic factors such as dyspnea or exercise limitation. This tool has been developed for chronic and long-term hospital patients with neurologic diseases [5-10]. Indeed, RCS-E v13 examines patients' needs and performance predicting the time needed for motor rehabilitation without considering needs in patients with respiratory diseases as dyspnea effect during daily activities or at rest. Furthermore, not taking breathlessness and its impact into account, RCS-E v13 could underestimate real disability in chronic respiratory diseases. Confirming this, it is clear from Figure 1 that there is a mismatch between the patient's complexity as evaluated by the RCS-E v13 score and the actual DRG reimbursement suggesting that many individuals are not fully captured in their complexity/disability by the RCS-E v13 per se (i.e., COPD and miscellaneous had the same RCS, but COPD had higher reimbursement; conversely, COPD and CRF had the same reimbursement but different RCS). At the same time, the RCS-E v13 values measured on particularly critical patients such as the TX/V subgroup are the most similar to values found in patients with severe neurological pathologies precisely due to the strong coexistence of motor and respiratory disabilities such as those of Intensive Care Unit survivors. To confirm this, our data demonstrated that only in the group of more severe patients (TX/V) and in the less severe one (miscellaneous) the RCS-E v13 values and the healthcare system reimbursement, were significantly correlated. Conversely, the weak and non-significant correlation for COPD and CRF patients demonstrates the limitations of the RCS-E v13 scale and that the current forms of reimbursement are probably not appropriate to the level of disability and care needs.

Our data confirmed what was previously described by Turner-Stokes [5] who stated that the RCS is a simple classification of the necessary and supplied care and rehabilitation inputs. This scale is therefore useful to support the classifications based on the DRGs to provide coding information about the clinical and rehabilitative complexity and the possible remuneration in different rehabilitation contexts. In conclusion, the RCS-E v13 disability score does not fully mirror the HS reimbursement in patients undergoing in-hospital PR.

**Table 4. Relationship between RCS-E v13 at admission *vs* health-care system reimbursement/stay.**

| | Rho | 95% IC | p |
|---|---|---|---|
| Whole group | 0.347 | 0.243; 0.443 | <0.001 |
| COPD | 0.294 | -0.013; -0.5494 | 0.053 |
| CRF | 0.095 | -0.059; 0.2445 | 0.213 |
| TX-V | 0.439 | 0.050; 0.712 | 0.025 |
| Miscellaneous | 0.311 | 0.079; 0.511 | 0.008 |

RCS-E v13, rehabilitation complexity scale-extended version; COPD, chronic obstructive pulmonary disease; CRF, chronic respiratory failure; TX/V, tracheostomized/ventilated.

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## Abbreviations

BI: Barthel index;
BiD: Barthel dyspnea index;
CAT: COPD assessment test;
CIRS: cumulative illness rating scale;
COPD: chronic obstructive pulmonary disease;
CRD: chronic respiratory diseases;
CRF: chronic respiratory failure;
DRG: diagnosis-related groups;
FIM-FRG: functional independence measure-function-related groups;
LoS: length of stay;
MRC: Medical Research Council;
$PaO_2/FiO_2$: arterial oxygen tension to inspiratory oxygen fraction ratio;
PR: pulmonary rehabilitation;
RCS-E v13: rehabilitation complexity scale – extended version;
RUG-III: resource utilization groups;
SPPB: short physical performance battery;
TX/V: tracheostomized/ventilated individuals;
HS: healthcare system.

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