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Initiative to Improve Recording of Respiratory Rate in an Emergency Care Setting: Re-Discovering an Abandoned Vital Sign

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Abstract

Background: Determination of respiratory rate (RR) is invaluable in the emergency triage assessment and in appraising the clinical status both in primary care settings and in the Emergency Department. Yet, it is seldom obtained and documented in both sceneries worldwide and in Israel. Since respiratory compromise can be easily missed in the absence of overt dyspnea, once and again we encounter flawed clinical judgment caused by overlooking this vital sign, with potentially grave consequences. This has been exemplified in few lawsuit cases we encountered with devastating outcomes that likely could have been managed earlier with better consequences if respiratory compromise has been detected and addressed on admission.

Aim: to improve RR recording in emergency medicine setup in specific clinical presentations.

Methods: A single-center intervention (staff meeting and individual training) designed to enhance awareness of healthcare providers regarding RR recording upon admission in pre-specified medical

presentations, assessed by files survey, comparing pre- and post-intervention adherence.

Results: RR documentation was checked in 708 and 673 patients before and after the intervention, respectively. Overall, RR recording rose from 20% to 35%, following intervention (Pv<0.01). In subgroup analysis, RR recording rose from 34% to 54% in patients with respiratory complaints (Pv<0.01) and from 7.4% to 18.2% in patients with non-respiratory complaints (Pv<0.01).

Summary and conclusions: Staff training and instructions improve RR recording. Yet, adherence remains sub-optimal. Obtaining and documenting RR and pattern in defined clinical conditions is needed for the sake of a better early clinical assessment, minimizing potentially preventable catastrophes. This may further be achieved by obligatory regulations, and facilitated by the introduction of new technologies for reliable RR documentation.

Introduction

General: Vital signs, including fever, heart rate, blood pressure and oxygen saturation (SO2) are routinely obtained for adult patients in Emergency Departments (ED) and in Primary Care Facilities (PC). They serve as early warning signs in the triage process, directing treatment priorities [1], and are a requisite in clinical assessment and medical decisions regarding patient's evaluation, placement, monitoring and management. Respiratory rate is an additional fundamental vital sign included in triage algorithms, assessing illness severity and patients' priority [2,3]. It is highly sensitive to a range of pathological conditions, including acute respiratory and cardiac events, sepsis, and clinical deterioration. It often changes earlier than other vital signs in response to physiological stress or decompensation, making it a critical marker for early detection of serious illness and impending respiratory failure [4-6]. Yet, it is seldom obtained routinely in ED and PC, with health practitioners only occasionally providing subjective assessment of the presence or absence of respiratory distress. Such subjective assessments may be misleading, as subtle indices of respiratory distress, manifested as mild tachypnea or increased tidal volume, are often overlooked by inexperienced health practitioners. Evolving respiratory distress is an independent prognostic indicator of clinical deterioration [7] and can serve as a "red flag" in patients' assessment. Yet, once and again we witness its erroneous under-detection, missing the therapeutic window of opportunity before the development of a clinical catastrophe, with consequent non-referral to acute-care settings on time, or erroneous discharge from DEM or from the outpatient clinic with devastating outcomes. This short review and complementary study are aimed to assess the impact of guidance of and instructions to medical personnel in on the awareness and adherence to obtaining this ignored important vital sign, and to propose its mandatory inclusion in ED and PC in specific clinical presentations.

Assessing respiratory rate

Respiratory distress is a clinical condition that can be easily detected by the patient's complaints and with a set of physical findings. These include, among others, subjective dyspnea and orthopnea, abnormal respiratory patterns such as Kusmaul breathing in metabolic acidosis, expiratory wheezing and stridor on insperium, suggesting lower or upper airway obstruction, respectively, the use of accessory respiratory muscles, inspiratory or expiratory alae nasi flaring, paradoxical movement of the abdominal wall during breathing, or a paradoxical pulse. Such

findings are sometimes accompanied by central cyanosis, a decrease in oxygen saturation (SO2), and manifestations of increased sympathetic tone, including tachycardia, pallor, and diaphoresis. Such complaints and prominent findings indicating respiratory distress are usually easily detected. However, mild dyspnea that is not accompanied by significant respiratory effort, and its only manifestations area mild increase in the respiratory rate and tidal volume, may be easily overlooked. This last measure is difficult to quantify, so respiratory rate per minute remains the only available vital sign, heralding evolving respiratory distress that may progress to a life-threatening condition.

The recommended technique for determining respiratory rate is to measure it over a full minute with a hand placed on the abdomen or chest. Measurements for shorter periods of time may be inaccurate **[8,9]**, since variations in respiratory rate due to anxiety, pain, or Cheyne Stokes breathing are sufficient to produce an incorrect measurement. Indeed, in a controlled study, the sensitivity of a shortened 15-second test in detecting moderate dyspnea was found to be only 23% compared to the recommended 1-minute measurement **[5].** Inaccurate determination of respiratory rate bears prognostic significance, delaying recognition of critical illness with a negative impact on the performance of clinical prediction rules such as SIRS or qSOFA. More importantly, such an error may be detrimental particularly at the primary care and emergency room settings, where under-detection of respiratory compromise may lead to life-threatening complications related to false reassurance **[10,11].** While recording heart rate, blood pressure, and oxygen saturation using automated equipment simultaneously with temperature measurement is routinely performed by medical professionals upon admission to emergency medical centers, determining respiratory rate as recommended for a full minute is considered as time-consuming and impractical given the hassle involved in the overcrowded ED and PC. Therefore, RR is only rarely obtained and recorded, and often, whenever required, its approximate estimate is documented, if et al. **[12].** New mechanical or electronic aids enable precise RR assessment **[13-15],** yet, they are hardly available and are seldom used in most ED and PC.

Furthermore, medical personnel are often erroneously reassured by a normal SO2, obtained by automated pulse oximetry, consequently overlooking dyspnea and tachypnea. Noteworthy, sO2 is not sensitive enough for oxygenation disorder with declining pO2 down to 60 mmHg as illustrated by the oxygen/hemoglobin dissociation curve **[18].** The true estimate of oxygenation disorder requires concomitant determination of pCO2 for the assessment of alveolo-capillary block, Moreover, dyspnea and tachypnea may represent serious disorders at the absence of hypoxemia, including metabolic acidosis (ketoacidosis, lactic acidosis, uremia, various intoxications), carboxy- and methemoglobinemia, cyanide poisoning, central stimulation (early salicylate intoxication) or a conversion reaction.

Thus, false reliance on normal sO2, as well an on other normal objective parameters may lead to overlooking of a wide array of medical emergencies that require early diagnosis and life-saving management. In other words, RR is a neglected vital sign, valuable for the early detection of evolving medical emergency in a host of medical conditions in primary care and emergency medicine.

Clinical and legal implications

Case analyses reaching lawsuits illustrate once and again that not obtaining RR can possibly lead to underestimation of evolving respiratory distress, with grave consequences. Conceivably, documentation of tachypnea could have served as a warning sign, calling for clinical re-assessment, probably with extended supervision and modified management. Examples outlined below, based on real-life cases reaching lawsuits, illustrate how, on our opinion, the obtaining or ignoring RR makes the difference between reasonable medical performance and medical malpractice.

A 35-year-old patient who, in the midst of the H1N1 virus pandemic, visited her primary care physician complaining of typical flu syndrome for several days, with the development of lassitude and shortness of breath over the course of several hours. In the clinic and later in the hospital, RR has not been recorded, and according to reported physical examination there was no respiratory distress. Oxygen saturation and a chest x-ray in the hospital were also reported as normal, and the patient was discharged home on oral antibiotics. A day later, the patient developed multiorgan failure secondary to H1N1 pneumonia with Staphylococcus aureus bacteremia, and died shortly thereafter. In retrospect, profound hypophosphatemia was noted at her first hospital visit, a deviation most likely reflecting sepsis **[16]** and respiratory distress with hyperventilation **[17].** It can be assumed that the treating team erred in the clinical assessment by failing to document RR as an expression of developing respiratory distress, erroneously reassured by normal sO2 and chest radiography. In this case, the failure to record the respiratory rate was used by the prosecution to establish medical negligence.

Similarly, a 55 years old patient presented to the primary care physician complaining of worsening shortness of breath over several days. Tachycardia and slightly low blood pressure were found. Heart and lung examination and sO2were reported as normal, but RR was not recorded. In retrospect, a history of developing pain in the calf with limited mobility for several days, and a description by family members consistent with developing respiratory distress prior to her presentation to the clinic, was obtained. Several hours later, circulatory failure developed, which ultimately led to death due to extensive pulmonary embolism. In this case too, the lack of RR documentation was used to determine failure to meet a required medical standard, as medical malpractice. By contrast, a 65 years old patient arrived at the emergency outpatient clinic with flu-like symptoms. Vital signs, including RR and sO2, were recorded and found to be normal. Two days later, she arrived at the hospital with respiratory failure due to bacterial pneumonia and died. The documentation of the vital signs in the emergency outpatient clinic, which also included RR, in addition to the absence of physical findings and additional ancillary tests such as a chest x-ray and blood count, established the assumption that the bacterial infection was a later complication along the course of a viral illness and helped to dismiss the medical malpractice claim.

These examples demonstrate the protective or incriminating effect of documentation or the lack of measurement and recording of RR, respectively, in medical malpractice law

Interventional Study

Aim: to assess the awareness and performance of our ED nursing staff regarding RR recording, and to

explore the impact of guidance on enhancing RR documentation rate.

Methods: We conducted an interventional retrospective analysis of RR determination in the ED before and after an instructive intervention that was carried out in the emergency department of the Mt. Scopus Hadassah Medical Center, Jerusalem, Israel - an urban 330 bed community hospital with an average of about 70000 annual patient visits. It included training during staff meetings and discussions following relevant events, in order to raise the awareness of the nursing personnel to the importance of RR recording in the initial and subsequent evaluation of patients in the ED. The staff was encouraged to specifically perform RR monitoring in patients with respiratory complaints, presumed infection, fever, abdominal pain and chest pain. The impact of team guidance on RR recording performance was monitored and patients' charts were evaluated prior to the intervention in patients admitted throughout 1/9/2023-30/11/2023, and in a subsequent cohort of patients during the time period of 1/9/2024-30/11/2024, following the intervention.

Participants: Analyzed recordings were of patients aged ≥ 18 admitted to the critical care section of the ED with an intermediate Emergency Severity Index (ESI) score (2-3). Critically ill patients (ESI 1) and mild ambulatory patients (ESI 4-5) were excluded, as were pregnant women.

Statistics: Statistical analysis was performed using R programming. Statistical significance was set at $p < 0.05$.

Ethics: Data went through an anonymization process and was exposed only to the research team. The study was approved by the Institutional Helsinki board (0504-24-HMO).

Results: In 2023, 708 relevant visits were recorded, with only 142 (20%) of them having a respiratory rate measured. In 2024, out of 673 visits, RR was measured in 238 cases (35%) **(Table 1).** Overall, there was a 75% increase in the rate of performing the test from 2023 to 2024, (from 20% to 35%, $p<0.01$), indicating a significant improvement in the implementation of the initial assessment protocol. Subgroup evaluation revealed that among patients with respiratory complaints (such as shortness of breath, cough or respiratory distress) RR documentation during 2023 was 34% (114 out of 334 patients) and rose following intervention to 54% of patients (177 out of 324) during 2024, a 59% statistically significant improvement ($p<0.001$), indicating enhanced awareness and implementation of the assessment policy **(Figure 1).** Percentage index of the number of breaths performed in patients with non-respiratory complaints was 7%, only (28 out of 374), in 2023 and rose to 18% (63 out of 346) in 2024. That is 2.5 times increment between 2023 and 2024 ($p<0.001$), yet the overall performance rate remained low.

Table 1: Performance rate of RR determination.

	2023	2024	P value
Total	20% (142/708)	35% (238/673)	<0.01
Respiratory complaints	34% (114/334)	54% (177/324)	<0.01
Non-Respiratory complaints	7.4% (28/374)	18.2% (63/346)	<0.01

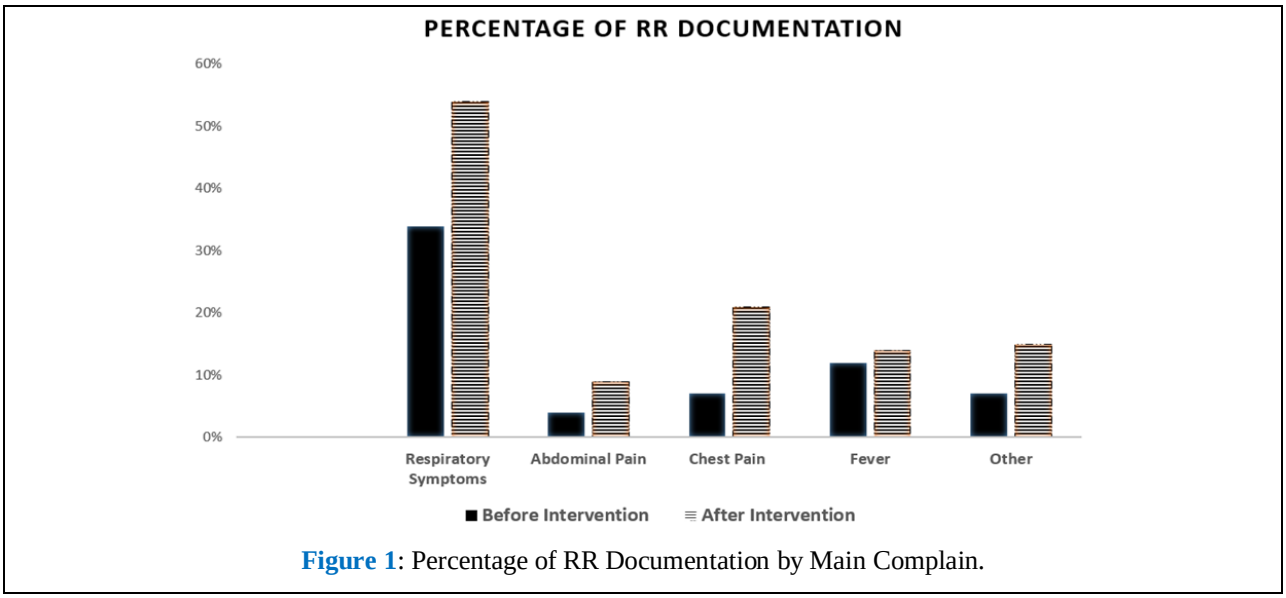

Figure 1: Percentage of RR Documentation by Main Complain.

Discussion

Inexperienced medical professionals can easily miss mild tachypnea with 24-28 berths per minute at the absence of overt features of dyspnea, such as the use of accessory muscles or paradoxical abdominal wall motion. Therefore, an appropriate determination of respiratory rate is invaluable in patients' assessment in the setup of acute illness, predicting the need for hospitalization and respiratory support. This has been demonstrated in a host of defined clinical presentations, including fever, respiratory complains, reduced consciousness, and chest- or abdominal pain **[18],** highlighting the need to routinely determine this neglected vital sign in such scenarios **[10,17]** in order to hasten the detection, diagnosis and management of evolving critical illness **[19].** The study was designed to assess the impact of raising awareness of medical personal in the ER regarding RR determination. It is a rather small and single-center study. Yet, it provides a proof of principal that this easily performed intervention does have an impact. However, the outcome is far from optimal, with a large proportion of patients remaining without RR documentation, particularly those without respiratory symptoms. The targeted study population was those with an intermediate ESI score, likely those without overt and clear-cut indices of respiratory distress, exactly the missed population where detection of RR abnormality may have served as a principal red flag heralding pending deterioration, at the absence of overt desaturation or chest X rays anomaly. Therefore, conceivably, in addition to enhancing awareness among healthcare personnel in ED and PC, RR determination should become a mandatory quality index, to be obtained in specifically defined medical conditions, as suggested in **(Table 2)** as denoted by validation of clinical importance in a cohort of 16,956 adult EMD patients **[9].** Studies performed some 20 years ago emphasized the imperfect yield of RR recording in the ED, showing that neither triage nurses nor an electronic monitor provides accurate RR measurements **[20].** Possibly, additional manpower, dedicated to perform high standard and optimal assessment might be needed to obtain reliable data. New more recently introduced electronic and mechanical devices **[10,14,15,21],** may also enable a more prolonged and reliable RR recording, reducing reading variabilities. Currently it is impossible to predict what might be the clinical impact of adopting our suggestions. Hopefully, it

may benefit the small fraction of patients reaching health care facilities without overt clinical distress, but with subtle RR abnormalities that may serve as early indicators of impending deterioration. In such patients RR conceivably may sharpen clinical assessment and medical decisions, preventing avoidable deaths.

Table 2: Suggested medical presentations where RR determination should be measured in ED (* importance validated in Ref. 9).

Categories	Comments
Respiratory complains *	dyspnea, orthopnea, cough
Chest pain *	
Abdominal pain *	
Other abnormal vital signs	fever *, tachycardia, hypotension or severe hypertension, sO2 < 90%
Diabetes	particularly IDDM and patients treated by metformin or SGLT2 inhibitors
Impaired consciousness *	
Suspected poisoning	
Clinical features suggesting deep vein thrombosis	
Elderly or frail patients	
Major trauma	
"anxiety" with hyperventilation	

Summary and Conclusions

RR recording, an important tool in health assessment is seldom obtained in acute care settings, justifying its nickname "the abandoned vital sign". We have shown that interventional training improves healthcare staff awareness and the rate of documentation of RR in the ED in pre-specified clinical settings. Yet, its overall recording remains sub-optimal and may suffer inaccuracies if not carefully obtained over 1 minute. We believe that healthcare authorities and emergency and primary care medical professional associations should define medical conditions requiring mandatory assessment of RR within the emergency room and in PC settings, regulations that should serve as a quality index. This should improve patients' assessment and management that may reduce preventable clinical deterioration among patients with mild respiratory distress undetected by other means. Optimal RR determination may require additional manpower or the introduction of new advanced and more accurate technologies.

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