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The journal particularly welcomes studies that aim to evaluate and understand complex health care interventions and health policies, and which employ the most rigorous designs and methods appropriate for the research question of interest. The journal also seeks to advance the quality of research by publishing methodological papers introducing or elaborating on analytic techniques, measures, and research methods. The journal publishes original peer-reviewed articles of interest to the international health care community.

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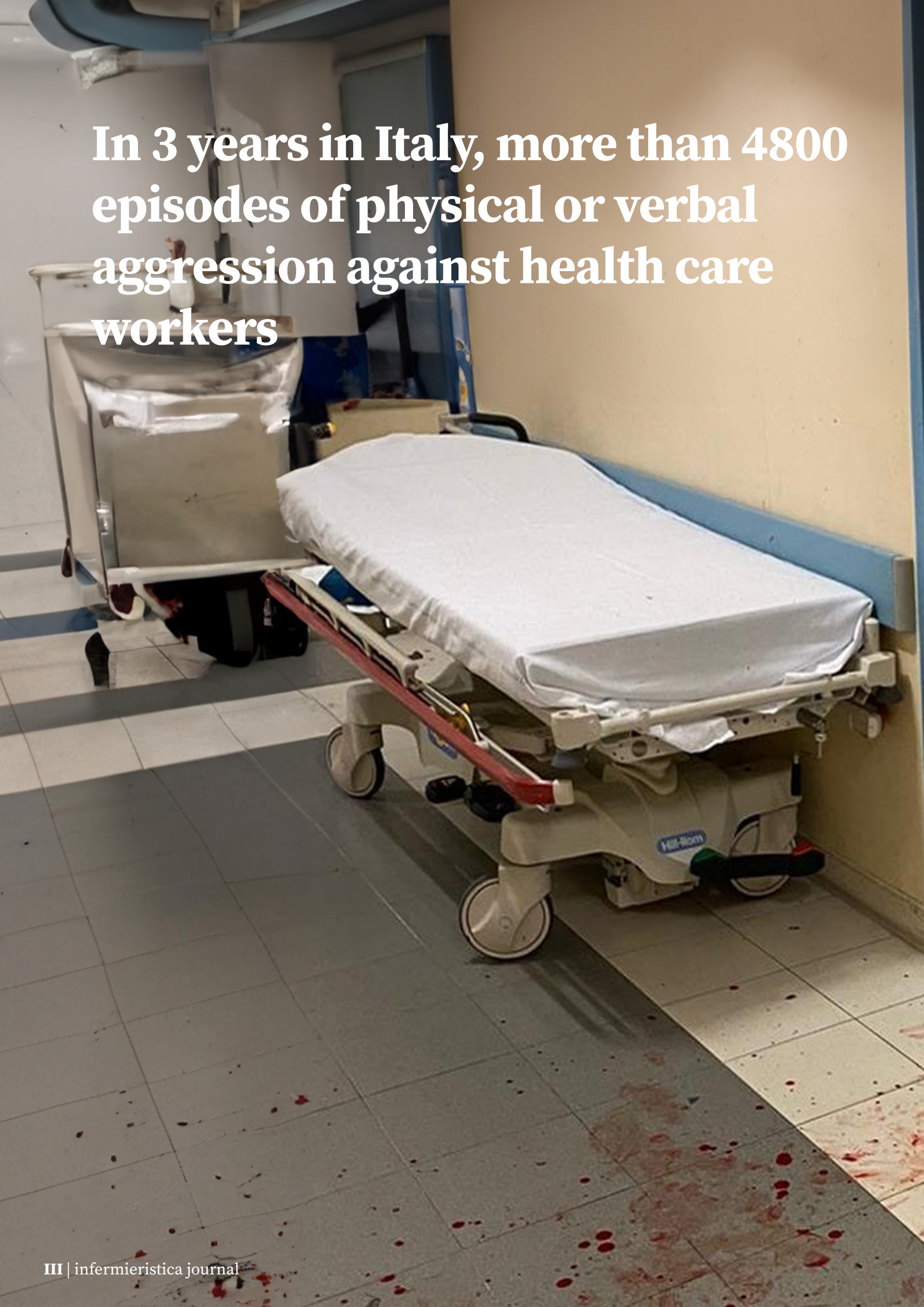

In 3 years in Italy, more than 4800 episodes of physical or verbal aggression against health care workers

In the three-year period 2019-2021, 4,821 cases were verified, for an average of about 1,600 per year. 37 percent of assaults are concentrated in the health care area, which includes hospitals, nursing homes, institutes, clinics, and university polyclinics. 33 percent of cases occur in residential social work services, which include nursing homes, nursing facilities and shelters. Finally, the remaining 30 percent fit into the non-residential social work sector. More than one-third of the physical and verbal assaults involve nurses and professional educators, who are engaged in educational and rehabilitative services with minors, drug and alcohol addicts, prisoners, disabled patients, psychiatric patients and the elderly within health or socio-educational facilities. This is followed, with 29 percent of the cases, by socio-health workers from the skilled professions in health and social services.

Editorial

Violence in health sector: the un-stoppable pandemic

Nicola Ramacciati[1]

[1]*Assistant Professor in Nursing Sciences, University of Calabria*

Certain words have an enduring emotional impact that transcend temporal and geographical boundaries and elicit an unwavering and increasingly evocative response. Among these words, the term "pandemic" stands prominently. Recognizing that there is a pervasive phenomenon on a global scale, that progressively resembles a "pandemic", has the potential to incapacitate us and lead us once more into a state of denial and rejection. This relates to the issue of violence, which includes not only the violence associated with conflicts and wars, but also domestic or local incidents that have extensively received media attention.

Workplace Violence[1] is an "endemic" kind of violence which particularly encompasses the health sector. Despite the proactive measures undertaken by well esteemed international institutions (e.g., the International Labour Office, International Council of Nurses, World Health Organization, and Public Services International), by means of guidelines issued since 2003 to address workplace violence in healthcare settings[2], this problem continues to persist on a global scale. Italy is especially affected by workplace violence, as demonstrated by the recent CEASE-IT study involving researchers from various Italian universities led by the University of Genoa. Preliminary data from this national study released by the National Federation of Nursing Professional Orders (FNOPI)[3] highlights that emergency and intensive care services, and medical areas, are the healthcare sectors most exposed to violence, with a prevalence ranging from 27.3% to 28.4%, respectively. In the CEASE-IT study the prevalence of violence in Emergency and Intensive Care services amounts to 59.4%, which is a high percentage but still lower when compared to another national survey dedicated to emergency nurses, where 91.5% of the nurses reported being victims of acts of violence (verbal, physical, or both) during the last 12 months before the survey was administered[4].

The rapid proliferation of violence within the healthcare sectors necessitates of extensive research in order to understand its prevalence and impact[5]. However, despite concerted efforts, the interventions designed to counteract this pressing issue exhibit questionable efficacy or lack sufficient scientific evidence[6], as highlighted by the concerning rates of violence in the healthcare settings. Urgent and comprehensive global actions are imperative to effectively combat this pervasive problem and ensure the safety and well-being of both healthcare workers and patients.

"Urgent" and "comprehensive" are two words that have been chosen intentionally. The urgency characteristic stems from the precarious state of the healthcare systems worldwide, rendering them exceptionally vulnerable. The resilience displayed by these systems can be largely attributed to the commendable dedication and self-sacrifice of the healthcare personnel and workers, whose unwavering commitment is universally recognized. However, frontline workers, particularly nurses and physicians across Western and Eastern nations, are adversely affected by the expansion of violence within the healthcare sector. An array of international studies has consistently found a statistically significant association between frequency of exposure to workplace violence and occurrence of severe health outcomes such as post-traumatic stress syndrome, burnout, and premature attrition from the profession[7,8].

Taking care of healthcare personnel is not merely a moral obligation of the societal collective within one nation but a categorical imperative to ensure the survival of the healthcare systems. Moreover, a comprehensive approach is crucial for effectively counteracting this phenomenon. This is why, a few years ago, Ramacciati, Ceccagnoli & Addey developed the conceptual model of the "Global Approach to

Violence towards Emergency Nurses" (GAVEN)[9]. This model, which encompasses four domains of violence, has garnered recognition from esteemed scholars like Timmins et al.[10], Yıldız & Tok Yıldız[11], and Yin et al. [12]. The GAVEN framework not only analyzes the triggers of violence against emergency nurses but also provides a comprehensive depiction of the factors determining the violence, included within four domains: "Internal" (pertaining to the characteristics of the emergency nursing staff), "External" (pertaining to the characteristics of patients, family members, and visitors), "Environmental" (pertaining to the structure of the emergency room), and "Organizational" (pertaining to the characteristics of the emergency department and hospital organization, such as work shifts, presence or absence of a security service, and procedures) (see Figure 1).

Figure 1. The "Global Approach to Violence towards Emergency Nurses" – GAVEN framework

The violence against emergency nurses expounded by this model is substantiated by the existence of 24 theoretical frameworks elucidating violence against emergency workers, as highlighted in a previous narrative review of theories and frameworks conducted by Ramacciati et al[13]. Starting from the awareness of the complexity and multidimensionality of the phenomenon, the GAVEN framework takes into account several variables.

The GAVEN framework takes into account internal factors related to emergency nurses, which includes gender, age, level of working experience, professional titles, roles within the ED, and the specific shift types they undertake. Understanding the composition and number of the ED team, as well as the nature of their employment (full-time or part-time), further enriches the framework's insights.

External aspects of the GAVEN framework regard the dynamics concerning patients and visitors in the ED. Their gender, age, socio-cultural conditions, and existing health conditions, such as alcohol or illicit drug abuse, mental illness, brain injuries, Alzheimer's or senile dementia, and various neurological and biochemical conditions, are integral components of the analysis. Furthermore, patient and visitor behavior, encompassing ED presentation in terms of triage code, waiting times, and length of stay, is carefully considered.

Organizational factors play a pivotal role with a special focus on regulatory measures and security protocols in order to address violence within the ED. Measures such as multi-language information displays, access restrictions, "Zero Tolerance" signs condemning violence, and the use of pass or identification cards for visitors and accompanying

individuals are also highlighted. Robust security measures, including closed-circuit surveillance, direct access to hospital security or police services through alarm bells, and the presence of bulletproof or shatterproof glass, reflect the emphasis of the GAVEN framework on safety. Incorporating a violence-reporting system and a rapid response team further strengthens EDs against potential violent incidents. Comprehensive procedures for managing aggressive patients or violent acts, supported by the pivotal role of a Stuart, a pivot nurse, are central to the framework's preparedness.

Additional concerns related to overcrowding or boarding, as well as the provision of specific training to counteract violence or aggressive behaviors, are essential components of the GAVEN framework. The recognition of support for the victim and de-escalation services further exemplifies the framework's comprehensive and compassionate approach.

Beyond human factors, the framework extends its scope to the organizational climate and environmental elements, including architectural measures. These may involve emergency unit entrance checks with no automatic door opening, enclosed nursing stations, bright lighting throughout the ED, examination rooms equipped with internal locks and alternative exits, and various comfort measures such as automatic food and drink dispensers, televisions or monitors displaying information, access to reading materials, and background music.

Finally, the GAVEN framework anchors its analysis with the critical variable of the annual number of patients treated in the ED, substantiating its data-driven approach. By encompassing such an extensive range of variables, the framework effectively addresses the pressing issue of violence within the ED setting and lays the foundation for designing evidence-based strategies and interventions to mitigate and manage this complex challenge.

While numerous violence risk assessment tools are currently available, the GAVEN-Score represents a predictive measurement tool that not only focuses on the antecedent and precipitating factors of violence but also encompasses parameters linked to the level of anti-violence approaches and the degree of comprehensiveness. The term "approach" encompasses a broad spectrum of skills, interventions, systems, and organization. The use of the term “global” underscores the need for finding comprehensive solutions that simultaneously address all risk factors associated with managing and mitigating workplace violence. The scores derived from the various subscales of the GAVEN-Score will enable the evaluation of both the level and extent of strategies aimed at containing violence. This approach aims to facilitate the implementation of precise and resolute interventions[14]. However, attaining this objective necessitates a multifaceted endeavor. All stakeholders, including physicians, nurses, administrators, managers, unions, scientific societies, lawyers, jurists, journalists, occupational safety and clinical risk managers, police and security forces, the general public, and policymakers, must collectively sustain this challenge[15].

The enduring and unstoppable pandemic of violence in the healthcare sector demands to be stopped. While it may seem daunting, we possess the capacity to overcome it. It is only through the collective efforts of all stakeholders that we can effectively combat and eradicate this affliction. Together, we will succeed.

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LA VIOLENZA NON TI FARÀ STARE MEGLIO.
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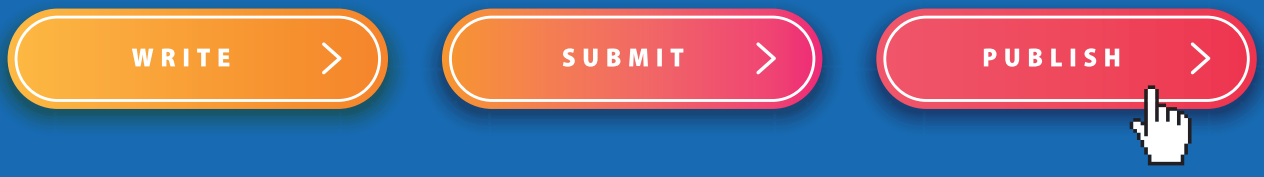

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Cultural Article

Intraoperative monitoring of the recurrent laryngeal nerve in thyroid gland surgery

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Niccolo' Fagni[1], Giacomo Gelati[1], Cristiana Veltro[1], Ferdinando Paternostro[1]

[1]Department of Experimental and Clinical Medicine-Section of Anatomy and Histology, University of Florence

Abstract: In Thyroid surgery, the two novel approaches are the trans-axillary Robotic thyroidectomy and the trans-oral and sub-chin techniques.
During these surgical approaches is mandatory to recognise the Anatomy. The lower laryngeal nerves originate from the X cranial nerve (vagus nerve) and innervate all the intrinsic muscles of the larynx except for the cricothyroid muscles (which are innervated by the superior laryngeal nerve instead). The "recurring" name is due to the course in the opposite direction to the nerve of origin.
Neuro-monitoring of recurrent laryngeal nerves is the most important of the recent technological innovations. However it is of fundamental importance for the operator to remember that this method does not prevent recurrent nerve injury. On the other hand a two stage thyroidrctomy can avoid a tracheostomy thanks to neuro-monitoring.

Keywords: Recurrent Laryngeal Nerves, Neuro-monitoring, Thyroid Surgery

Introduction

Thyroid surgery has a complex and constantly evolving history. In the commonly used "open" approach, the intra-operative steps have improved constantly to provide a correct and clean dissection that is increasingly minimally invasive and free of post-surgical complications. During its history, innovative approaches and strategies have emerged as alternatives with advantages and disadvantages to be considered and tailored to the individual patient. These may differ from open surgery at various steps, from the indication to surgery up to clinical decision-making, which is evidence-based and ultimately finds its root in the current international guidelines. Two novel approaches worth mentioning are the trans-axillary Robotic thyroidectomy and the most recent trans-oral and sub-chin techniques, in which the setting of the patient and the layout of the operating room are also changed in addition to the instrumentation used by the operator and the surgical technique.

The indications, which are at the base of this type of surgery, are essentially three:

- complicated or unmanageable forms of hyperthyroidism through long-term medical therapy.
- indeterminate or malignant cytology nodules.
- toxic or non-toxic multi-nodular goitre that generates compressive symptoms in the patient due to the correlation between anatomical relationships and volumetric increase in the gland (es. dysphonia, dyspnea, dysphagia).

In the development of the operative decision and strategy, the specialist has increasingly innovative tools, the use of which implies the integration of technical knowledge relating to the instrument itself, but also of knowledge of clinical anatomy and neurophysiology, surgical technique, and clinical management of the patient.

All this affects the operator's learning curve, the intra and post-operative safety profile as well as one of the most serious complications, recurrent laryngeal nerve injury.

Clinical-functional anatomy of the recurrent laryngeal nerve

The thyroid is in close anatomical relationship with some nervous structures of great functional importance.

The lower laryngeal nerves originate from the X cranial nerve (vagus nerve) and innervate all the intrinsic muscles of the larynx except for the cricothyroid muscles (which are innervated by the superior laryngeal nerve instead). The "recurring" name is due to the course in the opposite direction to the nerve of origin.

The vagus nerve emerges from the base of the neurocranium through the jugular foramen (or posterior lacerate hole, which arises between the rear portion of the petrous rock of the temporal bone and the anterior edge of the occipital bone). Through its anteromedial portion, the X cranial nerve emerges together with the IX and XI cranial nerve, while in the jugular portion proper (posterolateral portion) the sigmoid sinus can be found, which becomes the internal jugular vein just below the foramen.

The vagus nerve runs downwards within the carotid sheath that wraps the vascular-nerve bundle, which includes the internal jugular vein and internal carotid vein as well as the vagus nerve itself along its entire course up to the base of the neck. The right vagus nerve continues adhering to the anonymous artery, while the left vagus nerve runs in front of the aortic arch. This is where the recurrent laryngeal nerve originates, meaning that the two recurrent laryngeal nerves will be characterized by an asymmetry in their course and length (i.e. the right one surrounds the subclavian artery, while the second one runs over the aortic arch).

The lower laryngeal nerves continue going up in the tracheo-esophageal sulcus and anteriorly, taking relation posteriorly to the lobes of the thyroid gland. Finally, their course ends into the larynx in the intercricothyroid space to innervate the vocal cords, determining their movement by controlling the abduction of the posterior cricoarytenoid muscles. In its course, the nerve supplies branches to the deep cardiac plexus, tracheal and esophageal branches and to the inferior constrictor muscle of the pharynx.

The inferior laryngeal nerve is a mixed sensory-motor nerve as it also provides sensitivity to the larynx. This is fundamental in some important reflexes such as the cough reflex, which in this case has the function of maintaining the patency of the upper airways and consequently monitoring the swallowing act in such a way that the latter occurs correctly from a dynamic and motor point of view. An important surgical landmark of this region is Zuckerkandl's lobe or tubercle (i.e. the posterior pyramidal extension of the right and left thyroid lobes), which allows the inferior laryngeal nerve to be identified before it plunges into the larynx.

Usually, the recurrent laryngeal nerve is located in a medio-lateral position with respect to this tubercle, with more frequently horizontal direction to the right and oblique to the left.

The recurrent laryngeal nerve derived embryologically from the sixth pharyngeal arch and was first documented by the ancient roman physician Galen, who also gave the name to the most common of its anatomical variants: the loop of Galen (anastomosis between the inferior and superior laryngeal nerve that occurs in 4/5 of the population).

In about 10% / 20% of cases, however, the right recurrent laryngeal nerve does not recur and branches off from the vagus nerve directly to the level of the cricoid cartilage. Non-recurrence of the left recurrent laryngeal nerve is a rare finding and is usually associated with a complex arterial vascular variant.

Thus, a unilateral lesion of the recurrent laryngeal nerve can lead to a significant

alteration of the voice (dysphonia) and increased vocal fatigue (phonasthenia). A bilateral lesion, on the other hand, leads to a severe alteration of the vocal capacity and to a bilateral paralysis in adduction of the vocal cords with important respiratory distress. This becomes evident through the clinical signs of cornage and tirage up to the more serious phenomenon of abdominal reentry, in which the inspiratory effort is partially compensated not only by the use of the neck muscles but also of the abdominal muscles. A bilateral lesion is thus usually a very severe occurrence, such as requiring a tracheostomy.[1,2,3]

The upper laryngeal nerves also innervate the vocal cords; however, they do not determine their movement but rather the degree of muscular tension, thus regulating the high tones of the voice. Their damage determines an inability to use the higher vocal tones, to sing and to use the voice for a long time. Their preservation is important for all patients but especially for those who use their voice for professional purposes

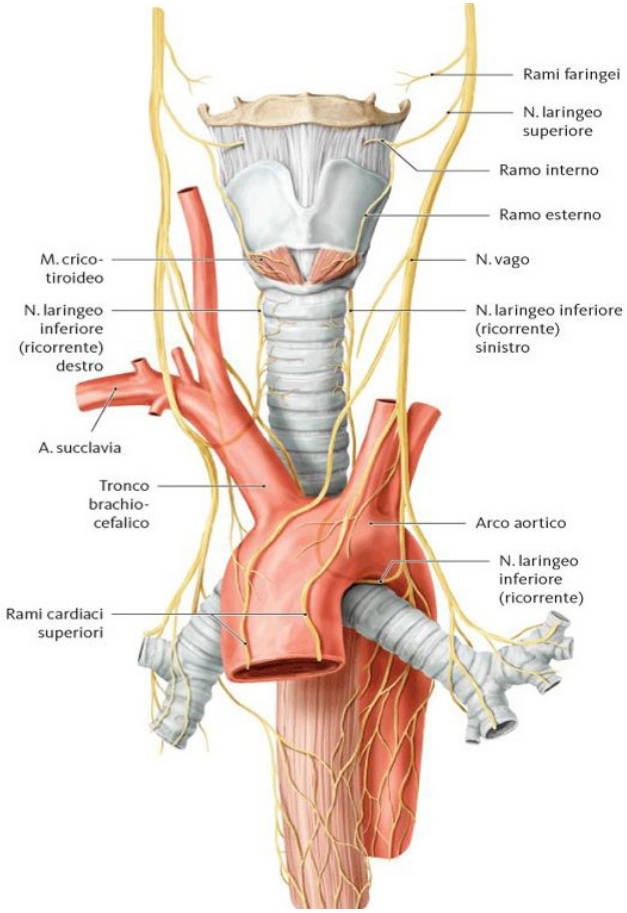

Figure 1: Anatomy and relationships of vagus nerve
M. Schünke, E. Schulte, U. Schumacher
Prometheus – Anatomy Atlas Text – Head, Neck and Neuroanatomy
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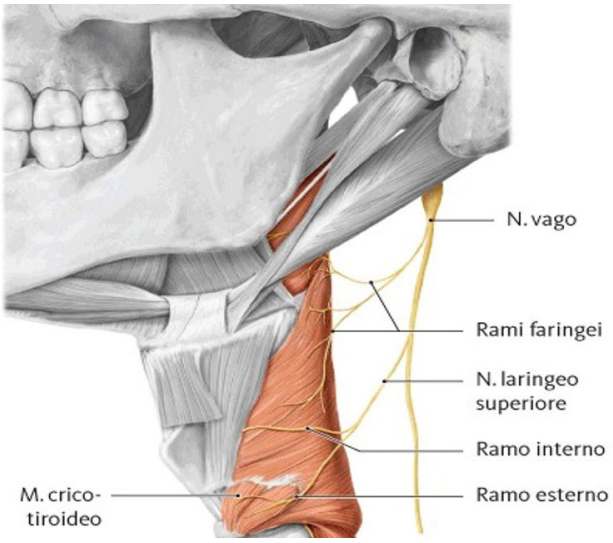

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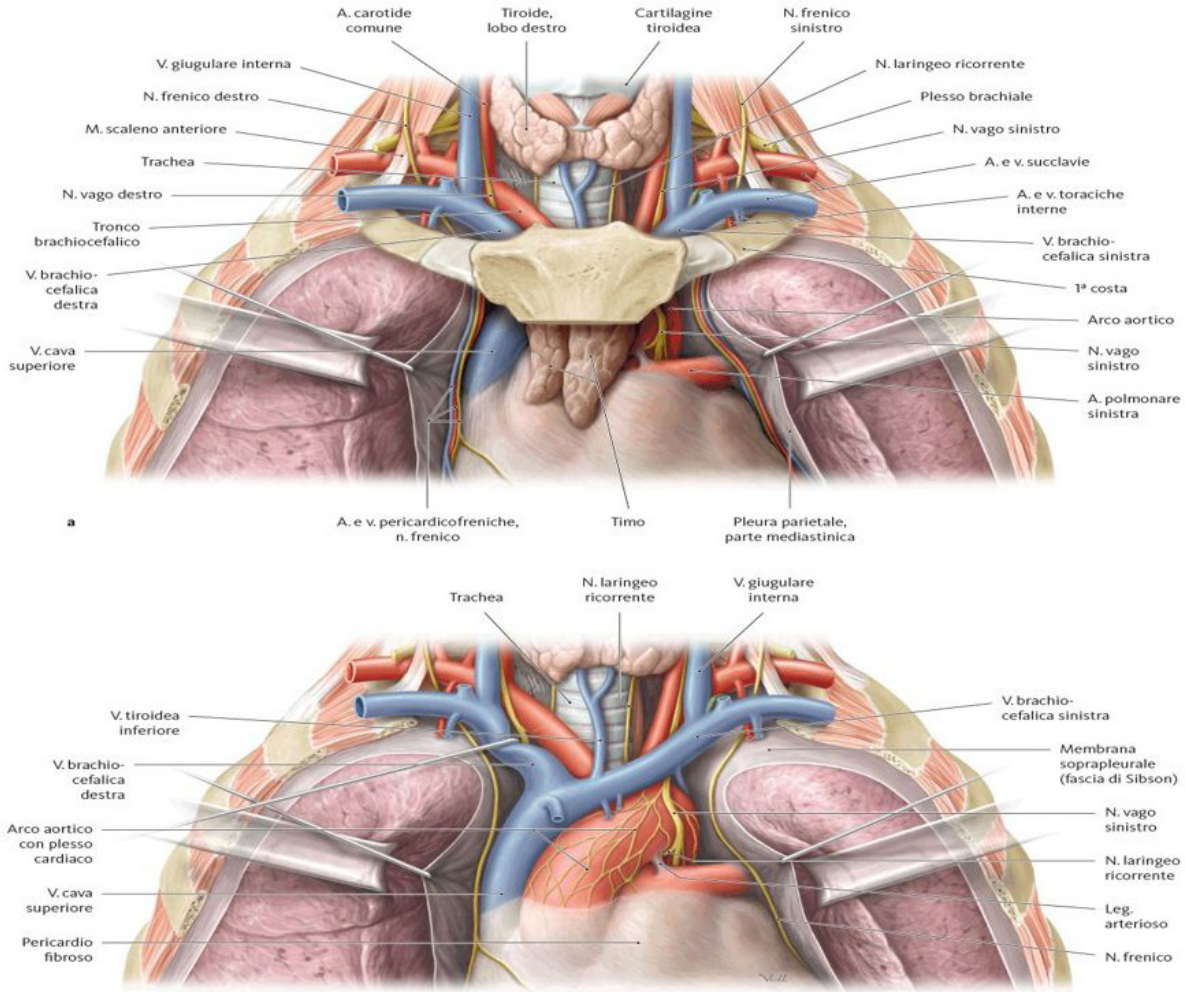

Figure 3: Anatomy and relationships of vagus nerve
M. Schünke, E. Schulte, U. Schumacher
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Neuro-monitoring

Neuro-monitoring of recurrent laryngeal nerves is maybe the most important of the recent technological innovations. It is of fundamental importance for the operator to remember that this method does not prevent recurrent nerve injury. In fact, this may still occur, most often due to the stretching of this nerve or the heat of thermal instruments rather than the accidental cutting of the structure. Neuro-monitoring can, however assist the operator in the surgical phases and times, thus allowing him to change the operative strategy during surgery if needed, even following the unilateral nerve injury and consequently reducing the need for tracheostomy to almost zero per cent.

Another important warning concerns young operators, who must keep in mind that this method must not be substituted for anatomical and surgical knowledge in the search for the recurrent nerve, as the instrument is created precisely for the purpose of monitoring and can replace neither the surgical competence of the operator nor his intuition and knowledge.

In this type of surgery, the tube used for endotracheal intubation is equipped with two special electrodes that are positioned, under the vision of the optical fibre laryngoscope, precisely in contact with the vocal cords in a type of classic oro-tracheal intubation approach.

The operator uses a thin electromyographic probe that selectively stimulates each structure before it is sectioned. The electrodes record the transmitted impulses, and the surgeon can analyze the amplitude of the recorded stimulus on the monitor, thus deciding whether to proceed safely with the dissection. The common scheme

used always provides for selective stimulation before and after nerve dissection so as to identify any lesions early as well as reassure the operator on the correct position of the tube and the closure of the electrical circuit. The vagus nerve is stimulated first, which gives us an indication of the correct positioning of the tube. Then, after identifying the ipsilateral recurrent, it is stimulated before proceeding to the lobectomy of the same side. After the dissection, another stimulation of the recurrent nerve is performed. Finally, the vagus nerve is stimulated again after dissection to ensure the absence of damage and the correct positioning. The same process can now be repeated on the contralateral side.

Stimulation is displayed on the monitor and changes according to the voltage selected for stimulation, which in turn depends on the type of nerve being tested and its action potential. The potential itself is thus displayed on the monitor if the nerve is functioning correctly. Here it is also possible to visualize the feedback on the laryngeal muscle contraction that occurs at the time of stimulation of the recurrent nerve.

Furthermore, if at the end of the dissection of the first half of the thyroid gland a nerve damage is detected (it is impossible to establish whether temporary or permanent, even with a macroscopically intact nerve), the surgeon can interrupt the operation, postponing its completion to a later time (i.e. "two-stage thyroidectomy"). When nerve function is resumed, in the event of a temporary injury, and after an accurate fibro-laryngoscopic study, which allows verifying the correct chord motility and morphology, it will be possible to reschedule the completion of the surgery. This conduct eliminates the risk of having to subject the patient to a tracheostomy. The discomfort of having to undergo two surgeries is thus counterbalanced by the undisputed advantage of safely avoiding a tracheostomy, either definitive or temporary.[4,5,6]

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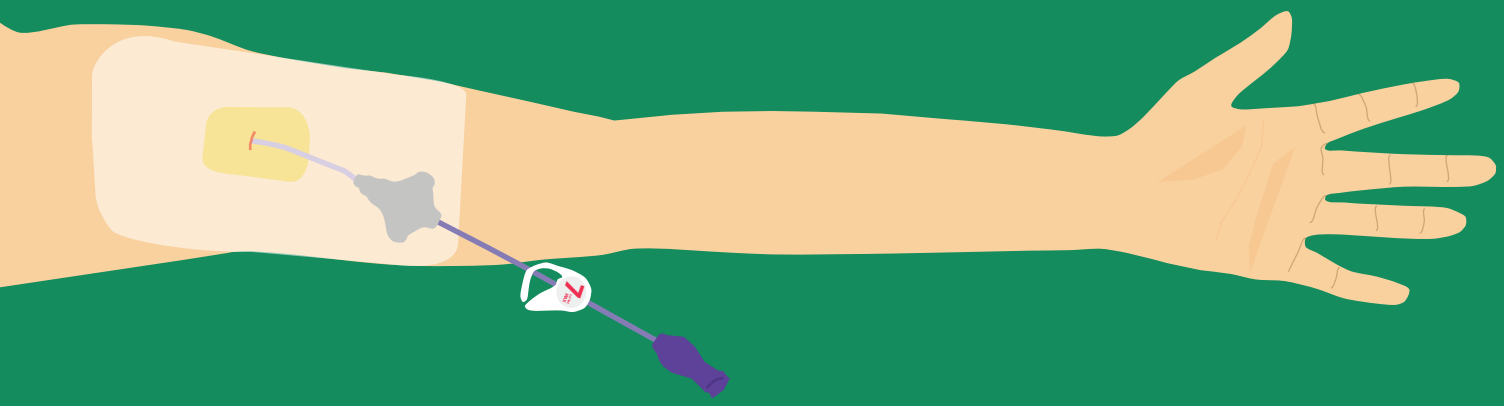

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Brief Report

Control of mother-to-child transmission of Chagas disease: the Tuscany Region model

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Anna Barbiero[1], Martina Mazzi[16], Antonia Mantella[1,3], Michele Trotta[2,4], Gian Maria Rossolini[1,5], Alberto Antonelli[1], Patrizia Bordonaro[11], Maria Grazia Colao[5], Anna Rosa Speciale[8], Tullio Di Benedetto[8], Mariarosaria Di Tommaso[8], Elisabetta Mantengoli[2], Felice Petraglia[9], Luisa Galli6, Marco Pezzati[12], Carlo Dani[6], Maria José Caldés Pinilla[13], Cecilia Berni[14], Bassam Dannaoui[15], Pedro Albajar Viñas[10], Alessandro Bartoloni[1,2,3], Lorenzo Zammarchi[1,2,3,4]

[1] Department of Experimental and Clinical Medicine, University of Florence, Largo Brambilla 3, 50134 Florence, Italy
[2] Infectious and Tropical Diseases Unit, Careggi University Hospital, Largo Brambilla 3, 50134 Florence, Italy
[3] Tuscany Regional Referral Center for Tropical Diseases, Careggi University Hospital, 50134 Florence, Italy
[4] Tuscany Regional Referral Center for Infectious Diseases in Pregnancy, Largo Brambilla 3, Florence 50134, Italy
[5] Clinical Microbiology and Virology Unit, Careggi University Hospital, 50134 Florence, Italy
[6] Department of Health Sciences University of Florence, Paediatric Infectious Diseases Division, Anna Meyer Children's University Hospital, Viale Pieraccini 24, 50139 Florence, Italy
[7] Department of Neuroscience, Psychology, Drug Research and Child Health, Careggi University Hospital of Florence, Largo Brambilla 3, Florence 50134, Italy
[8] Department of Health Sciences, Obstetrics and Gynecology Branch, University of Florence, Largo Brambilla 3, Florence 50134, Italy
[9] Biomedical, Sperimental and Clinical Sciences "Mario Serio", University of Florence, Largo Brambilla 3, Florence 50134, Italy
[10] Department of Control of Neglected Tropical Diseases, World Health Organization, Avenue Appia 20, CH-1211 Geneva 27, Switzerland
[11] Hospital General Laboratory, Careggi University Hospital, Largo Brambilla 3, 50134 Florence, Italy.
[12] Pediatric unit, Santa Maria Annunziata Hospital, AUSL Toscana Centro, Via Antella, 58, 50012, Bagno a Ripoli, Florence, Italy.ì
[13] Tuscany Regional Center for Global Health, Anna Meyer Children's University Hospital, viale Pieraccini 24, 50139 Florence, Italy
[14] Citizenship Rights and Social Cohesion Directorate, Tuscany Region
[15] Technological Innovation in Clinical-Assistance Activities Unit, Azienda Ospedaliero-Universitaria Careggi, Florence, Italy
[16] School of Human Health Sciences, University of Florence, Largo Brambilla 3, Florence 50134, Italy.

Abstract: Chagas disease is an endemic parasitosis in Latin America where the main route of transmission is vectorial. In Europe, due to migration phenomena, Chagas disease cases are increasing and the main way of transmission is mother-to-child, perpetuating the infection from one generation to the other. Congenital Chagas disease is in most cases asymptomatic at birth, but, if not diagnosed and treated early, it puts the child at risk of developing severe cardiac and gastrointestinal problems throughout life. According to the Regional Resolution throughout the territory of Tuscany, pregnant women born in continental Latin America (or born to a mother born in that area) should be offered free of charge serological test for Chagas disease during pregnancy or at delivery, with the main objective of controlling and stopping the transmission of the disease.

Keywords: Chagas disease, Pregnancy, Screening, Latin America, Neglected Tropical Diseases

Introduction

Chagas disease is a parasitic disease caused by the protozoan Trypanosoma cruzi; it is endemic in continental Latin America, where it is mainly transmitted by blood-sucking triatomines (vectorial transmission). Twenty-one countries are endemic for Chagas disease: Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, French Guiana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay, Venezuela[1]. The disease, which in the endemic area is often acquired in pediatric age, is characterized by an initial acute phase, generally oligosymptomatic, which remains unrecognized in the majority of cases. The infected subject subsequently enters the chronic phase of the disease, which in most cases (~70%) remains asymptomatic for life. However, about 30% of infected individuals, after a latency of several years (usually 20 to 30 years), develop severe heart involvement (arrhythmias, cardiomegaly, congestive heart failure, sudden cardiac death) or gastrointestinal complications (megaesophagus, megacolon)[2].

Chronically infected individuals, often unaware of their condition, can transmit the disease through blood transfusions, organ transplants and, and in case of pregnant women, to their child. The risk of maternal-fetal transmission during pregnancy is around 3% to 5% and the infection of the newborn child is referred to as congenital Chagas disease[3]. Congenital Chagas disease is asymptomatic at birth in the majority of cases (60-90%), with the possibility for the child to later develop the chronic complications of the disease as above mentioned. In a minority of cases (about 10%), signs and symptoms of a severe systemic infection may be present at birth: prematurity, low birth weight, hepatomegaly, splenomegaly, anemia, ARDS, anasarca, myocarditis, meningoencephalitis are the most common complications of congenital Chagas disease[4,5].

Chagas disease in non-endemic areas

In continental Latin America, Chagas disease represents a major public health problem, affecting 6-8 million people today. Due to the significant increase in migratory flows from Latin America to the more industrialized countries and the possibility of non-vector transmission, Chagas disease is now an emerging health problem in numerous non-endemic areas, including Italy[6]. Italy is indeed the second country in Europe and third in the world (after the United States and Spain) for the number of migrants welcomed from Latin America. In 2020, according to the Istituto Nazionale di Statistica (ISTAT) data, there were 366,343 Latin American migrants in Italy, of which 223,260 (60.9%) were women[7]. Using the estimated seroprevalence in the countries of origin, it can be hypothesized that between 4,700 and 9,700 people are affected by Chagas disease in Italy, of which 2,900-5,900 are women[8–11]. Based on seroprevalence data in endemic countries, epidemiological data in our country and estimated congenital transmission rate of the disease, it was estimated that between 2014 and 2018, 463 (95% CI 267-792) women with Chagas disease gave birth and 16 (95% CI 12-21) newborns could have been born with congenital Chagas disease; however, only three newborns were actually diagnosed in the same period[12]. Similar data were reported in the Spain, where a 60% rate of underdiagnosis among children younger than 14 years old was estimated[13].

The main factors influencing these data are lack of awareness and of knowledge of the disease among health care workers, worsened by the perception that Chagas disease is a very rare pathology in our latitudes, therefore not having a big epidemiological impact[14,15]. However, lack of diagnosis could rather reflect

the absence of screening programs, which need to be implemented in order to uncover the real burden of this pathology[16].

With the described epidemiological scenarios, in 2009 the World Health Organization, in collaboration with some delegates from European countries, has drawn up an official document that highlights the emerging problem of Chagas disease in Europe and recommends local health authorities to implement adequate measures for control and prevention[17].

However, while programs aimed to control the transmission of Chagas disease through blood transfusions and organ transplants are widely implemented in Europe and in Italy at national level, programs aimed to control of mother-to-child transmission of the disease are lacking throughout Europe[17,18].

There are only a few, localized examples of pioneer screening programs for control of congenital Chagas disease in Europe, such as those implemented in Valencia, Galicia and Catalonia, in Spain, where health policies have been adopted to control the congenital transmission of the disease[19–21].

At the moment, in Italy, national policies aimed to the control of mother-to-child transmission of Chagas disease do not exist. In this perspective, it is worth of note that much rarer pathologies, such as phenylketonuria and cystic fibrosis, are included since 1992 in the "extended neonatal screening" which is provided by the Italian law[12].

However, the first screening programs offering serological tests to Latin American pregnant women have been introduced in some realities, such as the province of Bergamo[22] and the Tuscany Region, which represents, together with those in Spain, one of the very few contexts in Europe where health policies have been implemented for the control of congenital transmission of the disease.

The Tuscany Region model for congenital Chagas disease control

With three regional resolutions, approved respectively in 2012, 2015 and 2019, the Tuscany Region has indeed included, among the free tests to be performed during pregnancy, the serological test for Chagas disease screening for women who were born in continental Latin America or who were born to a mother from that area. The laboratory test should be performed in the first trimester of pregnancy, when the pregnant woman is first taken in charge by obstetricians and gynecologists, but if this does not happen, it can still be performed later at any time during the pregnancy or during delivery. The test involves a simple venous blood sample on which a serological test is performed to search for IgG antibodies against T. cruzi[23].

Women who test positive are addressed to the Tuscany Referral Center for Tropical Diseases, where further investigations are conducted to establish the stage of the disease and the presence of any late complication of Chagas disease. After the end of breastfeeding, affected women are eventually offered antiparasitic treatment. The treatment, based on benznidazole, is in fact contraindicated in pregnancy and during breastfeeding[2]. The finding of maternal infection will allow the evaluation of the newborn through parasitological, biomolecular and serological tests; in case of documented congenital infection, the newborn will be treated with antiparasitic treatment, which is estimated to be 100% effective if it started in the first year of the child's life, while effectiveness tends to decrease progressively if the chronic phase of the disease is prolonged[24].

From a preliminary evaluation of the data collected at Careggi University Hospital, where a pilot project had already started in 2008, it appears that since 2012 the Tuscany regional program has reached about 45-50% of pregnancies at risk. Screening coverage is therefore estimated to be even lower among the other hospitals throughout the Tuscany Region. These data evidence the need to widely promote the knowledge of the "Program for the prevention and control of congenital Chagas disease in Tuscany Region" to all professionals involved, through awareness raising and training events aimed at midwives, nurses, general practitioners, gynecologists, neonatologists, pediatricians and health assistants.

In this perspective, since 2019, a training course entitled "Chagas in pregnancy: the program in Tuscany Region", aimed to all health care providers in the Region, was held at Careggi University Hospital. The course is intended to increase awareness towards Chagas disease, describing the main features of the pathology, with a focus on congenital transmission and illustrating the main points of the regional protocol. An online version of the course has been offered and is still available[25].

Moreover, in 2019 the so called "Chagas check-list" was introduced within the clinical informatic system in Careggi University Hospital, with the

aim of making it easier and more automatic for the health care provider to remember that Chagas disease screening test is recommended if the pregnant woman is at risk.

Conclusion

In conclusion, we believe that programs such as the one implemented in the Tuscany Region are fundamental for monitoring screening coverage in women at risk and to promote systematical screening in people at risk, representing the best strategy to control transmission of Chagas disease from mothers to their children.

We also support the use of informatic tools such as the "Chagas check-list", together with online and onsite training courses, which have an important role for the success of these kind of programs.

Moreover, it has been demonstrated that Chagas disease screening programs are strongly cost effective, not only when screening is addressed to pregnant women and the newborns, but also when the adult population is involved, if costs are compared with those of diagnosing, managing and treating the late complications of the disease[26,27]. The detection of a T. cruzi seropositivity will also permit to extend the screening to other family members or subjects coming from or still living in the same town or community.

Lack of sensitivity and awareness towards the disease can partly explain the still too low screening coverage in Tuscany Region; another big limitation is that the Chagas disease screening test, even offered for free to women at risk, is not included in the official pamphlet where all the exams to be done during pregnancy are prescribed as provided by the Italian law, needing to be prescribed on a separate prescription.

Another point of weakness is that this project was funded only for what concerns the cost of the screening tests and of the clinical management and follow-up of positive women and their children, while promotional, educational and training activities were not covered.

Sharing the example of the model implemented in Tuscany Region, we aim to encourage the implementation of congenital Chagas disease screening programs in many other settings in non-endemic countries, which are needed at national and European level, and to underline the need of higher attention towards this growing health issue among health care workers and health policies makers.

We believe that better knowledge and awareness of this burden among all health care workers, including nurses, health assistants, obstetricians, general practitioner and all physicians and not only infectious diseases specialists, are key elements for the control of congenital Chagas disease; only through homogeneously spread and solidly implemented national programs, the burden of congenital Chagas disease could be controlled and its perpetuation from one generation to the other could be interrupted.

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Case Report

The use of wireless technology for thoracic physical examination: a pilot case based on a literature review

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Marco Umberto Scaramozzino[1], Guido Levi[2], Ubaldo Romeo Plastina[3], Giovanni Sapone[4], Mariacarmela Nucara[5], Maurizia Festa[6]

[1] MD Direttore Ambulatorio di Pneumologia "La madonnina" Reggio Calabria (RC), Italia, Responsabile Servizio Endoscopia Toracica Ospedale Tirrenia, Belvedere Marittimo (CS)
[2] Reparto di pneumologia, ASST Spedali Civili Brescia, Italia, Dipartimento di scienze cliniche e sperimentali, Università di Brescia, Brescia, Italia
[3] MD, Radiologo presso lo studio di radiologia ed ecografia ECORAD, Villa San Giovanni (RC), Italia
[4] Responsabile del Dipartimento Infermieristico di Cardiologia Policlinico M.d.c. Reggio Calabria (RC), Italia
[5] Dipartimento di Medicina Clinica e Sperimentale, Sezione di Cardiologia, Università di Messina, Italia
[6] Biologa, scienze della nutrizione umana presso l'Ambulatorio di Pneumologia "La madonnina" di Reggio Calabria (RC) (nutrizionistafesta@gmail.com)

Abstract: Auscultation is a standard method of physical examination used by physicians and is widely accepted by doctors and patients for its simplicity, repeatability and non-invasiveness. Artificial intelligence is the 'new integrated frontier' of the thoracic examination, yet there are still concordance discrepancies in obstructive pulmonary diseases; on the contrary, for fibrotic diseases, the degree of concordance increases significantly, as shown by previous clinical studies conducted mainly in children. However, there are data in the literature that appear to be very discordant on certain types of lung noises, such as wet crackles and dry noises; therefore, the application of these devices in daily use in outpatient and hospital settings needs to be further expanded.
The integrated data allowed us to make the right diagnosis, also avoiding costs for the national health system and possible invasive procedures such as bronchoscopy, which today remains the "gold standard" for the histological diagnosis of sarcoidosis with lung localisation. Integrated technology could improve the diagnostic capacity in restrictive lung diseases, as shown in this clinical case. Several randomised controlled trials are still needed to increase the significance of this initial integrated

research work performed.

Keywords: Artificial Intelligence, AI, Thoracic Objective Examination, Obstructive and Restrictive Pulmonary Diseases, CT Chest, Crackles

Introduction

Lung sounds have been valuable indicators of respiratory health and disease since ancient times. Laënnec's stethoscope increased their diagnostic importance, but other methods, more sensitive and specific for respiratory assessment, have largely replaced auscultation in clinical lung diagnosis. We are now witnessing the next stage in the evolution of lung assessment by acoustic means[1].The coming years are likely to see an integration of respiratory sound analysers with computerised spirometry[2]. Lung auscultation with traditional stethoscopes has been used for decades, but has limitations in detecting breath sounds, especially the crackles that commonly occur in restrictive respiratory diseases. There are now proposed and recognised applications that allow the physician to record, store, play back and analyse respiratory sounds directly on the smartphone, complementing the common objective chest examination. In simulated scenarios, for fine crackles, an accuracy ranging from 84.86% to 89.16%, a sensitivity ranging from 93.45% to 97.65% and a specificity ranging from 99.82% to 99.84% have been evaluated in several studies. ranging from 99.82% to 99.84%. The detection of coarse crackles proved to be more challenging in the simulated scenarios. In the case of real data, the results demonstrate the feasibility of using a mobile application developed in a clinical environment to help the expert assess a subject's lung sounds[3]. A number of studies have attempted to objectively describe the audio-logical characteristics of wheezing and crackles in adults and particularly in children using auscultation with a digital stethoscope (DS)[4]. In some studies, a computerised stethoscope has been described that has new ways of analysing and displaying information and works in real time, classifies breath sounds into generally accepted categories and classifies sounds when different sounds are present simultaneously[5]. Electronic stethoscopes offer several advantages over traditional acoustic stethoscopes, including noise reduction, greater amplification and the ability to store and transmit sounds. However, the acoustic characteristics of electronic and acoustic stethoscopes can differ significantly, introducing a barrier for clinicians in switching to electronic stethoscopes[6]. With the optimised artificial intelligence (AI) detection thresholds, the positive percentage agreement (PPA) for crackle detection was 0.95 and the negative percentage agreement (NPA) was 0.99 for Clinicloud recordings; for Littman-collected sounds, the PPA was 0.82 and the NPA was 0.96. The PPA and NPA for breath detection were 0.90 and 0.97 respectively (Clinicloud auscultation), with PPA 0.80 and NPA 0.95 for Littman recordings.

One study concludes that AI can detect crackles and rales with a reasonably high degree of accuracy from respiratory sounds obtained from different digital stethoscopy devices, although some device-dependent differences exist[7]. With the integration of AI in medical care, independent validation of AI capabilities and weaknesses is important to ensure quality control[8]. Lung auscultation is a fundamental part of the physical examination for the diagnosis of respiratory diseases. The standardisation of the nomenclature of respiratory sounds, along with advances in the computational analysis of these sounds, have improved the usefulness of this technique. However, the performance of lung auscultation has been questioned due to the variable concordance between health professionals[9]. AI has recently emerged as an alternative method to many conventional methods. The implementation of AI techniques for analysing respiratory sounds can help physicians in the diagnosis of lung diseases. The most commonly used AI techniques for analysing respiratory sounds are ANN(artificial neural network) and k-nn(k-nearest neighbors). ANN has the ability to adapt well to complex non-linear data and to classify these data accurately and efficiently[10]. One study in particular by Grzywalski T et al., developed a diagnostic algorithm with AI integrated with the thoracic physical examination, which improved sensitivity and specificity in the paediatric thoracic examination, reaching values close to 100% diagnostic specificity and sensitivity[11].

Clinical case presentation

A caucasian female of 67 years old, came to my attention for reported episodes of nocturnal dyspnoea, nocturnal cough, wheezing, moderate exertional dyspnoea mMRC: 3 (Medical Council Research dyspnoea scale). She was being treated with ICS/LABA in single administration + LAMA, Montelukast, although the patient had no clinical or symptomatic benefit. In past anamnesis: Allergy to NSAIDs type II, (Antibiotics: Cephalosporin, Penicillin, Sulfonamides, Pyramidonics), Salicylates, Barbiturates. nasal polyposis reported. No use of ACE-inhibitors. Non-smoker, insulin-dependent DM in therapy with Metformin x 2/day, systemic hypertension, Previous presumptive diagnosis of Overlap Sydrome (asthma + COPD - ACOS) in atopy (did not perform bronchoreversibility test). He presented for overnight cardio-respiratory monitoring, which in the opinion of the pulmonary specialist was not indicative of OSA and no treatment was given (AHI:6.7) with AHI supine/not supine >2:1. Obesity, coronary stent placement two years ago, on current Clopidogrel therapy, hypercholesterolemia and hypertriglyceridemia. Performed simple and global spirometry, took laboratory tests, which showed respectively (see tables 1 e 2):

FEV1%	FVC%	FEV1/FVC	PEF	FEF_{25-75}%	RV	TLC%	RV/TLC%
71%	86%	89%	61%	35%	/	/	/
66%	79%	82%	67%	39%	124%	93%	135%

Table 1: Comparison between the first simple spirometry carried out in September 2022 and the global one in February 2023

FEV1%: Percentage of predicted value of FEV1

FVC%: Percentage of predicted value of FVC

FEV1: Maximum Expiratory Volume at first second

FVC: Forced vital capacity

TLC: total lung capacity

RV: Residual volume

RV/TLC: ratio of total lung capacity to residual volume expressed as a percentage of the predicted value

$FEF_{25-75\%}$: forced expiratory flow between 25 and 75% of FVC

Autoimmunity panel	Results	General blood tests	Results
ANA	Negative	GOT	23
P-ANCA	Negative	**Glycemia**	**214mg/dl**
ENA	Negative	Anti-phospholipid antibodies	Negative
C-ANCA	Negative	**Creatininaemia**	**1,01mg/dl**
Rheumatoid factor	9	**Azotemia**	**60**
Calciuria	**290mg/24h**	Coagulation	Negative
Anti-CCP	Negatives	D-Dimer	Negative
Lysozyme	16	LAC (lupus anticoagulant)	Negative
ACE	<1	**Glycated hemoglobin**	8,8%
CPR	2	WBC count	**230 Eosinophils**
ESR	30	GPT extension	30

Table 2 Laboratory tests brought to control

Comment on the tables: the diabetic and obese patient, despite the marked maximal therapy, still has a prevailing obstructive component with reduction of lung volumes and air trapping also due to poor therapeutic adherence. Since the last spirometry test she has gained weight (gaining three kilos more), with evident reduction of lung volumes.

Legend:

ANA: antinuclear antibodies

ANCA: antineutrophil cytoplasmic antibodies

ENA: extractable nuclear antigen

Anti-CCP: anti-cyclic citrullinated peptides

ACE: Angiotensin-converting enzyme

CRP: C-reactive protein

ESR: Erythrocyte sedimentation rate

GOT: glutamic-oxaloacetic transaminase

LAC: lupus anticoagulant

GPT: glutamate pyruvate transaminase

He also presented a chest CT scan of February 2023 which showed: calcific centrlobular nodules and calcific ilo-mediastinal lymphadenomegaly with associated areas of diffuse air entrapment and bilateral bronchial ectasia. On auscultation of the chest with the Eko Core stethoscope (Figure 1), diffuse "velcro" crepitations were present over the entire area, associated with obstructive findings on forced expiration (moans and hisses). At the outpatient visit, the lung noises were recorded and fully assessed on audio with the chest CT finding brought in for examination by the patient. The patient was then framed with the following clinical diagnoses: bronchial asthma with hyper-eosinophilia and nasal polyposis, associated with bilateral bronchial ectasia clinically not well controlled with reduced lung volumes, stage II sarcoidosis with pulmonary involvement (diffuse pulmonary lymphadenopathy and nodules with calcifications) and renal involvement, mild sleep apnoea syndrome prevalent in supine position associated with obesity: BMI (body mass index) 31, for which positional therapy was prescribed, type II diabetes mellitus not well controlled, worthy of diabetological and nephrological re-evaluation.

Figure 1: Eko Core system, smartphone interface, web interface and stethoscope and respective QR Code that allows you to hear with earphones the finding that has been auscultato to the thoracic physical examination of the patient in question. By framing the QR code it is possible to hear the finding of the thoracic objective examination carried out on the lady.

Discussion

Auscultation is a standard method of physical examination used by physicians and is widely accepted by doctors and patients for its simplicity, repeatability and non-invasiveness. Auscultation can be classified as direct or indirect. Direct auscultation connects the ear directly to the body wall of the examinee, while indirect auscultation uses a stethoscope[12].

Early diagnosis of respiratory problems is important to prevent chronic respiratory diseases and to intervene at an early stage. Respiratory sounds include valuable information regarding the physiology and pathology of lung and airway obstruction[13]. The first approach used in the non-invasive diagnosis of respiratory disease involves

the clinical history and auscultation with a stethoscope. The presence of crackling sounds, considered incidental and discontinuous lung sounds (LS), is a during auscultation. However, their detection is highly dependent on the skill and expertise of the operator. Computerised methods have been proposed to overcome the limitations of audio-visual crackle detection, automated detection based on signal processing techniques such as time-frequency analysis or time-varying autoregressive modelling. such as time-frequency analysis or time-varying autoregressive modelling[14]. In some clinical studies, the EKO Core technology used in this case description has been used to help create a digital memory for surviving family members by recording the heart sounds of dying children. Specifically, patients approaching the end of life use music therapy (MTHS) by recording the child's heartbeat and modifying environmental noise to isolate the heartbeat. Surveys were administered to family members in which all indicated that they would recommend the MTHS programme to other families faced with end-of-life decisions[15]. In a Korean clinical study, to test the accuracy of chest auscultation analysis in clinical practice, it was analysed how accurately medical students, trainees, residents and fellows classify breathing sounds. Several test sets were made with normal sounds and three types of abnormal lung sounds: crackles, rales and buzzes. The classification based on the learning curve that emerged is able to detect abnormal lung sounds with an AUC of 0.93 and an accuracy of 86.5%. of 86.5%[16]. Similar results were obtained in the categorisation of abnormal sounds into subcategories: crackles, rattles, or buzzes. Considering that this is the result of analysing sounds recorded in a real clinical field with various noises, these are impressive results. We believe that these accuracies are adequate for primary screening and follow-up testing of patients with respiratory diseases[17].

In another American paediatric clinical study, breath sound recordings were collected in a clinical setting with typical baby noises, cries, voices and movements. The artificial intelligence algorithm was able to fully analyse 93.3 per cent of the recordings, with an accuracy mostly similar to that of experienced paediatric pulmonologists The AI algorithm in distinguishing crackles and wheezing was 83.9 and 78.2 per cent, 79.3 and 57.5 per cent, and 64.6 and 66.4 per cent, respectively[18].

Studies by cardiology colleagues compared the results of personal auscultation with heart sounds recorded by the EKO Core stethoscope in patients with normal heart sounds, innocent murmurs, and a variety of pathological findings, showing that the Eko recordings had a high percentage of agreement with the results of personal auscultation and echocardiogram, with moderate reliability. Compared to the categorisation of the echocardiogram as 'normal/ecography not deemed necessary' vs 'abnormal', the Core allowed users to correctly categorise sounds with 88-94% agreement, mean (SD) 91% (2) and Cohen's kappa coefficient of 0.55(moderate)[19]. Finally, other studies carried out by another Chinese study group demonstrated how the use of lung auscultation with a new-generation wireless stethoscope is possible in hospitalised patients with SARS-CoV-2 pneumonia and allows the assessment of the auscultatory finding of 'velcro' crackles, which if it is widespread and audible predicts a poor prognosis in severe forms, whereas patients with moderate and severe forms without positive velcro auscultatory noises may have a better prognosis[20]. Finally, some clinical studies have compared fine crackles auscultated at the electronic stethoscope and chest X-ray and high-resolution chest CT (HRTC) images by assessing the degree of sensitivity and specificity of the two integrated methods in the diagnosis of interstitial lung disease (ILD), comparing two parameters: firstly, presence or absence of fine crackles determined by the analysis software; secondly, ILD on X-ray determined by pulmonologists, noting a higher sensitivity of fine crackle detection than that of chest X-ray in discriminating ILD in HRCT, while the specificity of X-ray was higher than that of fine crackles. The diagnostic accuracy was almost similar in sensitivity and specificity when comparing sound analysis with software and HRCT versus chest X-ray. The radiological pattern of usual interstitial pneumoniae (UIP) on HRCT has been reported to be associated with fine crepitus determined by auscultation by physicians[21]. Several clinical studies, state that low ACE levels during sarcoidosis are linked to several factors:

1) chronicisation of the disease with endothelial dysfunction

2) use of drugs (ACE inhibitors, chemotherapy or endothelium-toxic therapy, etc.).

There are also limitations linked to the low specificity and sensitivity of the serum ACE test, and even the serum levels most commonly found in patients with sarcoidosis are normal or reduced[22,23]. In the clinical case examined, the laboratory data were not helpful in the clinical approach to the disease. In this clinical case, the integrated approach with AI, functional and instrumental semeiological data was of great help in the diagnosis, because despite the radiological evidence of calcific central-lobular nodules and mediastinal lymph nodes, the laboratory tests and spirometry distorted the initial diagnostic hypothesis to some extent. The difficulty of the clinical case was that the patient had already been assessed by another pulmonologist colleague, the low ACE levels and the absence of a restrictive deficit on spirometry.

Conclusion

Artificial intelligence is the 'new integrated frontier' of the thoracic examination, yet there are still concordance discrepancies in obstructive pulmonary diseases; in contrast, for fibrotic diseases, the degree of concordance increases significantly, as shown by previous clinical studies conducted mainly on children. The use of mobile phone applications integrated with the stethoscope can improve the sensitivity and specificity of the thoracic objective examination. The data from the technology integrated with instrumental examinations have made it possible to make the right diagnosis, while also avoiding costs for the national health system and possible invasive procedures such as bronchoscopy, which is still the "gold standard" for the histological diagnosis of sarcoidosis with lung localisation. Integrated technology could improve the diagnostic capacity of the restrictive lung model, as shown in this clinical case. The role of the outpatient specialist is crucial in recognising these pathologies, allowing prevention of potentially progressive pathologies; moreover, the integration of instrumental data from chest CT and objective thoracic examination still remain the cornerstones of respiratory disease diagnostics in clinical practice. Application systems on smartphones make it possible to integrate the data, to store physiological and pathological noises, to listen to them with specific filters that qualitatively improve the sound, and to make the distinction in lung noises that is crucial in daily clinical practice. The real strength of the "objective thoracic examination 3.0" lies in integrating all available data (clinical, instrumental, laboratory, functional) to formulate a precision diagnosis, also characterising lung pathologies phenotypically. Electronic auscultation makes it possible to store pathological and physiological lung noises and thus make them comparable over time on a par with first-rate instrumental examinations such as high-resolution CT scans of the chest. However, there are data in the literature that appear to be very discordant on certain types of lung noises, such as wet crackles and dry noises; therefore, the application of these devices in daily use in outpatient and hospital settings needs to be further expanded. There is a need to understand the limitations of the technology and try to complement and not replace the operator in the diagnosis of lung diseases. The applications of integrated technology and AI are wide-ranging, and allow for the assessment of cardiological, pulmonary, paediatric and abdominal noise. The degrees of concordance in terms of sensitivity and specificity in diagnosing interstitial lung disease found in the literature are evident in this 'pilot clinical case'; with values approaching those of the prescribed literature, with specificity and sensitivity of 80% and 90% on the lung pathology in question. The applications of this technology can also be used in the university teaching field in the medical course, as it is possible with this technology to download files in .wav format and generate via third-party applications on the Internet permanent QR codes that can also be audible from smartphones or tablets.

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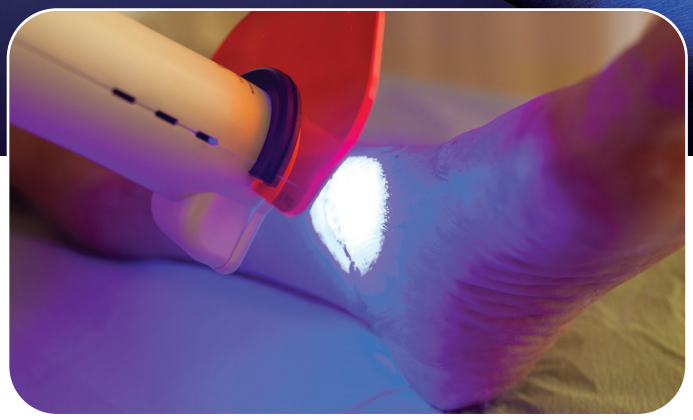

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Learning teamworking and non-technical skills: a pilot study of a postgraduate course at the University of Florence

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Veronica Verde[1], Yari Bardacci[2], Lorenzo Ballerini[3], Samuele Baldassini Rodriguez[2], Chiara Balestri[4], Paolo Iovino[5], Simone Belli[6], Stefano Bambi[7]

[1] RN, CCN, Emergency Department, Nursing Home "Villa Fiorita", Prato - Italy
[2] RN, CCN, Emergency and Trauma Intensive Care Unit, Careggi University Hospital, Florence - Italy
[3] RN, CCN, Emergency Department, Careggi University Hospital, Florence – Italy
[4] Pedagogist, PhD, Research Fellow, Department of Health Science, University of Florence - Italy
[5] RN, MSN, PhD, Assistant Professor, Department of Health Science, University of Florence - Italy
[6] RN, MSN, PhD, Emergency and Trauma Intensive Care Unit, Careggi University Hospital, Florence - Italy
[7] RN, CCN, MSN, PhD, Associate Professor, Department of Health Science, University of Florence - Italy

Abstract

Background: Non-technical skills (NTS) are the cognitive and social skills that integrate the technical skills of a worker. In healthcare systems, NTS exert positive effects on patients' safety and healthcare professionals' efficiency.

Aim: This study aims to assess the degree of NTS knowledge, before and after a workshop administered to a group of 17 nursing students attending a critical care nursing postgraduate course at the University of Florence.

Methods: A cross-over design study was conducted. The workshop was composed of short lectures on "fundamentals of teamworking" and "team building and communication", followed by team activities and gaming. At the end of the day a medical "escape room" about a shock scenario, was developed and run by the students. A questionnaire investigating participants' entertainment and self-evaluation of NTS use, was administered at the end of the simulation sessions.

Results: A sample of 17 nurses was enrolled. Pre-posttests were completed by 16 participants. Seventy-five % (n=12) of the respondents found the team working activities exciting. Most of the participants (62.5%, n=10) considered the "escape shock room game" enjoyable and stimulating and would recommend

the learning activities to other healthcare professionals (75%, n=12). Compared to pre-test scores, statistically, significant improvements in NTS understanding were found on the topics of "team building" ($p<0.001$; $r= -0.60$), "teamworking" ($p= 0.001$; $r= -0.56$), "membership" ($p= 0.001$; $r= -0.56$), "hard skills" ($p= 0.001$; $r= -0.57$), "soft skills" ($p=0.001$; $r= -0.56$) and "situational awareness" ($p< 0.001$; $r= -0.61$) items.

Conclusions: The process of NTS training is well accepted by critical care nursing students and can improve their competencies. Therefore, simulation based NTS training programs and gaming activities should be periodically implemented as part of Critical Care Nursing Postgraduate Courses.

Keywords: Non-technical Skills, Training, Healthcare, Gaming, Virtual Simulation

Introduction

Non-technical skills (NTS) are the cognitive and social skills that complement a worker's technical skills. Fletcher et al. (2003) described seven NTS: situational awareness, decision-making, communication, teamwork, leadership, managing stress, and coping with fatigue[1]. These skills are transversal for all healthcare professions and are equally important to guarantee quality and safety outcomes[2].

In healthcare systems, the positive effects of NTS on patient safety and healthcare professionals' efficiency are well recognize[2]. In studies conducted in acute medical fields (operating theater, intensive care unit, and emergency room), researchers found significant similarities between anesthetist's workload profiles and pilots in aviation; such analogies were referred to as high criticality and complexity at the tasks required, in monitoring, and rapid responses to critical events[3]. Aviation implemented specialist training programs called Crew Resource Management (CRM). These learning activities were designed to increase the use of NTS to improve safety critical behaviours. Studies showed the possibility of adapting the CRM program to healthcare professionals, especially for the teams working in operating theatres, intensive care units, and emergency rooms[3].

A behavioral marker system was developed by a group of researchers that designed "The Anaesthetists' Non-Technical Skills (ANTS)". The purpose was to provide observable improved behaviors related to NTS. It comprises four categories: "situation awareness", "decision making", "task management" and "team working". These categories include 15 skills elements with examples of good and poor behaviors provided for each element. The associated rating is provided by a four-point scale: good, acceptable, marginal, and poor; the items can also be answered with the option "not observed"[4] .

To train the anesthetists' NTS, a CRM approach was usually adopted using both classroom and simulator sessions. The development of high-fidelity human patient simulators, which feature a life-size, lifelike, computer-driven mannequin set within a realistic clinical environment, enabled the creation of clinical scenarios to examine the behavioral aspects of professional performance. Such simulators have been used successfully to integrate theory with practice in CRM skills. Simulated scenarios involving operating theatre-based cases were developed, allowing participants to put NTS into practice. Debriefing was conducted using the ANTS framework to discuss and provide feedback on behavioral aspects of performance. Debriefing was also used to investigate the underlying cognitive processes. Anaesthetists attending the original CARMA (Crisis Avoidance and Resource Management for Anaesthetists) felt strongly that the program (and indeed clinical practise) would have benefited more from the presence of the other disciplines with whom they would work in these challenging situations[3]. Therefore, a "second generation" CARMa (Crisis Avoidance and Resource Management) was developed by focusing on emergency room scenarios with the involvement of the disciplines most likely to be applied in such areas, as anaesthesia, emergency medicine, and surgery[3].

Different teaching approaches, including simulations and gaming activities were introduced to facilitate the process of NTS learning and related practical applications; for example, Dieckmann et al. (2016) developed a simulation-based game called "Hand-it-on". This activity is an out-of-context exercise where subjects use simple non-medical tasks that provide new learning opportunities and are combined in a way so that a complex pattern of interactions between the participants can emerge[5]. An important part of the experience is the debriefing phase, where the dynamics of the game are analyzed and then related to actual healthcare practice. The description of the events that occurred during the simulation could be compared to clinical practice. Many studies have demonstrated that simulations and game-like approaches can be effective in learning ability processes. Rosenkrantz et al. (2019) designed the "MERGE" (Medical Escape Room Game Experience), a game-like method designed to apply NTS in a complex team-based situation[6]. Participants in a university summer school and international healthcare congress had to solve a medical aspect riddle, namely simple ECG interpretation or basic knowledge about the ABCDE resuscitation approach. Riddles were deliberately kept simple in medical terms to keep the focus on NTS. The study showed how the experience had sensitized participants to the importance of NTS and how they were linked to clinical practice[6].

The escape room game was introduced as a teaching method in another study involving nursing students from a Spanish university (Gómez-Urquiza et al., 2019)[7]. In this research, the students, in the second year of the nursing bachelor's degree, joined an escape room game after participating in a 16-week theoretical lesson program. Teachers chose many theoretical elements in the game which the students had to recall for solving the puzzles and finding the key to the exit. The students were divided into groups, and they had 30 minutes to complete the game. The day after the game, nursing students were invited to complete an online questionnaire evaluating their opinion on the escape room game. The students found the game enjoyable, and useful, and it helped them to recall and apply knowledge discussed during the theoretical lessons[7].

NTS training is also associated with an improvement in technical skills: according to the study by Seo and Cho (2021) who conducted a pretest-posttest experimental investigation on 46 nursing students in the fourth year of a University bachelor program, CPR (Cardiopulmonary resuscitation) outcomes were better after a specialized education program of the KALS (Korean Advanced Life Support)[8]. The students participated at two 6-hour lectures in groups, training the KALS guidelines of the Korean Cardiopulmonary Resuscitation Association and the NTS such as teamwork and leadership. In addition, they also investigated communication confidence, critical thinking tendencies, and self-efficacy in performing CPR. The results showed an improvement in both the performance of NTS and technical skills after the specialized KALS education programs, suggesting that the success of the CPR procedure is affected by NTS[8].

A wide body of research was conducted across critical care settings in order to evaluate the effectiveness of simulation and team training programs. An Italian study (Dante et al., 2022) evaluated the impact of a characteristic teaching model based on multiple exposures to high-fidelity simulations (double simulation program repeated after fifteen days managing virtual critically ill patients' care needs) in a group of 21 registered nurses enrolled in an intensive care postgraduate course[9]. Furthermore, the researchers investigated both the learning outcomes and the perceptions of the attendees of the learning program. The students achieved better outcomes from the multiple exposures to high-fidelity simulations, improved self-efficacy and self-confidence and expressed appreciation and positive emotions about the overall learning experience[9].

According to Boling and Hardin-Pierce (2016), simulation-based team training programs in ICU (Intensive Care Unit) met the satisfaction and agreement of registered nurses from different ICUs and attendees of an intensive care postgraduate course, recruited for the research[10]. They agreed about the improvement of their skills and showed positive attitudes about the importance of team performance related to patient safety, and team behaviors[10].

The importance of NTS in healthcare is recognized and specific training has been implemented, starting with the development of a behavioral marker system in Anesthesia[4,11]. In fact, research studies were conducted on NTS training and educational programs both for healthcare professionals and students. Nowadays, there are no shared guidelines on NTS educational programs. In Literature, there

are many studies describing different training activities and educational methods[3,5,8]. However, only few studies have proposed the "escape room" experience for healthcare professionals and students[6,7].

The primary aim of this study was to assess the degree of knowledge regarding NTS of postgraduate critical care nursing students, before and after a workshop and an escape room game conducted inside a university. The secondary aim was to evaluate the level of satisfaction and usefulness of the team-building activities and NTS learning.

Materials and Methods

Design

A pilot quasi-experimental pre-post study was performed with a group of nurses attending the postgraduate course "Critical Care Nursing in Adult Patients" at the University of Florence (Italy).

Sample

Convenience sampling was adopted for our study. Inclusion criteria for the participants were being nurses attending the postgraduate course "Critical Care Nursing in Adult Patients" at the University of Florence (academic year 2020-2021) and being Italian native speakers.

Procedure

Participants attended a three-day workshop experience ("SIMaster workshop program"), which focused on practical issues like team building, technical skills, and NTS. The methods implemented, as well as the duration of the contents, are reported in Table 1.

"SIMaster" workshop	Contents	Method	Duration
8th November 2021	· ABCDE primary assessment of the critically ill patient	Lecture	1h 30min
	· Proactive behavior, preview, and planning · Situation awareness · Communication skills; handover	Lecture	1h 45min
	· ABCDE assessment with mini scenarios	Low-fidelity simulation and skill practicum	3h
9th November 2021	· Team building and team working · Leadership and membership.	Lecture	1h 30min
	· Technical skills and non-technical skills · Briefing, debriefing, and defusing	Lecture	1h 45min
	· Team Building and team working activities	Game-like approach	2h 30min
	· "Escape shock room"	Game-like approach	2h

12th November 2021	· Non-technical and technical skill evaluation according to the ABCDE approach and debriefing at the end of each session	High-fidelity simulation test	2h (each group)
	· Closing of the workshop	Discussion	1h

Table 1. Outline of the "SIMaster workshop program".

The workshop trainers were nurses coming from ICUs. On the first day, the participants were randomly assigned to four groups (three groups composed of four learners and the remaining one of five learners) to participate in different low-fidelity mini scenarios on the ABCDE approach to the critically ill patient.

The second day, the learners attended different out-of-context team building learning activities. There were different workspaces where the trainers conducted the activities and supervised the students and their interactions. At the end of the day, a game-like exercise called "Escape Shock Room" was performed. The learners were assigned randomly in groups of four to five components. One group at a time played in a high-fidelity clinical scenario with a High Fidelity (HF) mannequin, while the other students could observe the scene through a wide screen in a classroom connected to the webcam placed in the simulation room. The instructors supervised the sessions outside the escape room and followed the participants' interactions in real time through a webcam and an audio connection. The game aimed to solve different riddles and puzzles within a time of 20 minutes. The specific knowledge and skills that the students were required to demonstrate, was performing an ABCDE assessment, an electrocardiogram, and arterial blood gas or ventilation parameters assessment.

Instruments

A questionnaire designed by the research team was used to collect data on the level of satisfaction and interest, as well as the effectiveness of the training methods. The structure of the questionnaire was similar to the ones used in other studies that investigated the interest in NTS (Gómez-Urquiza et al., 2019; Rosenkrantz et al., 2019). It was composed of 16 items divided into two sections. The first section was aimed at collecting anonymous demographic data of the participants (i.e., age, hospital work setting, and years of work as a nurse). The second part investigated the degree of entertainment and use of NTS after the workshop experience through self-evaluation.

The questionnaire evaluates the learning ability of NTS of the participants through their degree of knowledge before and after the workshop, using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The abilities were investigated on the following topics: team building (ability and activities of creating and building a group), teamworking (acting together as a team), leadership (the ability to manage and lead a group), membership (sense of belonging to a group), hard skills (technical competences), soft skills (non-technical competences), briefing (exchange of information between the members of a group), debriefing (the process of reviewing following a simulated or clinical event), proactive and anticipating (developing in advance primary and contingency strategies for managing tasks and thinking ahead about potential outcomes and consequences of actions, intervention, non-intervention), situational awareness (the awareness of the environment in which one interacts), communication skills (the ability to convey or share ideas and feelings effectively), feedback (the process of returning of evaluative or corrective information about an action, event, or process) and handover (the patients nursing reports between colleagues at the change of shift).

The last part of the questionnaire investigates the satisfaction and usefulness of the workshop. The section presents 9 questions on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) and two open-ended questions exploring the impressions of the students about the team-building activities and the escape shock room experience.

Data collection

All participants were asked to complete, anonymously, an ad-hoc online questionnaire through the Google Forms platform, to explore the learned knowledge about NTS and the individual satisfaction with the whole workshop. The questionnaire was administered through Google Forms® platform. To prevent students from responding more than once, only one response per Google Forms platform user was allowed by the system. The expected time for the compilation was 5 to 10 minutes. The questionnaire was administered between the 21st of March 2022 and the 21st of April 2022, at the end of the study plan of the Critical Care Nursing postgraduate course.

Statistical analysis

A descriptive and non-parametric statistical analysis of the data was performed using Stata/MP4. Demographic data and the other variables are reported as median (IQR) ± SD as appropriate. The Wilcoxon rank sum test was performed to analyze the differences in NTS scores before and after attending the workshop. A p-value ≤0.05 was considered statistically significant. Qualitative data, regarding the experience of the students on the team building activities and the escape shock room experience, were reported through the word cloud using the Mentimeter software® Version 3.2.7, 2021-08-26.

Ethical issue

All data collected were collected and stored anonymously, according to the current national body of law about privacy and personal data management. No healthcare data or identifiable personal data was collected or stored.

Results

All the seventeen participants in the postgraduate course were deemed suitable to be included in this study. Responses to the questionnaires were obtained from 16 participants (94,1%). The average age of the students was 29 years (SD±3). About half of the respondents were currently working in ICU (56.3%, n=9). Most participants had been working as a nurse for 3-5 years (62.5%, n=10).

Age, years (mean ± SD)	29 ± 3
Hospital setting (n, %)	
ICU	9 (56.3)
Surgical ward	3 (18.8)
Medicine	2 (12.5)
Operating room	1 (6.3)
Subintensive	1 (6.3)
Years of working experience (n, %)	
1-2 years	4 (25)
3-5 years	10 (62.5)
> 5 years	2 (12.5)

Table 2. Demographic characteristics of the participants (n=16).

As shown in Table 3, statistical significance was found for most of the domains addressed during the workshop experience, except for the leadership and communication skills. Team building and team working showed an important increase in positive evaluations (respectively z= -3.450; p<0.001 and z= -3.218, p=0.001).

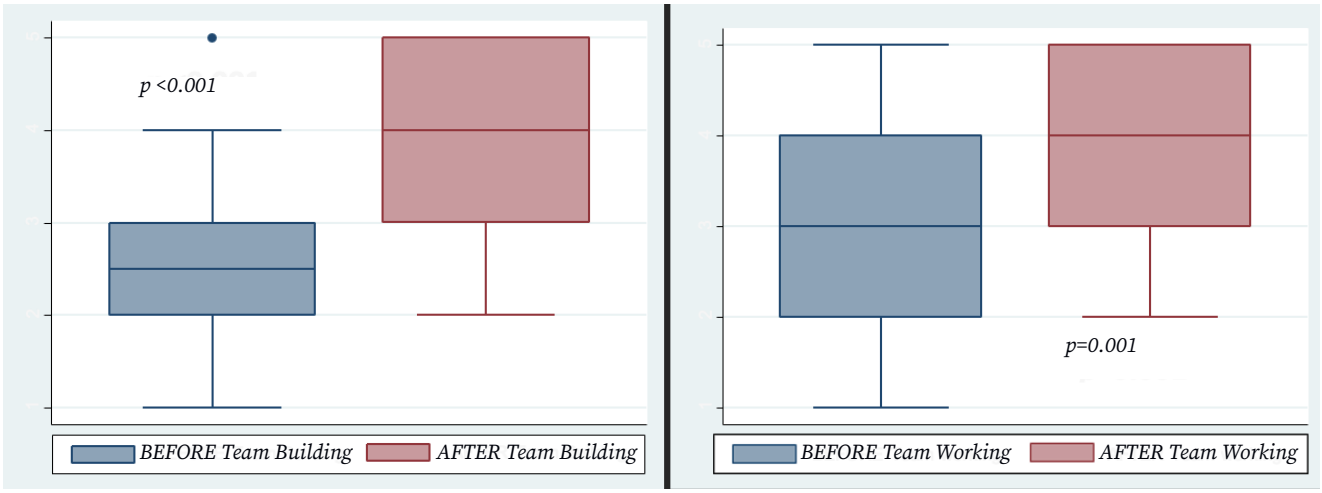
Membership revealed a positive development (z= -3.218; p=0.001). On the other hand, the results showed a previous knowledge of leadership (z= -1.658, p=0.09) and communication skills (z= -1.933, p=0.05). The results show a significant enhancement both in hard skills and soft skills (z= -3.275, p=0.001 and z= -3.175, p=0.001, respectively). Situational awareness was an issue little known by the respondents. Figure 5 shows an important increase in positive responses after the workshop (z= -3.490, p<0.001). The degree of knowledge about briefing and debriefing show significant improvements before and after the workshop (respectively z= -2.121, p=0.03 and z= -2.891, p=0.003).

Topics	Median SD		z-score	p-value
	Pre	Post		
Teambuilding	2.51.01	41.06	z= -3.450	p< 0.001
Teamworking	31.06	41.12	z= -3.218	p=0.001
Membership	41.36	40.99	z= -3.174	p=0.001
Leadership	41.01	41.09	z= -1.658	p=0.09
Hard skills	21.67	41.04	z= -3.275	p=0.001
Soft skills	2.51.41	41.08	z= -3.175	p=0.001
Briefing	41.02	51.12	z= -2.121	p=0.03
Debriefing	31.36	51.18	z= -2.891	p=0.003
Proactivity	31.36	41.06	z= -3.036	p=0.002
Situation awareness	21.09	41.07	z= -3.490	p< 0.001
Communication skills	41.14	51.16	z= -1.933	p=0.05
Feedback	3.51.26	51.0	z= -2.179	p=0.02
Handover	41.36	51.04	z= -2.547	p=0.01

Legend - SD: standard deviation.

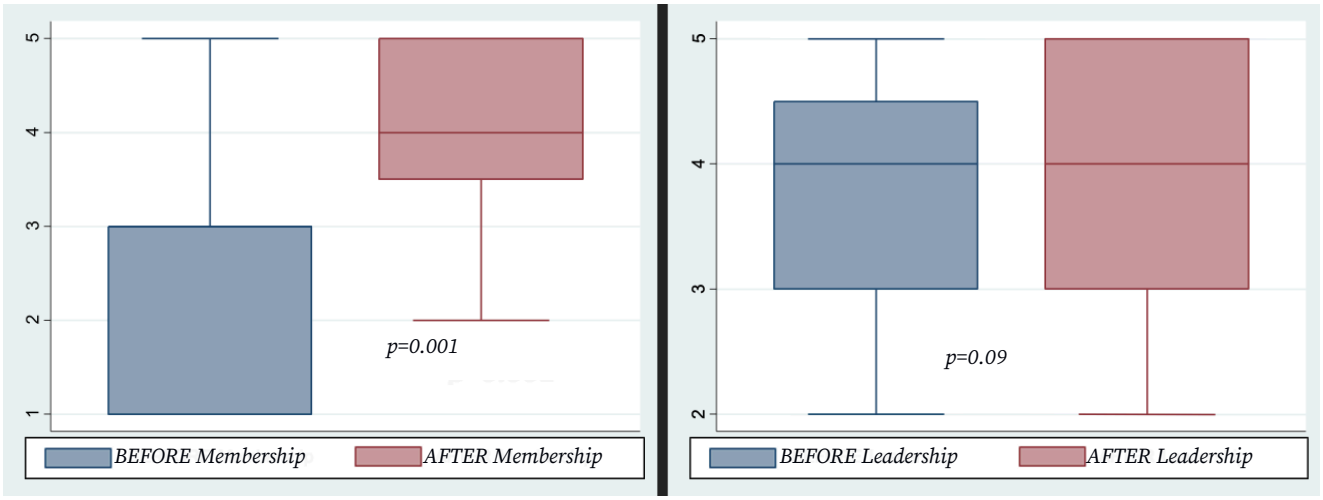
Table 3. Scores before and after the "SIMaster workshop" by topics

Below, the explorative statistical analysis represented by box plots (Figure 1-7).



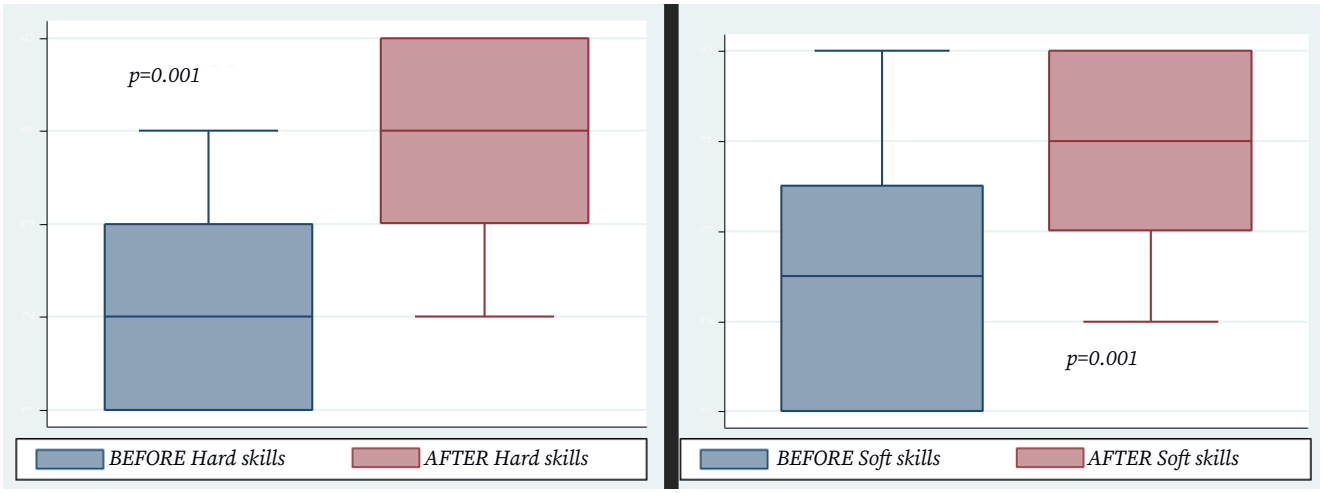
Data are expressed as median and quartile. Boldface P-value <0.05

Figure 1. Distribution of the degree of knowledge about team building and team working before and after the workshop



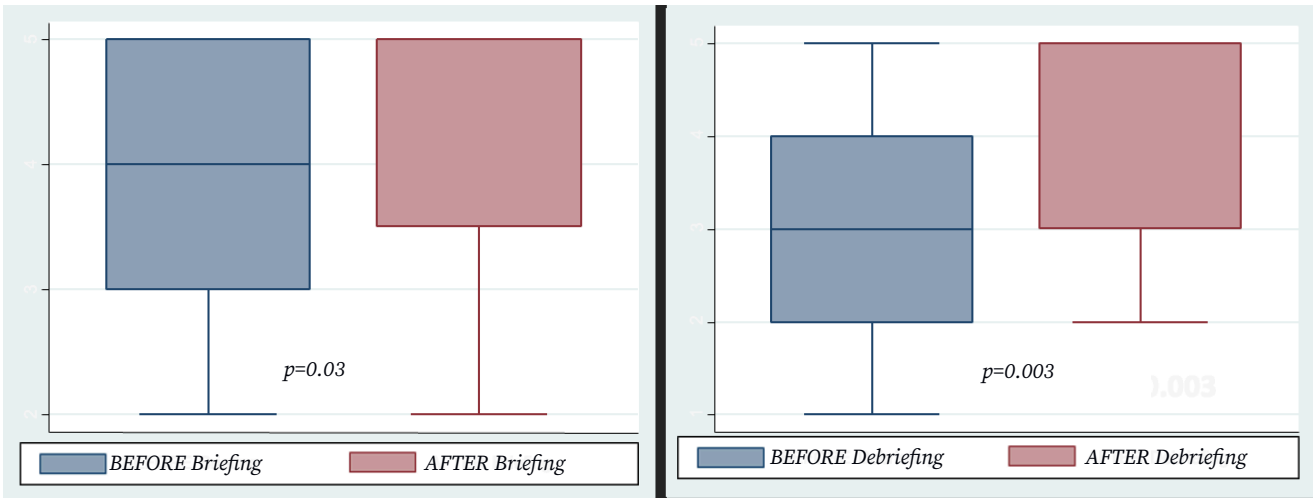
Data are expressed as median and quartile. Boldface P-value <0.05

Figure 2. Distribution of the degree of knowledge about membership and leadership before and after the workshop



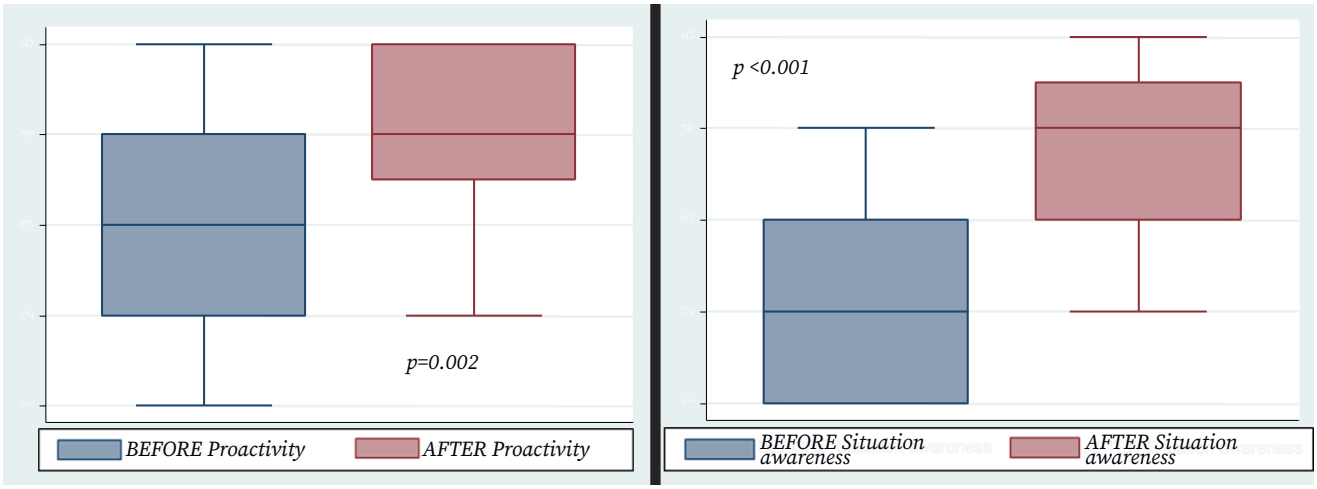
Data are expressed as median and quartile. Boldface P-value <0.05

Figure 3. Distribution of the degree of knowledge about hard skills and soft skills before and after the workshop



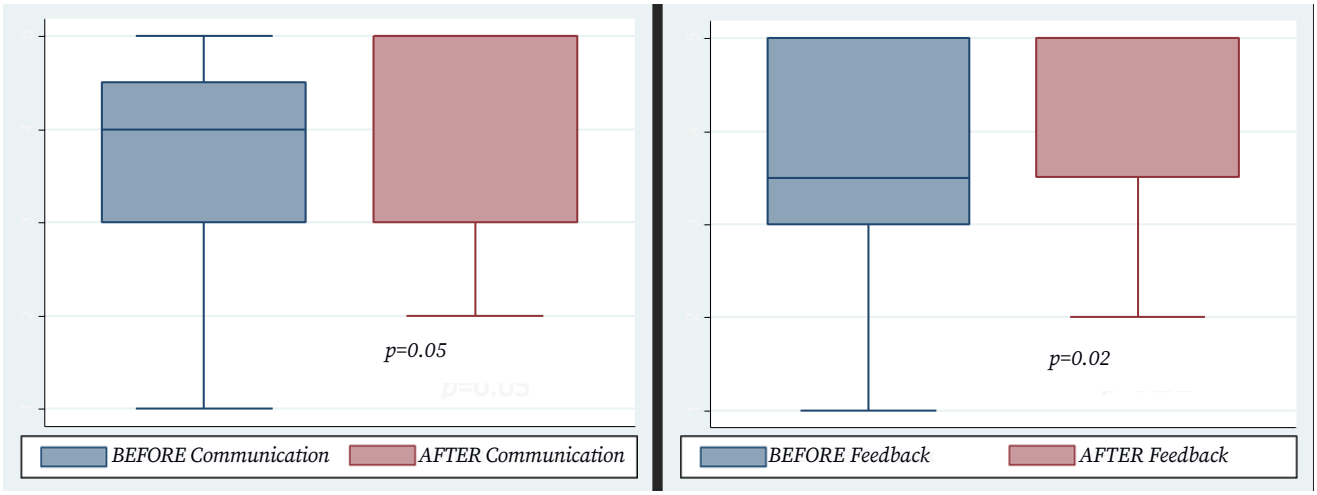
Data are expressed as median and quartile. Boldface P-value <0.05

Figure 4. Distribution of the degree of knowledge about briefing and debriefing before and after the workshop



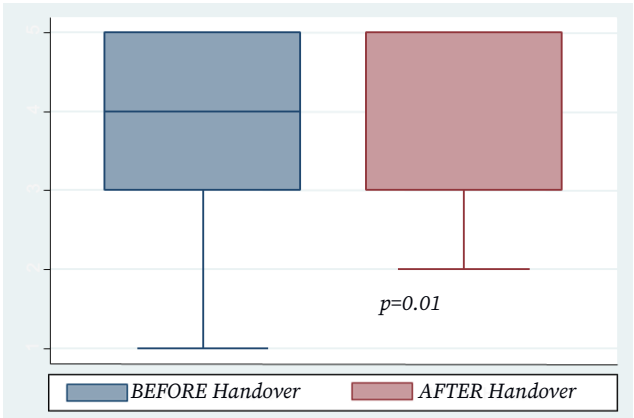
Data are expressed as median and quartile. Boldface P-value <0.05

Figure 5. Distribution of the degree of knowledge about proactivity and situation awareness before and after the workshop



Data are expressed as median and quartile. Boldface P-value <0.05

Figure 6. Distribution of the degree of knowledge about communication and feedback before and after the workshop



Data are expressed as median and quartile. Boldface P-value <0.05

Figure 7. Distribution of the degree of knowledge about team building and team working before and after the workshop

Lastly, the questionnaire investigated the satisfaction and the perception of the usefulness of team building activities and NTS learning. The responses to the last nine questions were assessed on a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree) and represented below in Table 4.

Items		Median
1.	Team building was a stimulating activity	5
2.	"Escape shock room" was a stimulating activity	5
3.	Team building activities reflect aspects of clinical practice	4.5
4.	Application of NTS in your workplace	5
5.	Need for educational NTS programs	5
6.	Usefulness of the learning activities for healthcare professionals	5
7.	Acquisition of new skills	5
8.	Reproducibility of the skills acquired during the workshop	4.5
9.	Recommendation of NTS to other healthcare professionals	5

Table 4. Satisfaction of the learners on the workshop through the questionnaire's items (16 respondents)

As shown in Table 4, the median had a score between 4.5 and 5 in all the items. Therefore, satisfaction was high in all the domains. The responses to the 2 open questions were positive. The results are represented in the form of a word cloud. As shown in Figure 1, the highlighted words to describe the escape room game and the team building activities were "stimulating" and "motivating".

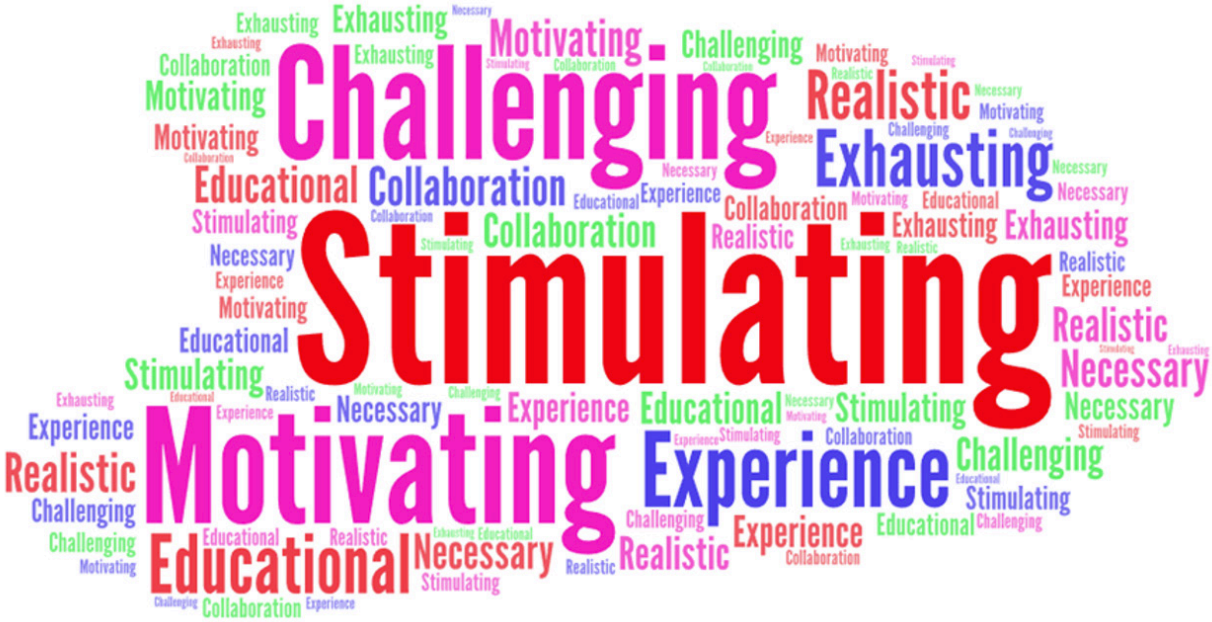


Figure 1. Representation of the brief comments about team building activities and the "escape shock room".

Discussion

This study aimed to assess the degree of knowledge regarding NTS, before and after a workshop experience. Our study shows a significant improvement in the acquisition of NTS after the learning activities and the escape shock room game. The solution of clues allowed the groups to acquire practical abilities in acute care. Moreover, the game allowed us to bring out and train NTS through the interaction and behavior of the teammates.

Of considerable importance was the finding of an important significance for most of the topics related to NTS, suggesting that the learning activities help them recall and apply knowledge, and promotes teamwork. Previous studies showed similar findings in the improvement of critical care knowledge in nursing students integrating clinical simulation into the theoretical lessons[12].

The results of our study indicate no significant improvement in the items "communication" and "handover". The two topics seemed to be already known by the learners before the workshop because these aspects are discussed in nursing bachelor's degree programs, and they are commonly used in clinical practice. Nevertheless, communication skills are not often the focus of most health education programs and nurses appear not to use it properly, due to the lack of training activities[13].

Moreover, the respondents of the questionnaire expressed their enthusiasm and found the activities and learning methods of NTS stimulating. These findings are similar to the studies published both for nursing and ICU registered nurses[7,14]. Participants agreed that NTS are important and necessary in daily clinical practice and that they deserve more training and development, not only for nurses but also for other healthcare professions[3,6,10].

Limitations and strengths

The first limitation of this study is related to the questionnaire, which was not tested and validated before its administration. Another limitation is related to the small sample size, which was due to the limited number of student participants at the Critical Care Nursing postgraduate course. Our study may also be affected by a recall bias due to the time from the workshop occurrence and the administration of the questionnaire to the interviewees. Despite the limitations, our study has also some strengths, including the fact that it was conducted on students attending a postgraduate course in "Critical Care Nursing in Adult Patients".

Conclusion

The results of our study show that the participant's score for NTS degree of knowledge improved significantly after the workshop. Although this study showed some limitations due to the low number of participants, and further studies are needed to confirm our results, it is interesting to observe how the opinions of the participants were favorable to the proposed activities. The development of simulation program for NTS, such as technical skills, should be part of the continuing education program, and these programs should be available in healthcare facilities and education courses. Specifically, in ICU, the integration of simulation programs, could help facing the increasing complexity of critical care settings and the presence of relatively inexperienced healthcare professions.

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Brief Report

Ambulance sanitization in Italy: a pilot study

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Camilla Zonzini[1], Sara Chiosi[2], Stefano Musolesi[3]

[1] RN, MSc, Pediatric Intensive Care Unit, Azienda Ospedaliera Universitaria Integrata Verona, Italy
[2] RN, MSc, Respiratory Rehabilitation, Fiorenzuola d'Arda, Italy
[3] RN, MSN,118 Emilia Romagna, Italy

Abstract

The assessment of biological agents' exposure in the work environment is an employer's duty. Air and surfaces could be transmission's vehicles of pathogens. We consider the ambulance as the work environment where, respecting hygienic targets of low risk, we can prevent out-of-hospital infections for workers and patients. In this brief report we analyzes standard sanitation and fumigation; the aim is to reach the lower level of surfaces' contamination.

Keywords: Pathogens, Ambulance, Fumigation, Biological Exposure, Hygiene, Sodium Hypochlorite

Studies have been carried out on health care-related infections, especially in the intra-hospital setting[1,2,3]. However, the correlation between the hygiene and disinfection of emergency vehicles, the presence of pathogens on their surfaces and the transmission of nosocomial infections to patients is not well highlighted. In fact, little attention is paid to infections acquired by patients or operators outside the hospital despite of emergency vehicles used to transport patients come into daily contact with potentially infected subjects, who can infect the operators and other users. The Italian Society Of Emergency Medical System Nurses (Società Italiana degli Infermieri di Emergenza Territoriale – SIIET) has recently published recommendations[4] recommending the sanitization of the emergency vehicles at least every 24 hours. Concerning the treatment with Ozone (fumigation technique), currently there are no specific indications for COVID-19. However, in a study performed in 2006, Ozone treatment was found to be effective in the treatment of room sanitation during the SARS epidemic in Beijing[5].The aim of this study was to detect the microbial load inside the patient transport compartment of ambulances before and after different typologies of sanitization.

Three ambulances from the AUSL of Bologna not sanitized in the last 48 hours prior the

measurements were randomly enrolled for this study.

Microbiological samples to evaluate the aerobic mesophilic load, were taken from (1) the backrest of the transport stretcher, (2) the knob of one of the O_2 tanks connected to the internal delivering system, (3) the internal handle for opening the rear door before sanitization, on three different ambulances. The sampling kit consisted of a sponge of size 4.5x9 cm, contained by an envelope of size 114x229 mm and with volume equal to 450 mL. After the sampling, standard sanitization through sodium hypochlorite was performed on two ambulances, while fumigation through Ozone Air 80® (Bertin srl - Tecnolife srl) was applied on the remaining one. After the sanitization, the microbiological sampling was repeated for each ambulance in the same three points. Samples were analyzed with standard culture methods after 72 hours.

18 samples were totally collected, 9 before the sanitization procedures and 9 afterwards. The aerobic mesophilic load detected on the three ambulances before and after the sanitizations methods is reported in table 1. A certain degree of variability in the levels of microbial contamination present in the three ambulances before the sanitization procedure is evident, as it is statistically significant the reduction in the level of contamination of the surfaces obtained after sanitization ($p<0.05$). Both the procedure of manual sanitization by electrolytic chloride and fumigation showed to be effective techniques for the reduction of microbial load on the investigated surfaces.

Further investigation is needed to understand if the microbial contamination found in this study is the result of randomness and if it could represent a real risk of transmission of healthcare-related infections. To explore this hypothesis, it will be necessary to broaden the field of investigation, including the detection, both qualitative and quantitative, of specific groups of microorganisms (or individual species) to which have particular pathogenic relevance (e.g. streptococci, staphylococci, pseudomonas, enterobacteriaceae carbapenemase-producers, salmonella, staphylococcus aureus methicillin-resistant).

Lastly, to understand if the amount of CFU constituted a real risk, we relied on some general indicators related to hospital environments. In fact, there are no specific indicators for emergency vehicles in literature, as this area is still little investigated and not regulated by specific guidelines.

SAMPLE ID	UFC PRE SANIFICATION	UFC POST SANIFICATION	UFC POST FUMIGATION
Ambulance 1 - stretcher	6.200 CFU/sample	EstimateD 500 CFU /sample	
Ambulance 1 - O_2 knob	4.800 CFU /sample	910 CFU /sample	
Ambulance 1 - rear handle	1.100 CFU /sample	< 400 CFU /sample	
Ambulance 2 - stretcher	2.600 CFU /sample	EstimateD 800 CFU /sample	
Ambulance 2 - O_2 knob	1.000 CFU /sample	< 400 CFU /sample	
Ambulance 2 - rear handle	1.300 CFU /sample	< 400 CFU /sample	
Ambulance 3 - stretcher	6.900 CFU /sample		< 400 CFU /sample
Ambulance 3 - O_2 knob	25.000 CFU /sample		< 100 CFU /sample
Ambulance 3 - rear handle	2.500 CFU /sample		< 400 CFU /sample

Legend - CFU: Colony Forming Unit

Table 1. Results of samples' analysis before and after the standard sanitization or fumigation

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