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Original Paper

Planking or the "Lying-Down Game:" Two Case Reports

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Abstract

Background: The monitoring and management of risks regarding children and young people admitted to the emergency department as a result of dangerous behaviors distributed via the Internet should be based on clinical reasoning and knowledge about these social media–related phenomena. Here we examine 2 cases of teenagers who reported severe injuries while performing the "planking" craze, a challenge that consists in lying face-down stiffly like a board on any kind of surface.

Objective: Our objective is to examine and describe the Internet craze called planking, also known as the "lying-down game," through 2 case reports from our experience, enriching this study with information gained through discussions with secondary school teenagers.

Methods: Details of the 2 case reports were taken from electronic medical records giving information on care support processes, care management, and the costs of traumatic episodes. Demographic data, hemoglobin and serum lactate values, and Injury Severity Scores were evaluated. The study took place in secondary schools of our city from 2013 to 2014 during medical education courses, with the aim of analyzing the influence of social media on teenagers' activities and behaviors.

Results: Both patients suffered multiple trauma injuries and needed high-level health assistance. The first patient underwent a splenectomy and the second one a nephrectomy; both of them required a long hospital stay (14 and 20 days, respectively), and the costs for their management have been estimated at US $27,000 and US $37,000, respectively. Their decision to perform the planking in dangerous locations was due to their ambition to gain peers' acclaim through shared videos and pictures.

Conclusions: Reporting and understanding these cases may potentially help prevent future events occurring in similar circumstances: the scientific community cannot leave this problem unaddressed. There is also a role of education resources for health care professionals; for this, we must identify and follow up strange or misleading information found on websites. A key element of this research study was to report physicians' misperceptions concerning planking and, with these cases used for teaching purposes, improve knowledge of the clinical and forensic aspects of this emerging problem.

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KEYWORDS

planking; the lying down game; serious games; blunt trauma; multiple trauma; social networks; health care costs

Introduction

The emergency department (ED) these days must also examine behavioral changes: our real challenge is to understand them within the sphere of programs for surveillance, research, and innovation. Preteen children and adolescents are the most frequent users of social networks, blogs, and forums of all kinds. The monitoring and management of risks in treating children and young people admitted to the ED as a result of dangerous behaviors spread by the Internet should be our basis for clinical reasoning. Medical decision making must be developed to deal with a specific problem: knowledge of a new practice by young people which may result in serious injuries due to multiple independent risk factors following falls from various heights and in different positions, etc (position, place, biomechanical characteristics, mechanism of injury). The 2 cases described here are not attempted suicides; descriptions of the accident scene show nonfatal falls from heights by 2 young men (Figures 1 and 2).

A key element of this research is to report physicians' misperceptions concerning planking and, using ED data, improve knowledge of the clinical and forensic aspects of this emerging problem. The context was developed by the authors according to clinical, forensic, and health care experiences including previous experiences of training at various graduate and postgraduate levels and with appropriate multidisciplinary input from experts in medical education, focusing on defining isolated but new social activities aimed at increasing young people's image of themselves on social network sites by gaining likes from friends and visitors to their profiles [1-4]. A "like" is an action which can be made by a social media user (Facebook, Instagram, etc): instead of sending a message or a status update, the user can click the like button as a quick way of showing approval and sharing the message. Scores are calculated with a great number of variables, including the number of followers and friends of each person, the frequency of updates, and the number of likes, retweets, and shares that each person receives [2,4]. High scores are linked to the level of influence and are calculated according to positive or negative feedback from the target audience, especially as regards increasing the number of likes which represent each user's profile [5-8].

Most adolescents use online networks to increase their knowledge regarding games, videos, culture, scientific knowledge, fact-related reproductive health, wellness programs, etc, but negative effects on mental health such as cyberbullying, sexting, and increasing the number of friends through blogs, photos, videos, sharing, or real-life background connections have been reported [8-10]. Social networks may be considered as new ways of communication which can influence individuals' lifestyles, either positively by gaining likes or negatively by losing them. The photos of young people during planking are unusual in both pose and situation and sometimes have the greatest effect when they are posted on the Web by young people simply because they believe they will attract new likes to their page through creative, funny, or crazy photos or videos [10-11].

At present, there are no official reports in the literature of lesions due to trauma as a result of planking, which has probably had little effect on immediate trauma fatalities, but these results can be projected to other trauma centers and processed to create injury surveillance data. Facebook is one of the most popular social network services with more than 1 billion daily active users around the world [1]. The goal of the adolescents is to upload videos, photos, and personal details with the intention of creating a self-descriptive profile. Social networking sites offer new social contact and knowledge of other people's attitudes and behavior mediated by, for example, the Facebook platform, but further exploration and developed strategies are necessary to understand when the interactive functions include high-risk behaviors and when they represent an opportunity to establish modern challenges through blogs, wikis, or posted contents. A recent review confirms Facebook's potential for the study of human behavior [3].

Planking consists of lying face-down, stiffly like a board, on any kind of surface (Figure 3). Participants have photos taken of themselves and upload them via the Internet in order to obtain a high number of likes on their profiles. Most cases of planking do not involve injury because the practice is rarely dangerous and usually performed in safe areas. However, adolescents often choose unusual and sometimes dangerous places in order to draw more attention and increase their number of likes.

The following case reports describe the patterns of injury and their severity in 2 cases of planking which resulted in traumatic lesions due to vertical deceleration. The literature contains some data of clinical series of children and adolescents admitted to EDs after falls from a height (>5 meters) or due to height trauma for various reasons (attempted suicide, dyads, homicide, accidents), the severity of injuries, and outcomes. However, surprisingly, we could not find any report on the pathology of trauma resulting from falls from a height in relation to planking [12-15].

Figure 1. Planking on a rooftop.

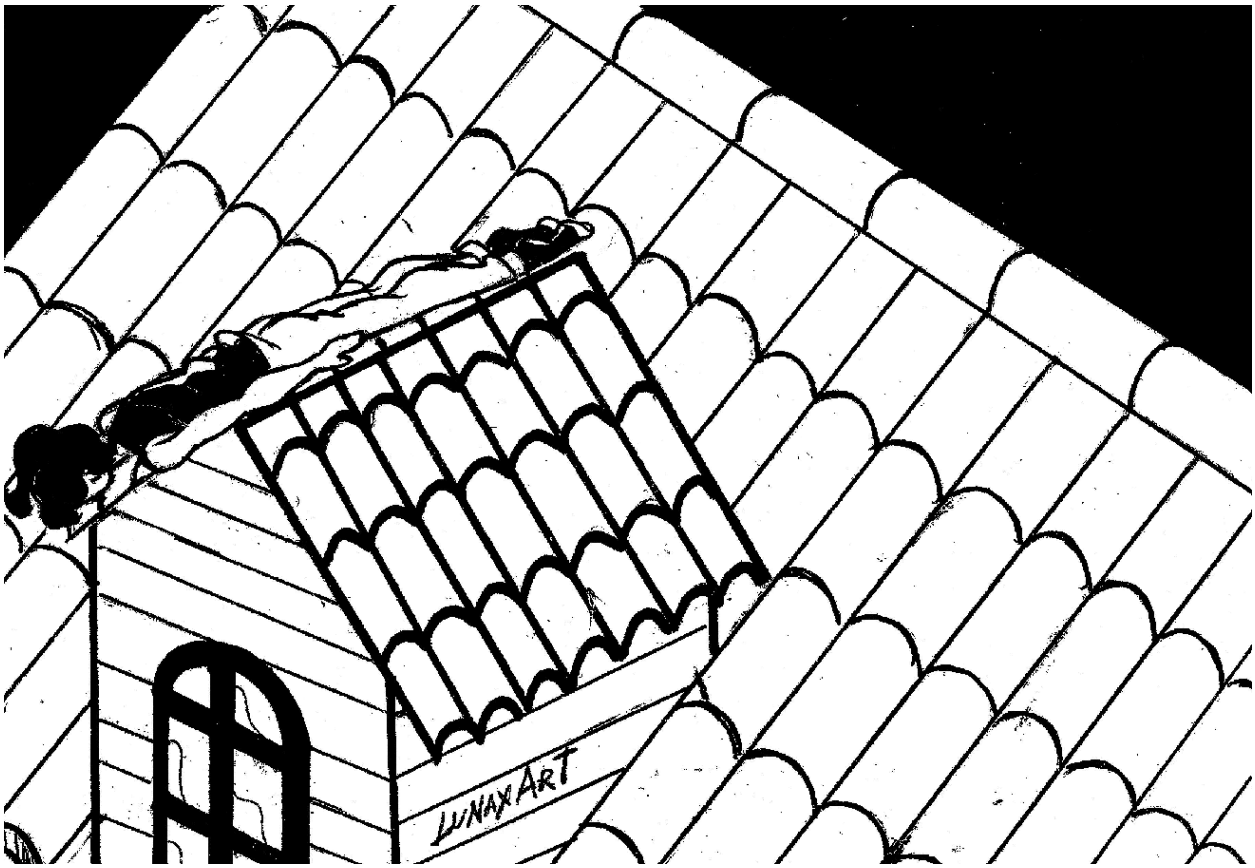


Figure 2. Planking on a balcony railing.

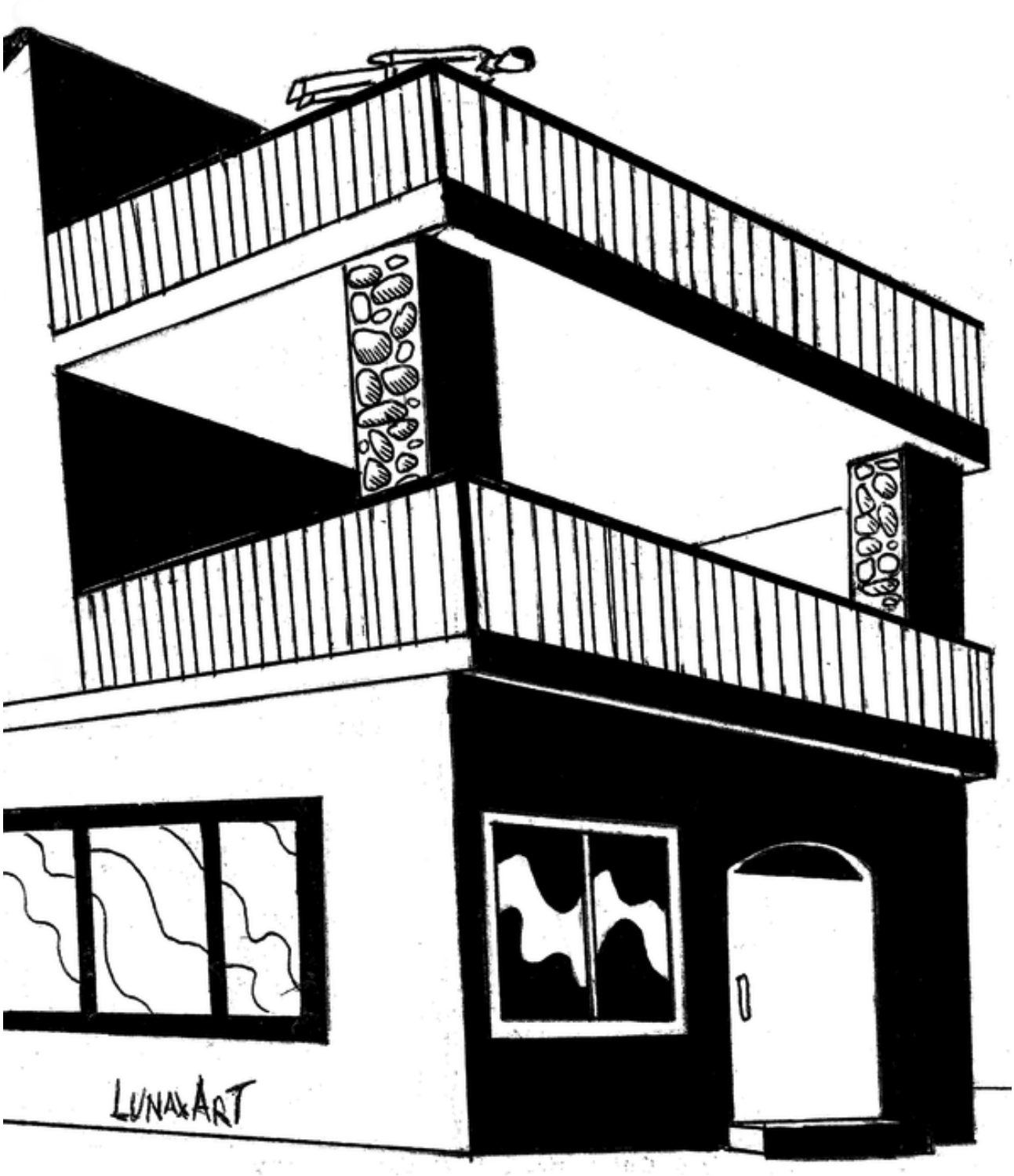
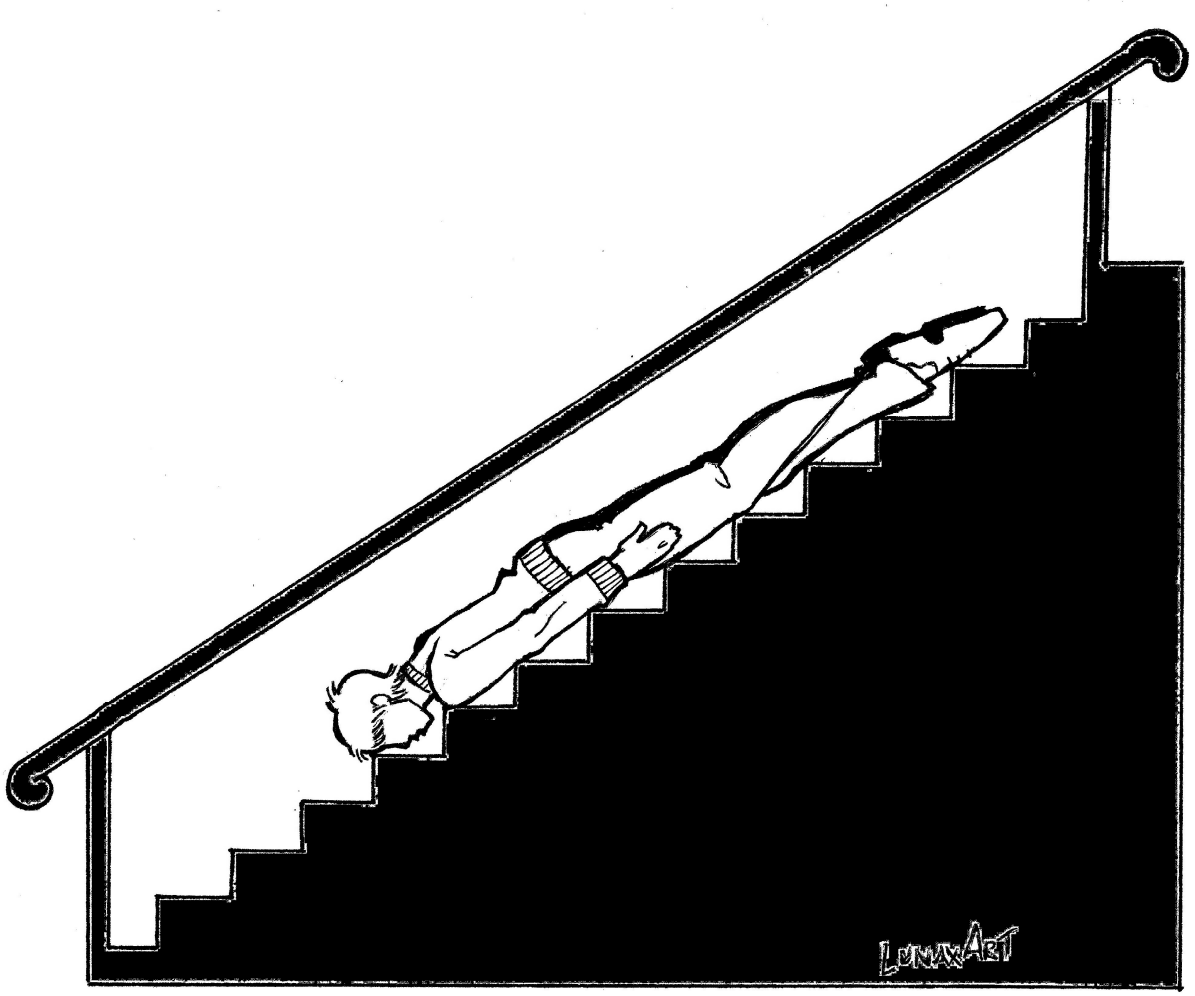


Figure 3. Planking or the lying-down game.



Methods

Details of the 2 case reports were taken from electronic medical records giving information on care support processes, care management, promotion of public and population health, and the costs of traumatic episodes. Demographic data, hemoglobin and serum lactate values, and Injury Severity Scores (ISSs) were evaluated. ISSs, an essential index of injury severity related to the risk of mortality, are reported to emphasize trauma pathways and costs. New opinions are introduced by physicians for additional care processing so that this preliminary health information could improve our knowledge of health care. The study took place in secondary schools of our city from 2013 to 2014 during medical education courses; during the lessons we analyzed the integration of social media on adolescents' activities and behaviors through discussions held in small groups of students with the authors' supervision. The results indicate that both multimodality and interactivity contribute to educational outcomes individually. Implications for educational strategies and future research directions have been discussed in previous studies [6-10].

Results

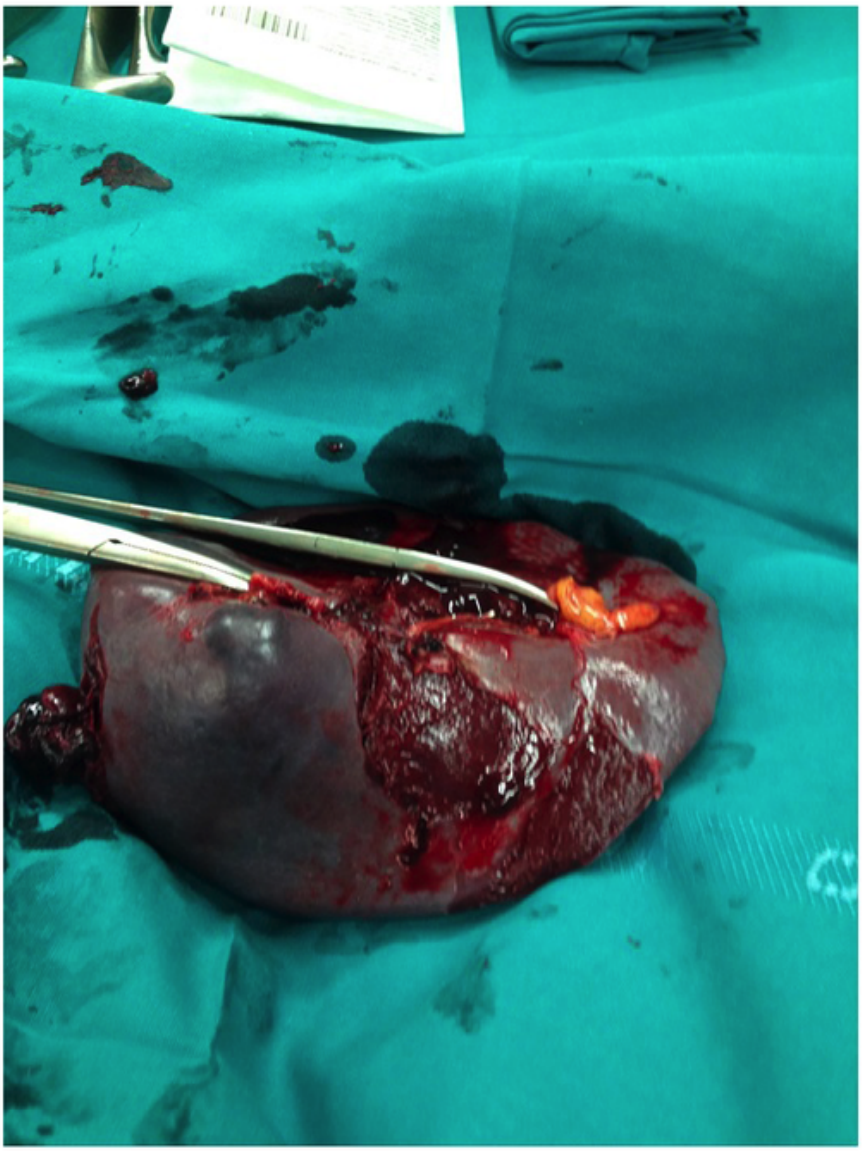
Internet profiles and information supplied by friends helped to determine the reasons for the place and position of the patient's fall, details of behavioral data, and any clinical effect of planking. Both accidents were the result of planking scenarios enacted by young people to enhance their status with their peers and included sharing pictures or videos through social networks. This attitude can be imitated by those who are deeply influenced by network sociality [5] and who feel challenged to undertake ever more extreme acts. The increasing popularity of photos in planking positions reveals the causes of injuries. We describe the cases of 17- and 18-year-old males who arrived at the ED with blunt abdominal and thoracic trauma injuries after planking accidents. Both patients were stable on arrival at the ED.

Case Report 1

An 18-year-old Italian boy was admitted to hospital after an accidental fall from a height of 5 meters. Neurological assessment revealed a Glasgow Coma Scale score of 14/15. On admission, blood pressure was 74/45 mm Hg, pulse 145 beats per minute, respiratory rate 32 breaths per minute, and hemoglobin concentration 8 g/dL. The report refers to an accident in which the boy was planking over a balcony; he

suddenly lost his balance and fell from a height of over 5 meters, first onto a canopy, which broke his fall to a certain extent, and then a further 2 meters to the ground. The dynamics were precipitation and the boy's semilateral or lateral left decubitus position during the impact. According to the splenic injury scoring system of the American Association for the Surgery of Trauma, the patient suffered a type III injury, with a subcapsular hematoma exceeding 50%, intraparenchymal hematoma exceeding 2 cm, and a 3-cm laceration through the splenic parenchyma. Classification of splenic injury was based on the rigorous definition of anatomic disruption [16]. Radiographs from the initial examination, which included chest, pelvis, and lateral and oblique cervical spine, were assessed together with radiographs of the specific sites of injury followed by laparotomy for blunt injuries. Abdominal sonography for trauma was used to investigate the splenic injury in the abdomen due to freed blood, and computed tomography (CT) scans were then taken. One hour later, due to sudden hemodynamic instability, sonography was repeated and found positive for trauma; surgical exploration was then decided upon. The subcapsular hematomas and parenchymal disruption of the spleen (Figure 4) were not discovered by ultrasound and did not result in a significant hemoperitoneum, but the subsequent focused abdominal sonography for trauma (Eco-FAST) scan with intravenous contrast helped diagnosis. Because of ongoing hemodynamic lability, the patient underwent emergency laparotomy. The severity of the case included blood accumulating in Morrison's pouch and in the pelvis and injury to the pancreas. The length of hospital stay was 14 days. The costs for patient 1, although trauma is generally underreported and depends on its severity, were €25,600 (approximately US $27,380) including laboratory and radiological work, intensive care unit stay, operating theater surgery, dialysis, and total costs of hospitalization.

Figure 4. Spleen removed through laparotomy.

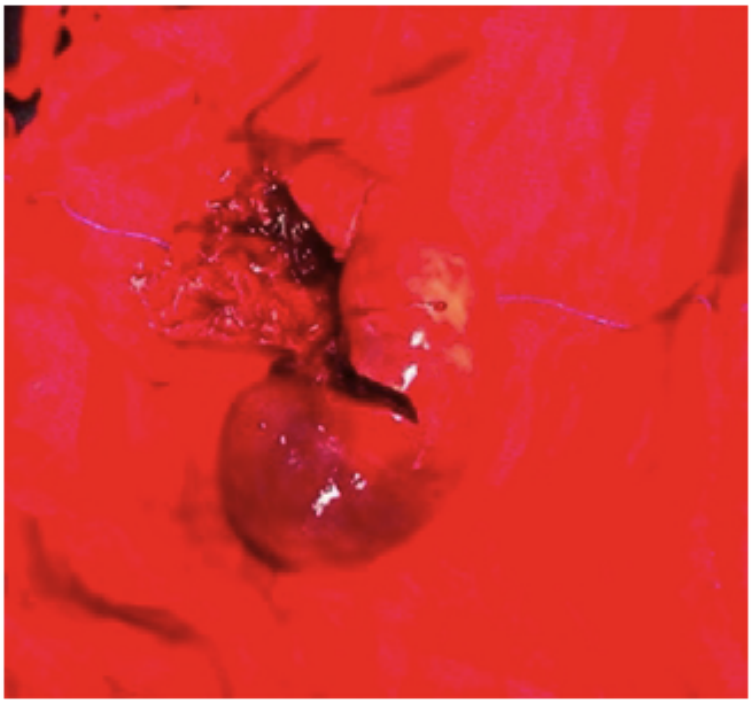


Case Report 2

A young male aged 17 was admitted to the ED. Initial vital signs were blood pressure 120/59 mm Hg, heart rate 133 beats per minute, respiratory rate 16 breaths per minute, and oxygen saturation as measured by pulse oximetry 97% on a nonrebreather mask. In the ED, vital signs were blood pressure 75/45 mm Hg, heart rate 145 beats per minute, respiratory rate 22 breaths per minute, and oxygen saturation (as above) 95%. Abdominal ultrasound and contrast-enhanced dynamic CT revealed a large retroperitoneal hematoma. The patient was submitted to surgery immediately and a left nephrectomy for acute hemorrhage due to full thickness perihylar laceration was performed. The mechanism of damage consisted of blunt renal trauma resulting from sudden deceleration, which affected the renal parenchyma and the vascular pedicle. This deceleration and the resulting hyperextension resulted in laceration and partial avulsion of the kidney at its proximal point of fixation. A preexisting renal abnormality decreased the possibility of salvage.

Figure 5 shows the parenchymal laceration extending through the renal cortex [17]. Hospital stay lasted 20 days. For patient 2, costs amounted to €35,000 (approximately US $37,440) including laboratory and radiological work, intensive care unit stay, operating theater surgery, dialysis, and total cost of hospitalization.

Figure 5. Full thickness renal perihilar laceration.



Discussion

Principal Findings

Trauma due to a fall from a height is a particular type of blunt trauma produced by rapid vertical deceleration and impact forces [12]. Such cases may include cervical spine fractures associated with other fractures of the thorax, scapula, bilateral upper arm, and/or pelvis [13-14]. Further internal damage may lead to delayed splenic rupture. Contusion of the spleen is characterized by the capsule filling with blood, and the opposite is true in the case of the kidney. Cases of spleen and kidney contusion differ greatly, due to their differing capsules; that of the spleen is thicker than that of the kidney, so blood keeps filling the capsule, producing a subcapsular hematoma. The cases reported here were critical but nonfatal accidents following falls by adolescents, representing “crazy” adolescent and young people’s behavior which may culminate in severe injury. See Textbox 1 for cases in which the exact location of planking may be a dangerous predisposing factor in determining unintentional injury.

Textbox 1. Location of planking accidents.

- Case report 1: Patient was planking on a roof, lost his balance, bounced off a canopy, and fell a total of 10 meters.
- Case report 2: Patient lost his balance, fell from a second floor balcony, turned over in the air and landed on his back, falling a total of 7 meters.

The importance of this point allows us to reflect more widely on various aspects of adolescents’ daily lives and lifestyles (Figure 6). These cases are focused on a specific context of wider academic research, and they suggest and support the development of a new important dimension for unanswered questions on the pitfalls of social network during dangerous

games. Ongoing audit will assess the impact and safety of the new blunt trauma related to planking phenomenon, new Web-based alcoholic games, biker roulette games, and the other challenge activities spread through the Web by the adolescents' virtual communities [6-10]. These samples are somewhat representative of most of the target population, and they represent an opportunity for future improvements in scientific works and performances of physicians, nurses, and sociologists. In writing this paper, we aimed at better understanding of the consequences of planking, which may be dangerous if it is done at heights or in potentially dangerous places (eg, higher than 5 meters or in or on such places as train tracks, crosswalks, public transport vehicles, canopies, terraces, balconies, roofs, curbs, street furniture). Adolescents feel the need to communicate emotions and actions, sometimes by performing rituals based on dangerous actions, in order to strengthen their social bonds with their peers. Our cases were similar to other reports describing patients after precipitation and were diagnosed as severe trauma. Based on a MEDLINE search of literature in English from 2000 to 2014, to the best of our knowledge, ours is the first case of trauma related to planking ever reported. Planking can be done in various ways, either by lying face down safely, or dangerously, perhaps while lying somewhere high up (descriptions of planking sites can provide important information on how the trauma-related injuries occurred, as in our 2 cases). The consequences of damage to the described organs generally reflect the magnitude of the height of fall, associated with extensive fractures of the upper and lower limbs and even more severe visceral injury to internal organs by direct impact [13]. Some activities are used as strategies to increase the number of followers, in line with the popular expression "big likes are on your mind day and night." For the new generation of adolescents, being popular means not only doing something that makes you appear older, stronger, and cooler than your friends in real life but also in virtual life on social networks, which are often equally important to adolescents in our society today. Good documentation of medical records is essential for reasons of economics. This study aims at enhancing greater insights in emergency and medicolegal teams, together with more knowledge about the influence of social networks on health care, which will expand to become an integrated clinical practice [6-10]. Planking is a relatively new phenomenon and has already attracted the interest of many adolescents [8]. Proliferation of new activities and games, presented in videos via the Web, can influence adolescent behavior; in planking, they result in photos in which an individual lies face down in unusual public spaces (Figure 7).

The Klout score is tangible proof of the effect of the Internet on adolescent lifestyle; this social network service offers tailored statistical analysis of social media. In particular, it estimates the influence of users through a score (0-100), ranging from the degree of interaction in user profiles of similar popular sites (eg, Twitter, Facebook, Google+, LinkedIn, Foursquare). A Klout score can be obtained on the extent of the network, its users, the content generated, and the feedback level obtained [9]. The cases we describe essentially define how planking may be dangerous; we report the possible severity of planking-related injuries and identify specific accidents and influencing factors. It is difficult to see how effective prevention measures could be defined, although restricted access to certain websites may be one option. Our findings have important implications in terms of insurance and changes in cause-specific injuries and intent-specific groups which may reflect differences in trauma coding. Intentional and unintentional injuries due to planking are more likely to be seen by ED personnel, although there are differences in how trauma data is coded (misclassification of cause-specific and intent-specific injuries). Improving the documentation of the circumstances of an injury-causing event is essential for prevention purposes, and many new categories could be added for falls: these 2 facts have particular implications for injury prevention. The safety of ED care has been identified as strategic in clinical practice in children and adolescents. There are few epidemiological reports in the literature, compared with the amount of data available on adults falling from heights, and proper comparisons of experiences and solutions applied in varying organizational contexts is urgently needed [12-14]. In this work, the direct costs of the 2 accidents are described: the costs of treatments in the trauma room, any fluid and blood replacement therapy, surgeries, treatments in the intensive care unit, and the human capital approach. This value is calculated based on individual injuries, but a standardized approach to economic evaluation is needed to further prioritize mainly regarding the investing in injury prevention. This study does not compare the costs for these cases and the economic aspects of trauma-related planking, but the authors propose to examine this in detail in future studies.

Figure 6. Planking may be performed in both safe and unsafe locations, the latter being associated with falls and injuries.

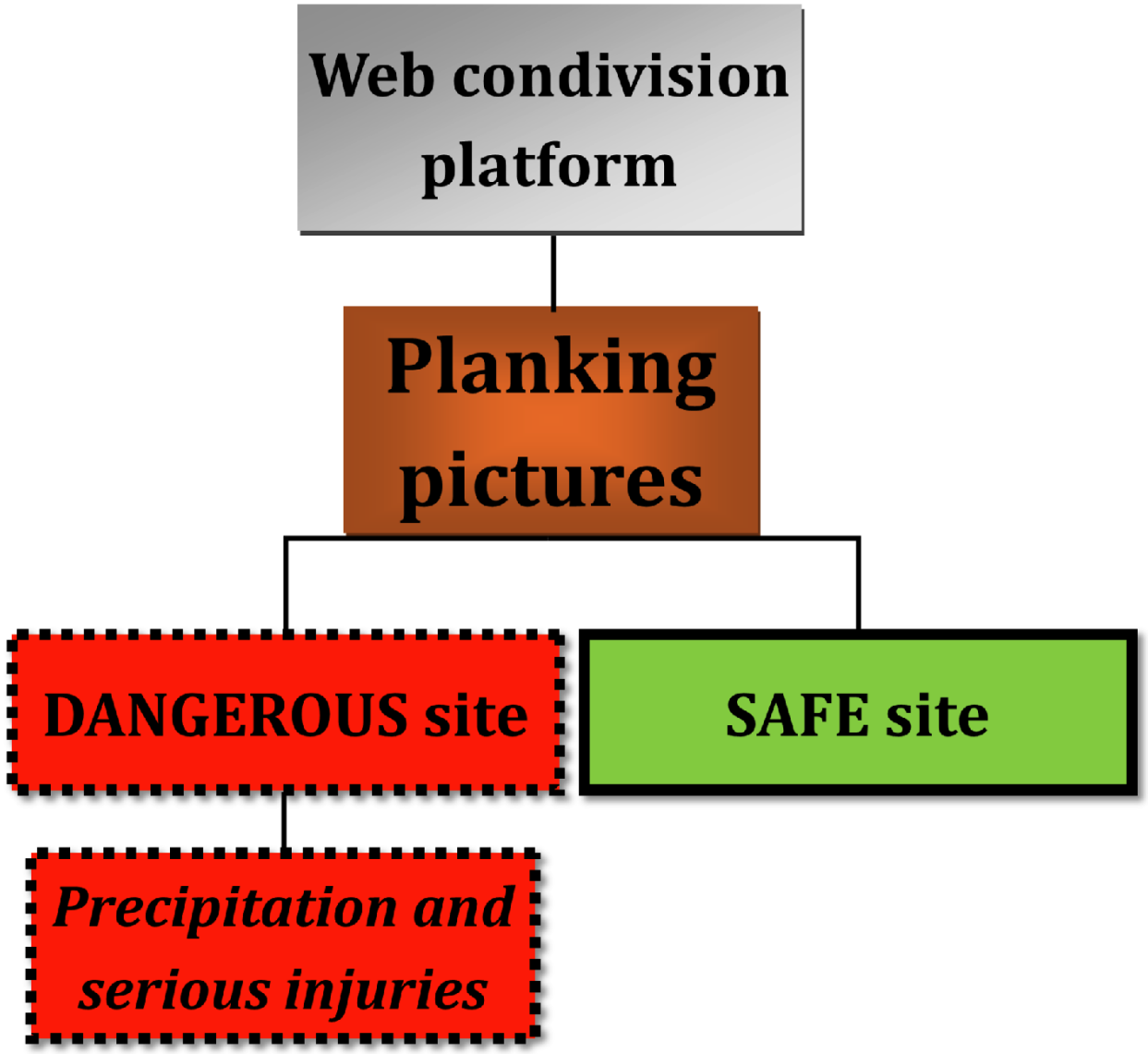
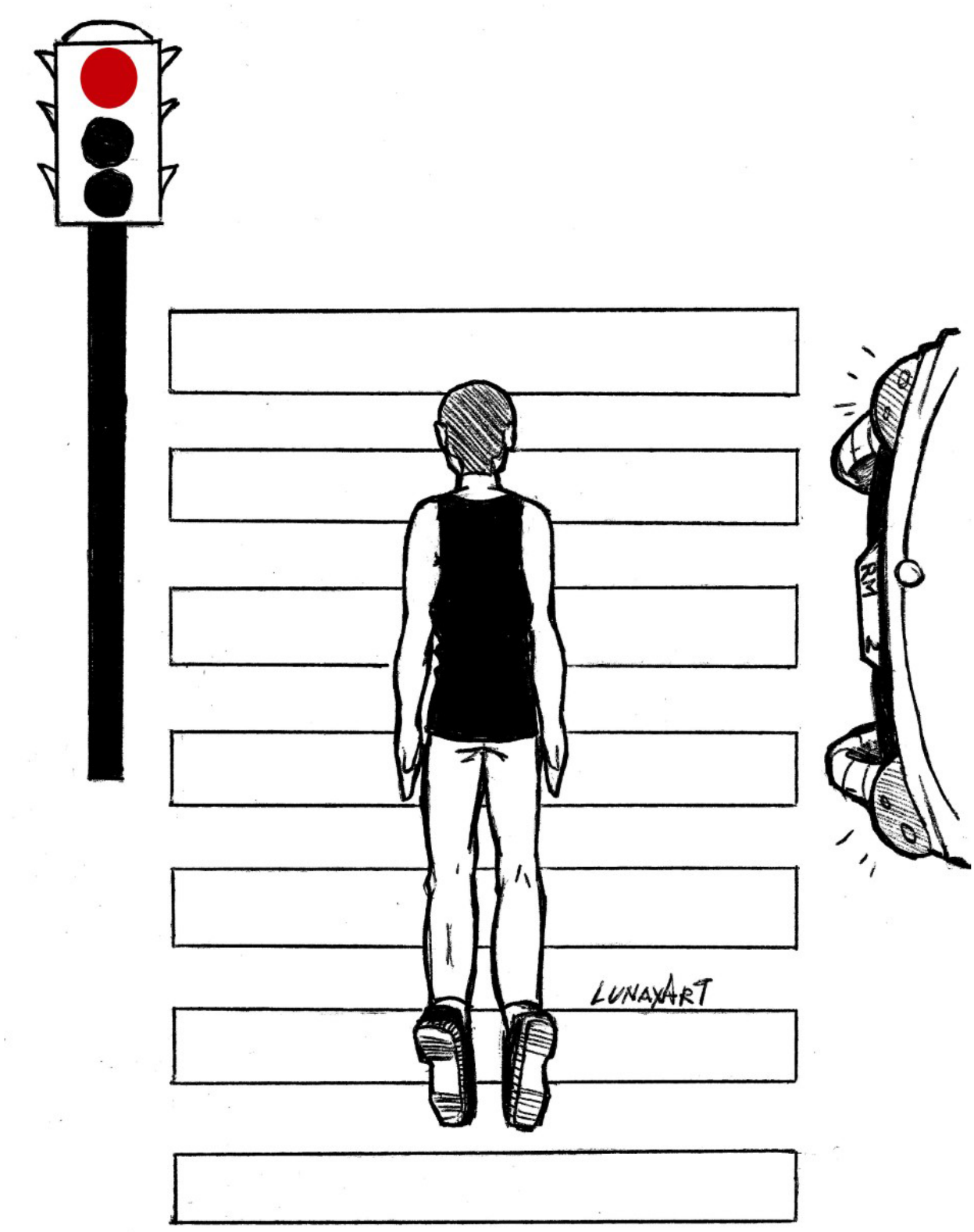


Figure 7. Planking on the street.



Limitations

This study has several potential limitations. First, these 2 participants were interviewed once but we examined cases reported in journals, available online, concerning high-risk social web activities. Second, case reports that may generate hypotheses for future clinical studies are in progress (a continually updated cases database, for example). Third, the authors know that no published studies have been conducted but similar data, such as that presented in this work, can be

further analyzed in future research. Fourth, this paper serves as an important first step to help to develop a broader area of research, and it underscores several critical situations that have not been presented in official medical databases. Last, very little is known about the psychosocial variables associated with these problematic behaviors, but they represent an emerging mentoring dynamic which is understudied.

Directions for Future Research

More research is needed in this area. The accidents that occurred during planking activities and the key aspects of influences due to the participation in other activities (eg, drinking games, drinking challenges, planking posted on the Web in different situation and in different areas, neknominations, Web nominations) suggest several critical implications for public and professional education researchers. It is crucial for ED physicians to implement the most effective control measures to reduce the risks associated with fall at heights following challenges to the lowest possible level. Currently, there is no standard definition of planking falls. Falls during planking activities represent an accidental situation related with an incorrect perception of the risks or with an overestimating performance during dangerous activities.

Conclusions

The injuries and distribution of fractures in the planking falls analyzed here probably originated from the lateral orientation of the body at the moment of impact. Our results highlight the need for further study of the influence of planking in cases of accidental falls from various heights. Previous consumption of alcohol is another problem linked to fatal falls that has not yet been reported for planking. By analyzing injury data, we can identify appropriate types of community prevention approaches, focusing on interventions implementing social changes. Community medical health initiatives may be successful in reducing unintentional injuries; public health begins with the description of a problem and continues with accurate data acquisition, description of injuries and their risk factors, and then builds a surveillance report with the newly acquired data from patients in ED. Several studies have shown that injuries sustained in children after falls are associated with better outcomes, as children have more flexible skeletons, relaxed muscle tone, and a greater proportion of body fat. In clinical and forensic medicine, injuries resulting from falls often become the basis for extensive investigations and autopsy results [13,15]. The general public should receive more information about the new risk of injury and the changing concept of safe behavior by adolescents [6,10]. Education could include information about health programs for adolescents, educators, physicians, and parents. For example, adults should demonstrate positive—and legally compulsory—behavior, always using seat belts while in a car and wearing crash helmets when cycling or biking, but increased knowledge of social network influences is also necessary for the new activity of planking, since this game can involve accidental falls from heights. Decisions on the entire trauma care process should be taken according to a multidisciplinary approach. This paper gives a general overview of the phenomenon of unintentional Web-related trauma and the need for proper education, as human factors contribute 95% to traumatic accidents. Health education and enforcement of legislation are key measures in the implementation of effective strategies.

Key points:

- Internet and social networks are rapidly becoming new ways of communication among adolescents, who change their lifestyles in order to make themselves appear more interesting to their peers, and can potentially influence their behavior. This also involves extreme acts such as planking.
- Planking consists of lying face down on a surface and trying to stay still in balance.
- Planking can sometimes lead to various kinds of trauma, and medical professionals must be aware of these games and practices.

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Conflicts of Interest

None declared.

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Abbreviations

CT: computed tomography
ED: emergency department
Eco-FAST: focused abdominal sonography for trauma
ISS: Injury Severity Score

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Original Paper

Evaluating YouTube as a Source of Patient Education on the Role of the Hospitalist: A Cross-Sectional Study

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Abstract

Background: Hospital medicine is a relatively new specialty field, dedicated to the delivery of comprehensive medical care to hospitalized patients. YouTube is one of the most frequently used websites, offering access to a gamut of videos from self-produced to professionally made.

Objective: The aim of our study was to determine the adequacy of YouTube as an effective means to define and depict the role of hospitalists.

Methods: YouTube was searched on November 17, 2014, using the following search words: “hospitalist,” “hospitalist definition,” “what is the role of a hospitalist,” “define hospitalist,” and “who is a hospitalist.” Videos found only in the first 10 pages of each search were included. Non-English, noneducational, and nonrelevant videos were excluded. A novel 7-point scoring tool was created by the authors based on the definition of a hospitalist adopted by the Society of Hospital Medicine. Three independent reviewers evaluated, scored, and classified the videos into high, intermediate, and low quality based on the average score.

Results: A total of 102 videos out of 855 were identified as relevant and included in the analysis. Videos uploaded by academic institutions had the highest mean score. Only 6 videos were classified as high quality, 53 as intermediate quality, and 42 as low quality, with 82.4% (84/102) of the videos scoring an average of 4 or less.

Conclusions: Most videos found in the search of a hospitalist definition are inadequate. Leading medical organizations and academic institutions should consider producing and uploading quality videos to YouTube to help patients and their families better understand the roles and definition of the hospitalist.

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KEYWORDS

YouTube; hospitalist; patient education

Introduction

Hospitalist is a physician who specializes in delivering comprehensive medical care to hospitalized patients after receiving training in general internal medicine, general pediatrics, or family practice; however, he may also receive training in other medical disciplines [1,2]. Hospital medicine is a relatively new and evolving specialty field, dedicated to the delivery of comprehensive medical care to hospitalized patients.

The term “hospitalist” was first described in literature by Wachter and Goldman in their article, The Emerging Role of “Hospitalists” in the American health care system [1]. They described this new specialty, its emergence, and their perspectives to the future. Now, hospital medicine is one of the fastest growing medical specialties. This rapid growth could be explained by the decreased length and cost of hospital stay under hospitalist care [3-7]. One study based on Medicare claims that its data showed an increase in the number of physicians

identified as hospitalists from 5.9% to 19% between 1995 and 2006 [8]. The Society of Hospital Medicine defines a hospitalist as a physician who specializes in the practice of hospital medicine [2]. The role of the hospitalists has evolved over time, and it includes providing high-value care for hospitalized patients, conducting quality improvement projects, and adopting leadership roles, which have a positive impact on patients' outcomes in terms of length and cost of hospital stay as well as readmission rates [1,9-11]. The perceived benefits have driven other specialties to adopt the hospitalist model [12].

As an emerging specialty, hospitalists face the difficulty of building a strong doctor-patient relationship. Building a rapport with patients is very important in clinical practice, as it enhances information gathering needed for diagnosis and is important for the shared-decision making process [13,14]. The hospital encounter is a short period to achieve this goal and patients lack insight into the role of a hospitalist. Furthermore, the communication barriers between the patient's primary care physicians and the hospitalists can interrupt the ongoing doctor-patient relationship in the inpatient and outpatient settings [13]. This interruption in patient-provider relationship may result in lack of adequate communication and missing important information affecting patients' outcome [15-18]. Unfortunately, few primary care and emergency department physicians inform patients about hospitalist coverage during their hospitalization [18,19]. This knowledge gap among patients can impede the therapeutic relationship and in turn negatively affect the patients' outcome and liability risk [20-22].

The term "hospitalist" remains ambiguous to a majority of first-time hospitalized patients and their families. Because the Internet has become a popular source for health care information [23,24], we believe that people may search the Internet for the term "hospitalist" to clarify or obtain further information on physicians practicing this specialty. Similarly, hospitalized patients and their families are more likely to search the Internet for "hospitalists" in view of the current trend of shift from primary care physician to different inpatient provider in an era of easily accessible Internet on portable electronic devices. One study estimated that up to 70% of Internet users in the United States utilize the Internet for health-related searches [25,26]. Among the search engines, YouTube is the second largest after Google [27]. Over 6 billion hours of videos are watched each month on YouTube [28]. The video-based forum offers access to a gamut of self-produced and professionally made clips that have been uploaded and shared by individuals and groups. The accuracy and quality of contents of such videos vary widely. To our knowledge, there are no studies in the literature that highlight the overall usefulness of social media such as YouTube videos' content in educating patients and families on hospital medicine and the role of the hospitalist. We sought to determine the adequacy and quality of using YouTube videos by the public as a way to define and depict the role of hospitalists.

Methods

YouTube was searched on November 17, 2014, using the following search terms: "hospitalist," "hospitalist definition," "what is the role of a hospitalist," "define hospitalist," and "who is a hospitalist." Videos found only in the first 10 pages of each search were included. A total of 855 videos were found. Non-English, noneducational, and nonrelevant videos were excluded, including the videos that lacked sound or were longer than 20 minutes. Duplicate videos were counted as one video. Using the inclusion criteria, we selected 102 videos for analysis. Selection process is depicted as a flowchart in Figure 1.

The selected videos were categorized according to uploader type (personal, academic institution, nonacademic institution, health advertisement, or news report); video category as per the YouTube classification (nonprofits & activism, people & blogs, science & technology, education, news & politics, and entertainment); and medical specialty (internal medicine, pediatrics, family medicine, obstetrics and gynecology, and others). We also collected the following information for each video: title, duration, number of views, likes and dislikes, upload date, and number of comments.

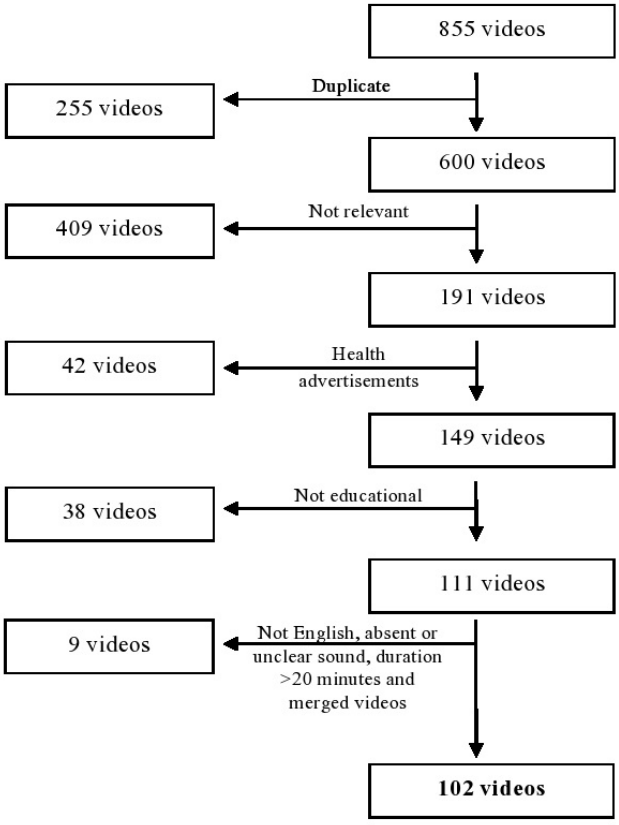
Next, a novel 7-point scoring tool was created by the authors based on the definition of a hospitalist adopted by the Society of Hospital Medicine (Table 1). Each measure describes an aspect or a characteristic role of hospitalists. The contents of the videos were evaluated based on the presence of the 7 measures depicted in the tool (Table 1). The information presented in the videos showed the appropriate implication depicted by the Society of Hospital Medicine's definition for each measure to be eligible for a point. Three independent reviewers evaluated and scored the videos. The mean scores were used to classify the videos into high, intermediate, and low quality in defining hospitalists and their roles. A video was rated high if the average score was 5 or greater, intermediate for 3 or 4 points, and low quality for 2 or fewer.

Data were analyzed using SAS software version 9.4 (SAS institute Inc). We used the measure of central tendencies to express descriptive statistics. Data are presented as mean (SD). An intraclass correlation coefficient (ICC) was used to assess the reviewers' performance.

Table 1. The 7-point scoring system to assess the quality and accuracy of the videos.

Quality and accuracy measure	Points
Defining the hospitalist as a physician who specializes in the practice of hospital medicine	1
Eligibility defined by residency training in general internal medicine, general pediatrics, or family medicine, but may also receive training in other medical disciplines	1
Prompt and complete attention to all patient care needs including diagnosis, treatment, and the performance of medical procedures (within their scope of practice)	1
Employing quality and process improvement techniques	1
Collaboration, communication, and coordination with all physicians and health care personnel caring for hospitalized patients	1
Safe transitioning of patient care within the hospital and from the hospital to the community, which may include oversight of care in postacute care facilities	1
Efficient use of hospital and health care resources	1

Figure 1. Flow diagram for selection of videos.



Results

A total of 102 videos out of 855 were identified as relevant and included in the analysis. Videos were categorized by the source of uploader into nonacademic institution (private hospitals and hospitalist groups; 55.9%, 57/102), news reports (24.5%, 25/102), academic institutions (8.8%, 9/102), personal (5.9%, 6/102), health advertisements (3.9%, 4/102), and others (online medical dictionary explaining the word hospitalist; 1.0%, 1/102).

After using our novel scoring tool, videos were classified into high, intermediate, and low quality. The average scores of the 3 reviewers (TH, MB, and MP) were 2.52, 3.46, and 3.36, respectively; the total average score for the 3 reviewers was 3.11 (SD 1.19). The interobserver agreement between the 3 reviewers showed an ICC of .809 (P<.001). Of the videos from all categories, 6 were classified as high quality, 53 as intermediate quality, and 42 as low quality, with 82.4% (84/102) of the videos scoring an average of 4 or less (Figure 2). The mean score of all videos was 3.11 (SD 1.19) with a minimum score of 0.33 and a maximum score of 6.0. The average number of views for the videos was 440.9 hits (SD 1401) with an average of 0.97 likes and 0.069 dislikes. The average duration of the videos was 3:17 minutes. Videos were uploaded between the years 2008 and 2014.

Videos uploaded by academic institutions had the highest mean score of 3.37 (SD 0.73) and those uploaded by health

advertisements and other media had the lowest. Table 2 shows the frequency and percentage of each category. Among the 7 scoring points of our scoring tool, point 3 addressing the hospitalist role in patient care including diagnosis, treatment, and the performance of medical procedures was seen most frequently on the videos. On the other hand, points 4 and 7 in our scoring tool were detected the least. These points addressed the hospitalists' involvement in collaboration, communication, and coordination of care to hospitalized patients and the efficient utilization of health care resources, respectively. Figure 3 shows the average frequency of each point of the scoring tool.

Videos were analyzed based on the YouTube category system. The videos came under the following 6 categories: Education (37.3%, 38/102), Science & Technology (32.3%, 33/102), People & Blogs (16.7%, 17/102), Nonprofits & Activism (9.8%, 10/102), News & Politics (2.9%, 3/102), and Entertainment (1.0%, 1/102). Figure 4 depicts the category distribution of the videos and the average scores by each category. The highest average score was for Nonprofits & Activism, and the lowest score was for Entertainment.

Next, we analyzed videos based on the specialty of hospitalist: internal medicine (75.5%, 77/102), pediatrics (12.7%, 13/102), Obstetrics and gynecology (6.9%, 7/102), family medicine (2.0%, 2/102) and others that included surgery and cardiology (2.9%, 3/102). Figure 4 demonstrates the specialty distribution and average scores by specialty.

Table 2. Source of the video.

Type of uploader	Frequency (N=102), n (%)
Nonacademic institutions	57 (55.9)
News reports	25 (24.5)
Academic institutions	9 (8.8)
Personal	6 (5.9)
Health advertisements	4 (3.9)
Other media	1 (1.0)

Figure 2. Frequency distribution of video scores.

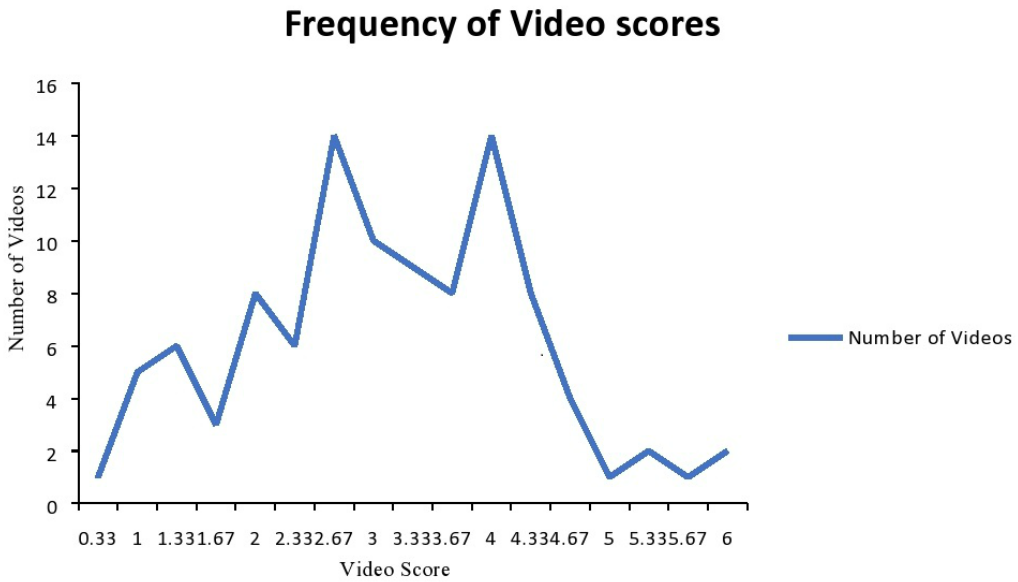


Figure 3. Average usage of the 7 scoring points.

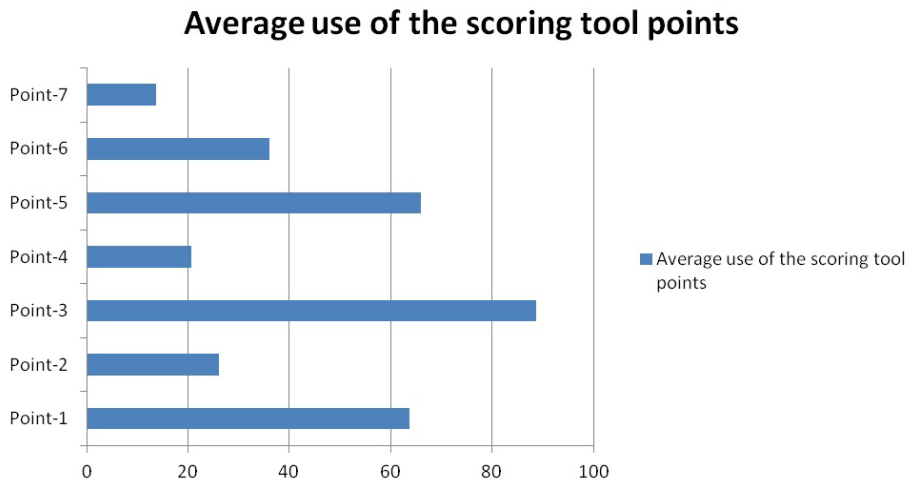
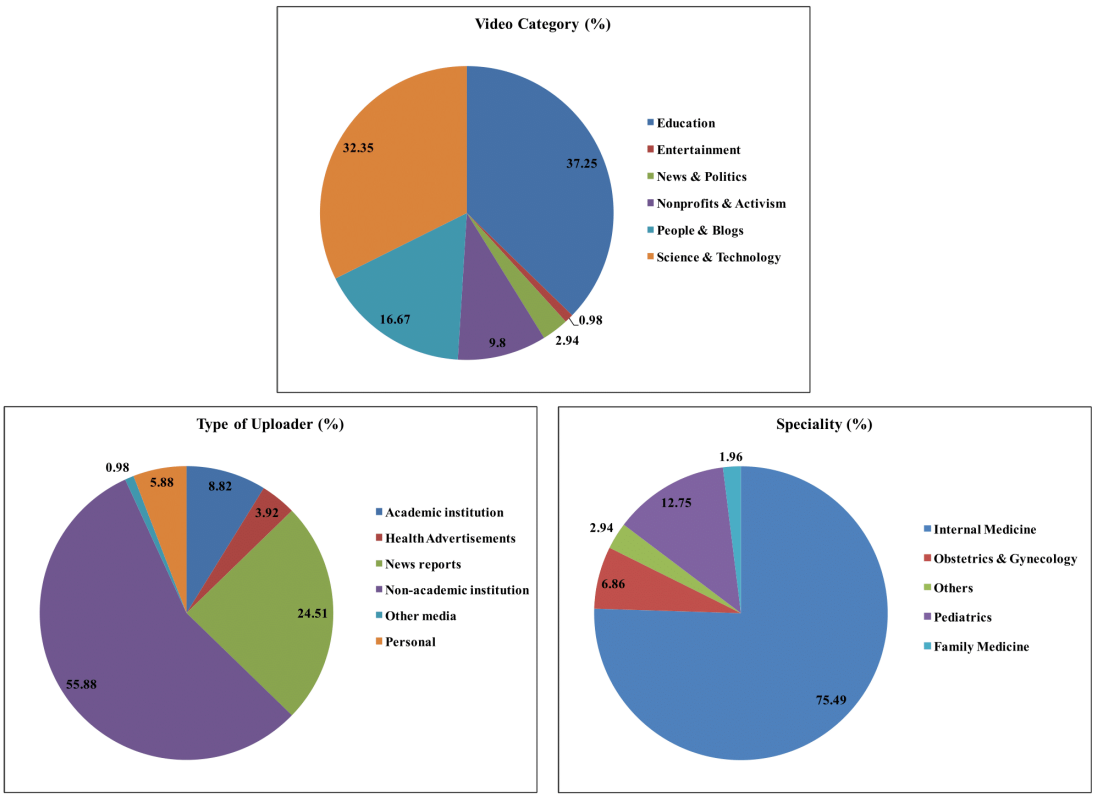


Figure 4. Distribution of the videos by video category, specialty, and source.



Discussion

Principal Findings

Health care information available in social media websites, such as YouTube, Facebook, MySpace, and Twitter, include accounts of personal illnesses, disease support groups, medical breakthroughs, updates in health and disease, journal articles, and clinical support tools for laypersons and health-related professionals [23,24]. Social media use has been increasing due to the advantages of its low cost, ease of publication, and interaction with a large community. Among the many types of social media and websites, YouTube remains the fastest growing. YouTube is considered the second most viewed website on the Internet [29]. Also, YouTube is the most visited and popular website for video-sharing in the United States for obtaining information. It is increasingly used as a platform to disseminate health care information and patient education. However, because there has been no quality check, the information that is available on YouTube can provide contradicting or misleading information to the layperson. Keelan et al [30] were among the first to analyze the quality of health care information in YouTube. Since then multiple studies have

been published addressing the efficacy and quality of medical contents of the YouTube videos. To our knowledge, ours is the first study to assess the accuracy and usefulness of YouTube content in defining the role of hospitalists.

Hospital medicine is a relatively new specialty, leading patients and their families to potentially be puzzled the first time they encounter a hospitalist. The doctor-patient relationship forms the basis for optimal therapeutic and patient satisfaction outcomes [31,32]. With the increasing use of this specialty in hospitals, the patient experience is at jeopardy unless patients have made an informed decision to work with this new provider during the times of their utmost need. We believe that patients and their families do not fully understand the roles of this specialist, and they may search for further information on the Internet, particularly video-format sharing websites like YouTube. We conducted this study to evaluate the credibility of YouTube as a source of patient education on the role of the hospitalist.

YouTube has been used for providing health related information, but studies on YouTube contents have been published on only a few topics such as vaccination [30,33], tobacco use [34], breast-feeding [35], the influenza pandemic [36], basic life support [37], and acute myocardial infarction [38]. These studies show that health information found on YouTube can be misleading. A recent analysis was conducted to identify the measures used in studies assessing the quality of YouTube videos [39]. The study showed that multiple measures are used to evaluate the quality of video information including expert-driven, popularity-driven, or heuristic-driven measures. The authors finally concluded that caution should be applied when using YouTube for patient educational materials [39].

Our study shows that most uploaded videos were posted by media or as part of a news report and not related to any professional society, that is, mainly from the nonacademic institutions. Almost one half of the videos found on the primary search were deemed nonrelevant. Of the videos deemed relevant, none included all 7 points of our rating scale to completely define hospitalists and their roles. Most videos did not include the following points from our scoring tool: hospitalist involvement in quality improvement, efficient utilization of health care resources, and the qualifications required to become a hospitalist (Figure 3). A significant number of videos that described the hospitalist were uploaded solely to advertise hospitals or recruit hospitalists. However, videos uploaded by academic institutions received the highest mean score of 3.37 (SD 0.73), indicating a potential role for such institutions in using social media to provide an accurate definition of hospitalists and their roles. Kelly et al, [40] in their study of the content of YouTube in regard to nursing identity, showed similar results to our study. The authors concluded that professional bodies need to act to protect the nurses' identity, representation, and job descriptions. Our study identifies the importance of social media websites and their potential usefulness for disseminating accurate information about the definition of hospitalist. During the process of hospital admission, the health care provider should communicate the definition and role of the hospitalist in providing and coordinating patient care to the patient and family. Video-sharing websites could serve as a powerful platform for dissemination of information on hospital medicine and the hospitalist.

Study Limitations

This is a cross-sectional study. Content on YouTube changes constantly and more videos are uploaded daily. Furthermore, video optimization and analytics may also alter the search results. Also, this data is from a single video-broadcasting website on the Internet. The external validity of such data may be affected and may not project the scenario over the Internet as a whole.

Conclusions

Most videos found in the search of a hospitalist definition are nonrelevant. Our study indicates the inadequacy of using YouTube as a tool in defining the role of hospitalists without some guidance in directing search engines toward the higher quality videos. Patients and families need to be cautious when using YouTube as a source for health-related information. Leading medical organizations and academic institutions should consider guiding the process of producing and uploading quality videos to YouTube to help patients and their families better understand the roles and definition of the hospitalist.

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Conflicts of Interest

None declared.

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Original Paper

Using eHealth Technologies: Interests, Preferences, and Concerns of Older Adults

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Abstract

Background: The Internet and eHealth technologies represent new opportunities for managing health. Age, sex, socioeconomic status, and current technology use are some of the known factors that influence individuals' uptake of eHealth; however, relatively little is known about facilitators and barriers to eHealth uptake specific to older adults, particularly as they relate to their experiences in accessing health care.

Objective: The aim of our study was to explore the interests, preferences, and concerns of older adults in using the Internet and eHealth technologies for managing their health in relation to their experiences with the current health care system.

Methods: Two focus groups (n=15) were conducted with adults aged 50+ years. Pragmatic thematic analysis using an inductive approach was conducted to identify the interests, preferences, and concerns of using the Internet and eHealth technologies.

Results: Five themes emerged that include (1) Difficulty in identifying credible and relevant sources of information on the Web; (2) Ownership, access, and responsibility for medical information; (3) Peer communication and support; (4) Opportunities to enhance health care interactions; and (5) Privacy concerns. These findings support the potential value older adults perceive in eHealth technologies, particularly in their ability to provide access to personal health information and facilitate communication between providers and peers living with similar conditions. However, in order to foster acceptance, these technologies will need to provide personal and general health information that is secure, readily accessible, and easily understood.

Conclusions: Older adults have diverse needs and preferences that, in part, are driven by their experiences and frustrations with the health care system. Results can help inform the design and implementation of technologies to address gaps in care and access to health information for older adults with chronic conditions who may benefit the most from this approach.

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KEYWORDS

Internet; telemedicine; self care; chronic disease

Introduction

Canadians aged 65 years and older currently represent 14% of the population, and this proportion is expected to increase to approximately 25% by 2036 [1]. In 2011, 3 of 4 Canadian seniors reported having at least one chronic condition, and 1 in 4 reported having 3 or more chronic conditions [2]. The burden of chronic disease on the health care sector and society as a whole has an effect on increased costs, reduced patient function, and poorer quality of life [3]. There is also a trend toward a higher incidence of chronic diseases such as diabetes in younger age groups. For example, those in the 45 to 64 years age range represented almost half (48%) of incident cases of diabetes in Canada in 2009 [4].

Ongoing management of chronic conditions requires considerable effort, time, and energy by patients and often family members [5]. This is largely because what individuals do between clinic visits will impact their health far more than what happens in the doctor's office [6]. eHealth technologies such as personal health records (PHRs) and remote monitoring tools can potentially support self-management efforts on a wide scale. For example, PHRs linked to electronic health records (EHRs) give individuals secure access to their personal health information (PHI), and in some cases provide direct access to their care team. For people living with chronic diseases, up-to-date health information and easier access to providers can empower them to learn more about their health conditions, take more responsibility to better manage their health, communicate more efficiently and effectively between visits, and ultimately experience better health outcomes [6].

Recent estimates have shown that 22% (nearly 1.5 billion) of people worldwide use the Internet regularly [7], with older adults representing the group with the highest rates of increase in the past decade [8]. However, increased Internet use has not yet translated into greater use of eHealth technologies in chronic disease populations [9,10]. One challenge has been to design systems that are accepted and used effectively by older adults, which should include features for ongoing monitoring, interpretation of PHI, and recommendations [9,11-14]. Sociodemographic factors including age, sex, and socioeconomic status [15-24], and a lack of user-friendly interfaces have been identified as key barriers to eHealth uptake in older populations [25]. However, no studies have qualitatively explored the relationship between older individuals' experiences with the health care system and their needs and preferences for using the Internet and eHealth technologies for managing their health. These experiences are important to consider as this age group represents the highest users of the health care system [1] and have the most to gain from tools that can facilitate the management complex comorbidities often found in aging populations. Preferences for entering, maintaining, and disclosing portions of their medical record, and considerations required to adapt Internet resources and eHealth technologies to sustain interest over time remain understudied [26]. Although identified barriers include limited computer literacy, computer anxiety, cognitive impairment, health literacy, and physical impairments [27], features that help to both motivate and sustain self-management efforts in older adults remain largely unexplored.

Therefore, the goal of this study was to learn more about the interests, preferences, and concerns of adults aged 50+ years regarding use of the Internet and eHealth technologies to manage their health in relation to their experiences with the current health care system. The age range was chosen to focus on a segment of the population who have or are at higher risk of developing chronic conditions.

Methods

Definitions

We defined eHealth as any technology which enables the performance of a health-related task, either accessible on the Web or enabling a Web-based information exchange (eg, health portals, software connecting to the Internet, and mobile apps). Health-related tasks were broadly defined as any activity related to health behavior change, enabling health information exchange, or health-related administrative-type tasks (eg, e-booking of medical appointments).

Interview Guide Development

First, a scoping review was conducted to identify knowledge gaps around factors that impact use of the Internet and eHealth technologies. The following databases were searched: Cochrane (1977-2012), MEDLINE (1970-2012), EMBASE (1980-2012), and CINAHL (1970-2012) using combinations of MeSH terms and keywords including chronic disease, technology, self-efficacy, health attitudes, and health promotion. The literature search yielded a list of candidate domains that were reviewed by content experts (IS, SA) for relevance. Focus group questions were generated using Kruegar guidelines [28] and included the following: (1) Have you ever accessed your health record/medical chart? (2) Do you know whether you have access to your personal health record? (3) Do you think you would use a website where you could login and access your electronic health record/medical chart? (4) How would you feel about sharing your health information and your health problems with your clinical team via this web portal? (5) How would you feel about receiving advice based on your symptoms via a web portal? and (6) What would further entice you to manage your health through the use of an electronic health chart?

Recruitment

To recruit participants, posters were placed in rehabilitation clinics and community organizations in a large urban city in Quebec, Canada inviting adults aged 50 years and older to participate. Participants both with and without chronic diseases were included to explore the use of the Internet and eHealth technologies for the prevention and management of chronic diseases.

Focus Groups

Two focus groups were conducted, each lasting 2 hours, which were led by a trained member of the research team. An assistant was present to take notes, provide clarifications, and summarize key points throughout the session. All sessions were audio taped.

Data Analysis and Theme Development

Audio files were transcribed and compared with the original recordings to verify accuracy. Three reviewers (SA, SB, and PW) conducted a pragmatic thematic analysis [29] independently to identify themes [29]. Themes were compared and differences were discussed and reconciled. Similar subthemes were combined to provide an encompassing theme.

Results

Study Participants

Participants were 15 adults who were mostly female (73%, 11/15) with a mean (SD) age of 67 (10); see Table 1). Eight (53%, 8/15) had completed high school and the remaining were university educated. Almost all (87%, 13/15) reported regularly using the Internet at home or elsewhere (eg, public library) and 12 (80%, 12/15) reported having 1 or more chronic diseases.

Focus Group Themes

Five themes were identified: (1) Difficulty identifying credible and meaningful sources of information on the Web; (2) Ownership, access, and responsibility for medical information; (3) Peer communication and support; (4) Opportunities to enhance health care interactions; and (5) Privacy concerns. Themes are discussed in more detail in the following section.

Difficulty Identifying Credible and Relevant Information on the Web

All participants expressed frustration with finding credible and relevant information on the Web regarding their health conditions. Most felt overwhelmed by the volume of information available and had difficulty identifying whether information was credible or not.

> *You go to Google and you have about twenty different things. Which one is the best one to go to?* [P14]

> *One thing I've found is that there is so much absolute garbage out there. And that's what I find difficult in dealing with my health situation...What is an online medical dictionary that's correct? If you're sick, no one's going to sit with you and tell you this is where you find (the information).* [P4]

Even when users were confident that the information was trustworthy, they noted that it was often not presented in a meaningful way or in ways that made it easy to understand. They felt that information needed to be presented in a user-friendly way and placed into context so that individuals can understand what it means and how to act on it.

> *I like things boiled down. I want the essentials. If I type in a medication and ask for the side effects, I don't want it (the Internet site) to give me the runaround.* [P11]

> *If we take the example of high blood pressure, sometimes they will say, "you are 135 over 80," people don't know what that means. Is this something that needs to be checked?* [P8]

Table 1. Characteristics of focus group participants.

Participant	Sex	Age group (years)
P1[a]	Male	50-59
P2	Female	50-59
P3	Female	60-69
P4	Male	50-59
P5	Female	60-69
P6	Female	50-59
P7	Female	>80
P8	Female	>80
P9	Female	70-79
P10	Male	60-69
P11	Female	>80
P12	Female	>80
P13	Female	>80
P14	Male	60-69
P15	Female	60-69

[a]P: participant.

Ownership, Access, and Responsibility for Medical Information

All participants expressed a desire to have greater access to their medical records and many viewed themselves as the ultimate owners of their medical information. However, some expressed frustration at being treated as if they did not have a right to access their information when needed. Most reported encountering frequent barriers to gaining ready access to PHI through usual channels (requesting results of medical tests or copies of medical records, and so on.)

Opinions varied as to who should be responsible for managing their health information. Two people expressed interest in assuming responsibility for compiling their medical information so that it could be shared with all care providers, including the ability to edit the data when needed. This desire to act as gate-keeper was presented as an important strategy to increase both the continuity and quality of the health care they received because new providers often did not appear to have access to their existing medical record.

> *When I go to my family doctor, who's supposed to combine everything in a way that there is everything in my charts from over the past 20 years? So I highlight and I make specific copies after consult(ing) with other specialists.* [P3]

> *There was a time when I went to the Emergency (Department). I had my records with me, so I gave them the copy, and they lost it. Within a day only (they were lost)...but luckily I had kept my copy. They...put it in the file, but they said, "Keep your copies with you in case you need it again." I have my whole medical record.* [P1]

Others expressed some resentment at the burden of having to act as administrators for their medical information. They noted that even though they owned the information, they did not want to have to assume responsibility for maintaining their medical record and providing it to different providers:

> *I find it very offensive...that you pay these doctors and you pay for the health care system and they have all your records...And it was like they took ownership of your life but they didn't take responsibility.* [P15]

Most participants viewed the lack of a consolidated health record as the most significant challenge they faced when trying to obtain their medical records. Four expressed frustration with the burden of obtaining access to records kept by different providers.

> *...Specialists, they have their own charts for us. So even if I go to medical records, I'm not able to see or get the copy of my results because they don't have them on the computer. So, the point is, when you go to the particular clinic and you ask for the results of the procedure or the specific test that was done in this clinic there is a problem to get the copy. I have to go to the medical records office. I fill out the form each time I want to see results. And make the trip. Then pick it up, or they send (it) to you. Some places when you ask to make a CD of your scan or something, they ask you to pay them, so you go to a different place...and it's a lot of work for people with medical issues to do.* [P3]

> *You have to remember that the system isn't a static thing. What they'll give you today (PHI) may not be what they're going to give you tomorrow, and vice versa...The other thing that's hard to figure out is who has the power to give us what we want. It may not be the doctor. That's not always clear. So that if you have a day where you're seeing five different people, who's the one who has the power to get you what you need?* [P4]

Peer Communication and Support

Participants acknowledged that new technologies offered opportunities for increased communication and support when seeking health information. Many found that people who had lived with a similar health condition offered helpful information and emotional support (eg, online support groups, patient forums, and patient ratings of hospitals or clinics) and therefore viewed them as valuable resources. For example, one person noted that online support groups offer a platform for people to share tips, not only on how to manage their condition in daily life, but also on how to navigate the health care system more easily.

> *You can say, "Oh, don't go to (there) because they'll give you the runaround. Go to this hospital." Or "No, don't take your child there because they do this. Go here instead." Word of mouth and trust and people who share illnesses or have loved ones who share illnesses, are very dependent on (peer) information...It's protecting yourself from the system, from the very system that's there to protect you. So I think those support groups are very good for that.* [P15]

However, some also raised concerns about the reliability and trustworthiness of information that has been provided by other patients.

> *I'm not a doctor nor a physician or whatever...I read if there are suggestions, but I won't give my knowledge because who am I? When you read something on the Internet, be careful because everybody acts like a "specialist," so I'm hesitant on that.* [P2]

> *I went on a couple of forums...to me it showed something very clearly, it's that so many of these people on the forums are doing this in isolation...What I (also) found was that it (the online forum) could be very easily loaded. In other words, that they would have people saying, "Oh, this is really great and wonderful software," and then if you dug (around) it would be people that are working for the companies that were supposed to be making the software.* [P4]

Opportunities to Enhance Health Care Interactions

Participants also discussed a number of ways in which the Internet and eHealth technologies could impact the health care experience. Many viewed technology as offering an opportunity

to simplify management of their health and make certain tasks more convenient (eg, prescription renewals, requesting appointments).

> *There's the continuity of care, which would be like a schedule function, saying, okay, you have to see the specialist at this time, or renew your prescription, or have your prescription changed. Or even if you get a certain amount of refills around one prescription, tells you you're down, you know, flashes, so that the next time you have to go back to a physician and get a renewal for it.* [P4]

Others noted that technology could potentially reduce feelings of vulnerability by allowing for more continuous monitoring of their health status and providing a way to interact directly with providers when immediate communication was needed. One participant imagined possible future scenarios:

> *We could take a scenario where a nurse or a doctor is watching the rates and says: "You have increased here" or "Here's a pattern these last few days," and they know that that indicates something might be coming on: a stroke from diabetes, or something...That's life saving. They can email the person: "Come into the office" or "Go to the emergency room."* [P15]

One participant described a recent situation where she felt upset at having to take responsibility to educate herself about her newly diagnosed medical condition.

> *I'm old lady and now I discovered that I have something genetic. And I ask him (the doctor), "Could you please just write the name of this so I could figure it out myself on the Internet?" (The doctor said) "I have no time. I have other patients. Did you see the corridor?" So I stood up and I turned towards the door and I said: "No. I need the name of my disease if I have to go on Internet and learn what you're supposed to tell me yourself."* [P3]

Privacy Concerns

The most common concerns raised about the Internet and eHealth technologies centered around privacy. All participants indicated that security of information was paramount and that they would need assurances their PHI would remain confidential before considering using any Web-based technology. For some, concerns about confidentiality appeared to outweigh potential benefits.

> *I wouldn't (use the internet or eHealth technologies) because...I have a wife who works for a hospital, and they are hacked so many times I wouldn't trust it.* [P4]

> *Never forget when you're on the Internet, you're not alone...So take care what you ask, take care what you do...because some people they are very, very smart on that.* [P8]

> *The issue always goes back to security, who is going to get access to your records and can records be manipulated by hackers and all that. You know...It's one thing that hackers come into your emails, it's horrible. But when hackers come into your financial and your medical, this is life-threatening.* [P15]

Discussion

Principal Findings

Older adults often have complex health conditions, essential self-management tasks, and frequent encounters with providers that can be facilitated with eHealth technologies. The aim of this study was to go beyond the known factors influencing eHealth uptake among older adults which include age, sex, socioeconomic status, current Internet use, and privacy concern [15,16,18-24], by exploring participants' perceptions of these technologies in relation to their experiences with the current health care system. We found that individuals perceived there was potential value including convenience and reduced burden by using technologies that could improve access to PHI and facilitate communication between providers and peers living with similar conditions. However, we also found that acceptance of these technologies will require assurances that their PHI is in fact secure, readily accessible, and easily understood.

One of the greatest challenges consistently voiced by participants was being able to identify and access credible information about health conditions on the Web; a finding also reported by others [30-33]. Low health literacy often renders content incomprehensible [34,35]. Participants indicated that they need help in identifying information that is (1) credible, (2) unbiased, (3) easily understood, and (4) meaningful or relevant to them. There is an opportunity to develop Web-based resources to help older adults identify credible sources of information that are written in ways that make the information easy to understand. Strategies to address this include having both providers and patients review all materials prior to publication. While new methods of validating Web-based information [36] will also help to increase the credibility of information individuals receive on Web-based sites [37], additional effort is required to ensure credible tools are readily available and easily understood by older adults.

Participants had significant security and privacy concerns related to having medical information on the Web; others have noted similar concerns [18,22,24,38,39]. Although security concerns represent an important barrier to Internet and eHealth technology uptake, there is evidence that these attitudes can be changed with careful message framing. Angst and Agarwal [40] showed that privacy concerns alone are likely not sufficient to halt the acceptance of such technologies. Work continues to identify mechanisms that can help reduce the risk of unauthorized access to personal health data [41,42]. Therefore a parallel challenge is to adequately frame messages and provide the training necessary to ease users' concerns.

Another important theme was the potential role that the Internet and eHealth technologies could play in facilitating the coordination of care services. Participants discussed the challenges of accessing medical information within their health record, which is especially important when many believed that it was ultimately going to be up to them to gather their health information and provide it to their doctors. Others have also

reported on the desire of individuals to be able to access their health information [43,44].

Our results mirror one of the main findings in Ancker et al [45], in that those who have had poor experiences with accessing PHI are more likely to take on the primary responsibility for managing their own information and sharing it with their different providers.

Interestingly, a recent systematic review [46] found minimal evidence to support the notion that access to medical records resulted in improved health outcomes, however, being able to review their health-related information did enhance patients' perception of control. Participants view the Internet and eHealth technologies as a source of convenience and a way to improve the logistics around this coordination with features allowing patients to perform transactional tasks such as booking appointments and renewing prescriptions. These administrative-type features are also highly valued by patients in the literature [33,47-49] and therefore the inclusion of these features should be considered as a mechanism for motivating individuals to use technology for long-term self-management.

The concept of who owns medical information was important to participants. Most believed they were the true owners of their health information; as such, they have the right to have ready access to it and to make it available to their other providers as needed. Empowerment is a key mechanism in the self-management of chronic diseases, particularly for older individuals [50]; therefore, leveraging this idea of ownership of health information by providing patients with access to this information could reinforce feelings of empowerment [51]. Participants in this study view eHealth as a means to gain access to their PHI but this is likely not to be sufficient to guarantee a technology's uptake. PHRs for example have been shown to offer better access to PHI, however, evidence shows that there remain barriers to their uptake, notably that many PHRs do not include patient-oriented functionalities [52]. If technology is to be leveraged to provide easier access to PHI and, in doing so, strengthen the patients' idea of ownership and empowerment, a patient-oriented approach to development is required to make sure that those needs are met.

Participants also discussed the value of online communities to facilitate peer support; however, several participants raised concerns about the quality and credibility of information that may be shared on social media platforms. Participants thought that the inclusion of health professionals as monitors or contributors might help offer some degree of quality control, although this approach can increase costs substantially. The question of health professionals interacting with patients on Web-based social networks requires further study in relation to privacy and legal issues [53]. One recent study looked at the use of online health communities (OHC) aimed at facilitating multidisciplinary communication among the frail and the elderly. OHCs are Internet-based applications that provide a platform uniting patients and professionals to not only share information between one another, but also to improve the coordination of care for people who have multiple caregivers. The investigators attribute an inability of the OHC to improve activities of daily living, mental health, and social activity to very low usage of the system [54].

Older adults in our study expressed interest in online communities and tools to facilitate sharing of health information and self-management strategies and the coordination of care. We also found their interest and use of the Internet and eHealth technologies to manage their health and interactions with providers are influenced by their experiences with the health care system. In particular, our study highlights the importance that patients place on the sense of ownership of their medical information, the value they place on transaction-type task (eg, booking appointments, renewing prescriptions), and how these technologies impact the health care experience. Key functionalities that participants value in eHealth products include those that (1) provide health-related information that is credible, unbiased, easily understood, and meaningful; (2) ensure security of personal medical information; (3) provide easy access to personal medical information; (4) facilitate self-coordination of care; and (5) provide access to online communities for peer support.

Despite the numerous survey-based studies aimed at elucidating factors that influence eHealth uptake among older individuals, few have evaluated how experiences with providers and the health care system work together with sociodemographic and other predictors to influence attitudes and behavior. Understanding individual differences, including how positive and negative health-related experiences impact attitudes, needs, preferences, and concerns, is essential for the development and implementation of tools in ways that encourage uptake and long-term use. However, our study has limitations. We explored the views of a convenience sample of a limited number of older adults. Participants were recruited from a large urban medical center in a system that provides universal access to health care. Future studies should explore more novel themes such as the sense of ownership of medical information, value placed on transactional tasks, and experiences with navigating the health care system. These should be explored with sample sizes large enough to understand how they fit within explanations of the digital divide experienced by older individuals. In other words, are these views merely the symptom of a cohort effect, in which case, can we expect them to change over time? Or, are they more concretely linked to aging and chronic conditions, and therefore we can expect these views to persist over time? Developing technologies with end user needs and preferences in mind is essential to ensuring that technology contributes to rather than hinders positive interactions among providers and patients they care for, and results in improved health outcomes. In the context of chronic disease management, the Internet and eHealth technologies hold potential for supporting healthy aging and patient self-management.

Conclusions

The Internet and eHealth technologies can help older adults manage their health by giving them access to health information and a means to become a more active player in their own health care. Focus groups conducted with individuals aged 50+ years extend earlier findings regarding the influence of sociodemographic factors including age, sex, and socioeconomic

status that influence interest in and use of the Internet and eHealth technology uptake. We also identified several primary needs and preferences which centered on access to PHI, security, usability, and convenience. Our results can help inform the design and implementation of Internet resources and eHealth technologies, especially for older individuals who may be less comfortable with technology use but who represent the fastest growing adopters of the Internet.

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Conflicts of Interest

None declared.

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Abbreviations

EHR: electronic health record.
OHC: online health communities.
PHI: personal health information.
PHR: personal health record.

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Short Paper

Quality of Social Media and Web-Based Information Regarding Inappropriate Nuclear Cardiac Stress Testing and the Choosing Wisely Campaign: A Cross-Sectional Study

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Abstract

Background: The World Wide Web and social media provide the public with access to medical information unlike any other time in human history. However, the quality of content related to cardiac stress testing is not well understood.

Objective: The aim of our study was to evaluate the quality of content on the Internet relating to the use of cardiac nuclear stress testing and the Choosing Wisely campaign.

Methods: We searched the World Wide Web, Google Video (including YouTube), and Twitter for information relating to these two topics. Searches were performed using English language terms from a computer in the United States not logged into any personal user accounts. Search results were reviewed for discussion of specific topics including radiation risk, accuracy of testing, alternative testing options, and discouragement of inappropriate test use.

Results: We evaluated a total of 348 items of content from our searches. Relevant search results for Choosing Wisely were fewer than for other search terms (45 vs 303). We did not find any content which encouraged inappropriate testing (ie, screening in low risk individuals or testing prior to low risk operations). Content related to Choosing Wisely was more likely to discourage inappropriate testing than search results for other terms (29/45, 64% vs 12/303, 4.0%, odds ratio 43.95, 95% CI 17.6-112.2, $P<.001$).

Conclusions: The Internet content on nuclear stress tests consistently discouraged inappropriate testing. The Choosing Wisely content was more likely to discourage inappropriate testing, less relevant content was available. Generating authoritative content on the Internet relating to judicious use of medical interventions may be an important role for the Choosing Wisely campaign.

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KEYWORDS

myocardial perfusion imaging; health services research; Internet; unnecessary procedures

Introduction

Patients are increasingly using the Internet and social media to understand health conditions and for decisions about proposed medical interventions. Increasing evidence suggests that the Internet and social media are effective at driving health behaviors [1]. Misinformation and patient demand may contribute to the estimated US $200 billion in unnecessary medical services within the US healthcare system [2]. In an effort to combat this issue, the American Board of Internal Medicine Foundation and numerous other medical organizations have partnered in the Choosing Wisely campaign, a movement to raise awareness among physicians and patients about unnecessary tests, procedures, and treatments. The program aims to help patients "choose care that is supported by evidence, not duplicative of other tests, free from harm, and truly necessary." Inappropriate use of myocardial perfusion imaging (MPI) is discouraged on multiple Choosing Wisely lists, especially when applied in asymptomatic and low risk patient populations.

Despite efforts such as the Choosing Wisely campaign to better inform both patients and doctors about low-value care [3], inappropriate nuclear MPI are still commonly performed [4]. Given the semielective and outpatient nature of many MPI, patients could conceivably use the Internet to obtain information about the test before having the MPI performed.

We conducted this investigation to evaluate the quality and quantity of publicly available information on the Internet and social media regarding nuclear MPI. We specifically sought evidence of misinformation on MPI that could contribute to inappropriate MPI. We hypothesized that content related to the Choosing Wisely campaign would be more likely to contain information related to the appropriateness of testing than general Internet content on MPI.

Methods

We conducted a descriptive cohort study using searches of the World Wide Web using Google Web Search (Mountain View, CA), video clips using Google Video Search (Mountain View, CA), and social media content on Twitter (San Francisco, CA). We did not include other platforms, such as Facebook, where search results are based on the user's personal contact group and do not provide an open public-facing search. Three search terms were used on each platform: "nuclear stress test," "myocardial perfusion imaging," and "Choosing Wisely stress test." The only exclusion criteria were irrelevance (not mentioning nuclear stress tests specifically) and non-English language. We did not use any advanced search features or apply "hashtags" in conducting the searches. The searches were performed from a computer located in the United States and none were accessed while logged into a private account in order to minimize any bias in the results provided by each search engine.

Data were collected from June 2015 to August 2015 by DB. Search results were stored in a custom, secure, Web-based database, Research Electronic Data Capture or REDCap [5]. Each relevant search result was categorized by the source (Web, video, or Twitter) and the author type: patient, physician, hospital or practice, academic, news or informational, or other. The specific data elements gathered for each piece of content were the presence of any discussion on: (1) radiation risk of nuclear stress testing, (2) alternative testing options, (3) the accuracy of MPI for detecting heart disease, and (4) discouragement of inappropriate testing. Sampling in each search was continued until further search results were considered futile.

The primary outcome of interest was to compare how frequently the topic of inappropriate MPI was mentioned based on the search result employed. Secondary outcomes were to report descriptive characteristics of the search results including the author type and distribution across different Internet and social media platforms. As a descriptive study, no formal power calculation was performed a priori. The research protocol was reviewed by our institutional review board and classified as exempt from further review. The study design had no direct human involvement. No changes to the study design, conduct, or outcomes were made after initiation. Selected pairwise comparisons were made using Fisher exact and chi-square tests using SPSS version 21 (IBM, Armonk NY). $P<.05$ was considered significant.

Results

A total of 456 search results were analyzed with 348 retained after 108 were excluded as duplicative, irrelevant, or non-English language. The plurality of relevant results came from the Web (n=154) followed by Twitter (n=125) and then video sources (n=69). The author type was different for each source; whereas video content was seen from all author types, Web results were predominantly from private and academic practices (113/ 154, 73.3%) and the Twitter search yielded mostly results from patient authors (84 /125, 67.2%). Content from individual physicians on the three platforms was minimal (23 /347, 6.6% overall; Figure 1).

The content of relevant search result material differed based on the search term used (see Table 1).

Searching for Choosing Wisely yielded the fewest results of the 3 search terms (Choosing Wisely n=45, nuclear stress n=223, MPI n=80). Of note, none of the search results actively encouraged inappropriate MPI (such as for screening in asymptomatic patients, annual testing in heart disease patients, or routine use prior to invasive procedures or operations). Results of the "Choosing Wisely" search were more likely to discourage inappropriate MPI than results for "myocardial perfusion imaging" or "nuclear stress test" (n=29 of 45 vs 12 of 303, odds ration [OR] 44.0, 95% CI 17.6-112.2, $P<.001$). "Choosing Wisely" results were also more likely to discuss the accuracy of MPI (20 of 45 vs 15 of 303, OR 15.4, 95% CI 6.6-36.3) or radiation risks (18 of 45 vs 64 of 303, OR 2.5, 95% CI 1.2-5.0, $P=.005$). Discussion of alternative testing options did not differ between the search terms (3 of 45 vs 20 of 303, OR 1.0, 95% CI 0.2-3.8, $P>.99$).

Figure 1. The distribution of content author types differed across the platforms we analyzed. Web content came primarily from private and academic practices, while Twitter content was primarily from patients, and video content was authored by a variety of sources.

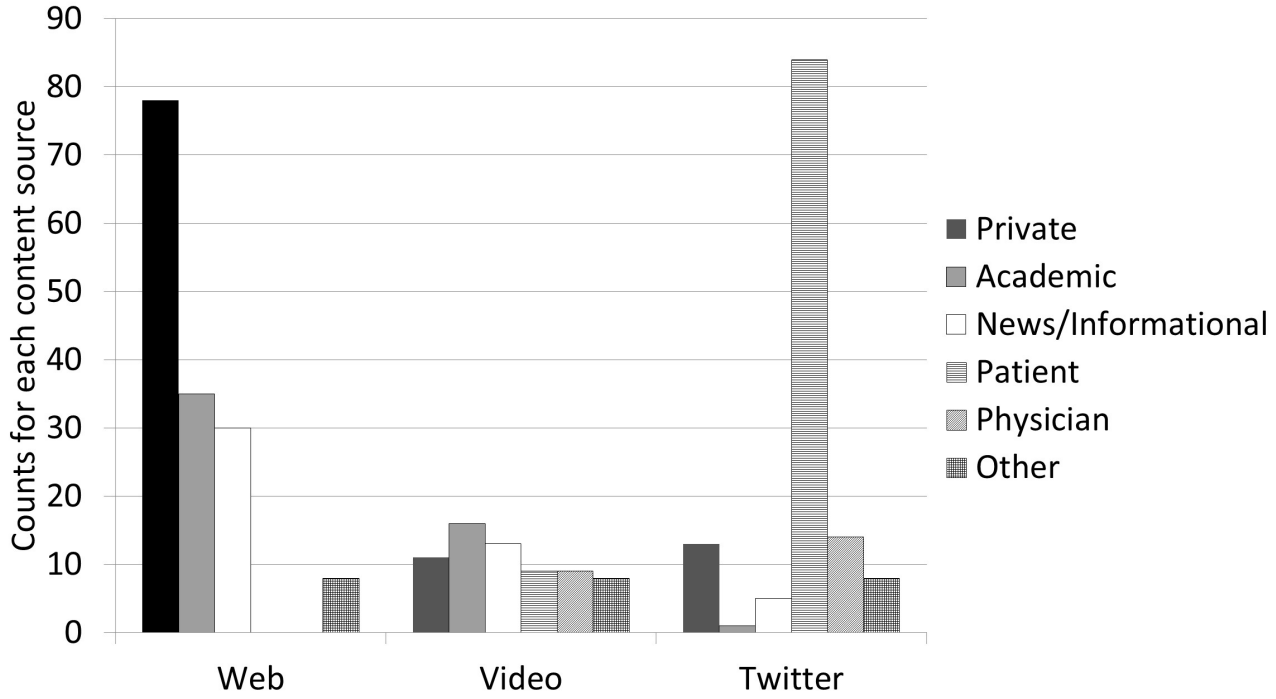

Table 1. Search results for n=348 items of content on the Internet or social media.

Search term	Source	Radiation n (%)	Alternatives n (%)	Accuracy n (%)	Inappropriate use discouraged n (%)
Nuclear stress test	Web (n=92)	17 (18.4)	4 (4.3)	4 (4.3)	1 (1.1)
	Video (n=43)	12 (27.9)	5 (11.6)	3 (7.0)	2 (4.7)
	Twitter (n=88)	13 (14.7)	1 (1.1)	0 (0.0)	1 (1.1)
Myocardial perfusion imaging	Web (n=45)	17 (37.7)	8 (17.7)	7 (15.5)	6 (13.3)
	Video (n=12)	3 (25.0)	1 (8.3)	1 (8.3)	1 (8.3)
	Twitter (n=23)	2 (8.6)	1 (4.3)	0 (0.0)	1 (4.3)
Choosing Wisely stress test	Web (n=17)	12 (70.5)	0 (0.0)	11 (64.7)	13 (76.4)
	Video (n=14)	5 (33.3)	2 (14.3)	6 (42.9)	7 (50.0)
	Twitter (n=14)	1 (7.1)	1 (7.1)	3 (21.4)	9 (64.3)

Discussion

Principal Findings

In this pilot sample of Internet and social media content regarding nuclear MPI, our search for content related to Choosing Wisely was significantly more likely to discuss appropriateness of testing, accuracy of MPI, and radiation. In fact, the topic of test appropriateness was only discussed in 4% of content found with non–Choosing Wisely searches. This finding is disappointing given that Appropriate Use Criteria (AUC) for nuclear MPI were first published in 2005 [6]. From that time until the most recent update of the AUC in 2013, there appears to have been no appreciable decrease in the rate of inappropriate MPI in the published literature [4,7]. Similar to the lack of Internet content related to appropriateness, physician and provider awareness of appropriateness is low. In a recent survey, 36.6% of respondents had never heard of AUC and only 12.5% reported using them regularly [8].

We were reassured when we did not observe any content that actively encouraged inappropriate MPI (asymptomatic screening, low risk patient screening, or annual testing as part of a cardiology evaluation). This would suggest that publicly searchable information on the Internet is not a significant contributor to the unnecessary use of this particular testing modality.

Limitations

This investigation has limitations including a small sample size and limited search resources. A more robust methodology may include direct observation or mixed methods assessment of Internet search and social media users for greater detail of their opinions and understanding of unnecessary testing.

Conclusions

Our findings add to a growing body of literature examining the interface between the medical community and the Internet or social media [9,10]. An investigation which took a similar approach to ours and focused on myocardial infarction also found both inconsistency in the content and lack of substance for relevant concepts such as prevention and risk factors [11]. These authors and others have called for more authoritative content to be developed for these platforms which patients are using to gather information and make decisions about care [12]. Development of such authoritative content may be an important role for the future of the American Board of Internal Medicine Foundation and its partners in the Choosing Wisely campaign. Specific consideration should be given to the format, audience needs, and ideal vehicles for distribution when new content is developed.

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Conflicts of Interest

None declared.

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Abbreviations

AUC: appropriate use criteria
MPI: myocardial perfusion imaging
OR: odds ratio

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Original Paper

Thoracic Surgery Information on the Internet: A Multilingual Quality Assessment

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Abstract

Background: Previous data suggest that quality of Internet information regarding surgical conditions and their treatments is variable. However, no comprehensive analysis of website quality exists for thoracic surgery.

Objective: The aim of this study was to quantify website quality in a multilingual setting using an international standard for assessment.

Methods: Health On the Net (HON) principles may be applied to websites using an automated toolbar function. We used the English, French, Spanish, and German Google search engines to identify 12,000 websites using keywords related to thoracic conditions and procedures. The first 150 websites returned by each keyword in each language were examined. We compared website quality to assess for tertile (is the quality better in first, second, or third 50 websites returned) and language differences. A further analysis of the English site types was undertaken performing a comparative analysis of website provider types.

Results: Overall, there are a considerable number of websites devoted to thoracic surgery: “lung cancer” returned over 150 million websites. About 7.85% (940/11,967) of websites are HON-accredited with differences by search term (P<.001) and tertiles (P<.001) of the first 150 websites, but not between languages. Oncological keywords regarding conditions and procedures were found to return a higher percentage of HON-accreditation. The percentage of HON-accredited sites was similar across all four languages (P=.77). In general, the first tertile contained a higher percentage of HON-accredited sites for every keyword.

Conclusions: Clinicians should appreciate the lack of validation of the majority of thoracic websites, with discrepancies in quality and number of websites across conditions and procedures. These differences appear similar regardless of language. An opportunity exists for clinicians to participate in the development of informative, ethical, and reliable health websites on the Internet and direct patients to them.

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KEYWORDS

thoracic; Internet; multilingualism; language; websites

Introduction

Background

As patients are diagnosed with serious conditions and await complex procedures, it is accepted that they inherently will explore the Internet for answers. Over 80% of patients, health care professionals, and other invested groups utilize the Internet to seek medical information, seeing it as a reliable, trustworthy, and accessible source [1-3]. Industry groups, clinicians, and health care institutions may construct websites with commercial interests in mind [1,4]. In contrast, only a minority of websites are sponsored by government or educational organizations and nonprofit organizations, which may provide objective, unbiased, and hence more accurate information, compared with other sponsors [5,6]. Therefore, the Internet's accessible source of health information, and frequency of use by the majority, substantiates the need to assess its quality and validity.

Thoracic surgery is a common mode of treatment for many patients with lung cancer. However, patients face a range of extensive and unregulated information regarding conditions and procedures on the Internet, often affecting their expectations and informed decision-making [7,8]. Moreover, language affects the quality of information [9-14], which impacts on multicultural societies and non-English speaking patients who require reliable information.

Health on the Net

Clinicians also require tools both to identify quality information for themselves and also to direct their patients to reliable, high quality Internet resources [11-13]. High quality and reliable health information can be found through the help of several tools [10,11,15]. The Health On the Net (HON) Foundation is one such tool. HON is a not-for-profit multilingual accreditation body that aims to accredit health websites according to its key principles of authority, complementarity, confidentiality, attribution, justifiability, transparency of authorship, sponsorship, and advertising [11]. The HONcode offers directions for users in evaluating and creating a trustworthy and reputable website [16,17]. Of note, website quality has been tested using the HONcode tool across a range of specialties with only a small percentage of websites (7-27%) being routinely accredited [6,18-20].

A comprehensive literature search regarding website information within the sphere of thoracic surgery was undertaken, yielding no studies that evaluate the quality of thoracic surgery-related information on the Internet. In this study, we aimed to evaluate the quality of current Internet information on thoracic surgery websites based on HON principles, and to compare differences between English, French, German, and Spanish language sites. The effect of language relates to what websites appear on different Google search engines (English, French, German, and Spanish), and whether there are any differences in HON-accredited websites. Our secondary goal was to assess and compare information quality based on types of website sponsors.

Methods

Search Engine and Search Terms

Our methodology has been previously described and used [11-13,21]. On this occasion, however, we used the corresponding Google search engine for each respective language search. We performed an Internet search of 20 terms in December 2014 to March 2015 (Table 1) and assessed 12,000 websites. As formal medical terminology has been used for search terms, the same search term used in English was used for the French, German, and Spanish searches on their respective Google search engines. The terms searched were "pectus excavatum," "pectus carinatum," "Nuss procedure," "Ravitch procedure," "Lorenz bar repair," "lung cancer," "nonsmall cell lung cancer," "small cell lung cancer," "VATS," "video-assisted thoracic surgery," "lung resection," "lung wedge resection," "pneumonectomy," "thoracotomy," "mediastinoscopy," "bronchoscopy," "EBUS," "endobronchial ultrasound," and "lung lobectomy." An expert thoracic surgeon deemed these terms the most common and pertinent medical conditions and procedures for review in this study. These search terms were selected because they are the most objective terms that patients would hear during a consultation. By searching these terms, more meaningful data from websites can be ascertained. Ethics or Institutional Review Board (IRB) approval was not required for this study, since it does not involve patients but only Web-based review of publicly accessible websites.

Internet Searching for Accredited Websites

International and independent, qualified accrediting bodies check HON status at regular times, ensuring that HON certification meets the strict internationally accepted requirements. Moreover, the HON function has been evaluated by many studies, and judged to be a high caliber tool [10-13,22,23].

Access beyond the first page of results by patients is rare [24]. Thus, the first 150 websites yielded by each search were identified and sequentially screened for quality as defined by the HON Foundation. HON principles through the HONcode toolbar function (downloaded from http://www.hon.ch/ for use on any personal computer. HONcode toolbar is easily installed, providing an accessible and visual cue for users) were then applied. According to the HON Foundation website [10], there are 8 criteria evaluated for HONcode certification of a website. These are (1) authoritative (indicate qualifications of authors), (2) complementarity (information should support, not replace, the doctor-patient relationship), (3) privacy (respect privacy and confidentiality of personal data submitted to the site by visitor), (4) attribution (cite the sources of published information, date medical and health pages), (5) justifiability (site must back up claims relating to benefits and performance), (6) transparency (accessible presentation, accurate email contact), (7) financial disclosure (identify funding sources), and (8) advertising policy (clearly distinguish advertising from editorial content). This toolbar automatically activates if a website is accredited by the HON Foundation (HONcode+), as opposed to the toolbar not lighting up, indicating that the website is not HON-accredited (HONcode−). On the basis of the

previous studies, approximately 5% of websites could be deemed HONcode+, but have not been accredited yet [10-13].

Analysis of Accredited Websites' Likelihood of Being Viewed

A secondary analysis of the first 150 websites encountered for each search term was undertaken, as previously described [6,18,25]. First, all returned websites for each search term were divided into tertiles (first 50, middle 50, and last 50). The proportion of accredited sites in each tertile and language was then analyzed and compared by the chi-square test. The purpose of this analysis was to determine whether accredited websites were appearing preferentially—that is, in the pages least likely (last 50) versus most likely (first 50) to be viewed.

Quality Control

For quality control, an English-language search of the control term, "lung cancer," had nonaccredited sites within the first 150 discovered websites manually evaluated using the HON criteria to determine their HON status to ascertain if they fulfilled the criteria despite not being officially accredited.

Logistic Regression Examining Variables Associated With HON Status

This test was conducted using the three major variables of our study, namely a search term, language, and tertile, of the first 150 websites returned. The reference groups for each variable were excavatum, the first tertile, and English, respectively.

Analysis of Website Sponsors

For all search terms, an analysis was undertaken from English-language websites to determine who the website sponsors were. Only English language websites were examined due to the authors' lack of proficiency in the other languages. The site sponsors were organized into the following groups: (1) lawyers, (2) nonprofit organizations, (3) government organizations or educational institutions, (4) commercial, (5) thoracic specialists and their professional organizations, (6) Books, articles, and references, (7) other health care professionals, (8) other (social media, forums, personal websites, newspapers, and (9) unrelated.

Sponsorship was determined independently by information on the retrieved Web page regarding its origin; if sponsorship was not obviously apparent, the website was explored until sponsorship could be determined. The concept of sponsorship is not to be confused with the Google terminology of "sponsored links," which either highlights pages at the start of retrieved search or lists links on the side of the page under a banner. As in a previous analysis, such pages were not included in this study [11].

Statistical Analysis

Comparisons of proportions across types of cancer and language were performed by the chi-square test (or Fisher exact test when counts were <5). All statistical tests were two-sided. Odds ratio and 95% CI were also calculated from the logistic regression analysis. The data analysis for this study was generated by SAS software version 9.1. (SAS Institute Inc).

Results

Internet Search Results for Accredited Websites

The total number of websites for each thoracic surgery-related search term is variable (Table 1). "Lung cancer" had the most websites with approximately 150 million websites followed by "small cell lung cancer" with approximately 112 million websites. "Ravitch procedure" returned the least number, with only 159,890 websites.

The total percentage of HON-accredited sites was notably low across all search terms (median 8%; see Table 1). "Lorenz bar repair," "EBUS," "endobronchial ultrasound," and "VATS" had less than 5% of HON-accredited sites (Table 1).

Regarding linguistic differences (see Table 2 and Figure 1), there was a similar number of HON-accredited thoracic websites across all languages evaluated. English (8%) and German (8%), French (7%) and Spanish (7%) had a similar percentage of HON-accredited sites.

Tertiles were examined to ascertain where HON-accredited websites were more likely to appear. HON accreditation was seen statistically more commonly in the first tertile (0-50 sites) of websites (see Table 3 and Figure 2).

Table 1. Number and percentage of HON-accredited websites.

Category	Search term	Total websites returned	HON[a]-accredited (600 per term)		Total	HONcode%[d]	*P* value
			HONcode+[b]	HONcode−[c]			
Anatomy							
	Pectus carinatum	1,069,000	49	551	600	8	
	Pectus excavatum	2,120,000	68	532	600	11	
	Total	1,594,500[e]	117[f]	1083[f]	1200[f]	10[e]	.06
Approach							
	Thoracotomy	2,596,000	46	554	600	8	
	Total	2,596,000[e]	46[f]	554[f]	600[f]	8[e]	.55
Cancer							
	Lung cancer	149,500,000	79	521	600	13	
	Nonsmall cell lung cancer	67,600,000	96	504	600	16	
	Small cell lung cancer	111,500,000	80	520	600	13	
	Total	111,500,000[e]	255[f]	1545[f]	1800[f]	13[e]	.29
Endoscopy							
	VATS	26,320,000	26	574	600	4	
	Video-assisted thoracic surgery	1,934,000	40	560	600	7	
	Total	14,127,000[e]	66[f]	1134[f]	1200[f]	6[e]	.08
Imaging							
	EBUS	2,293,000	15	585	600	3	
	Endobronchial ultrasound	793,000	24	576	600	4	
	Total	1,543,000[e]	39[f]	1161[f]	1200[f]	4[e]	.29
Lungsurg							
	Lung lobectomy	1,840,000	48	552	600	8	
	Lung resection	22,310,000	32	568	600	5	
	Lung wedge resection	928,000	44	556	600	7	
	Pneumonectomy	3,889,000	44	523	567	8	
	Total	2,864,500[e]	168[f]	2199[f]	2367[f]	8[e]	.26
Surganatomy							
	Lorenz bar repair	1,529,000	12	588	600	2	
	Nuss procedure	512,200	47	553	600	8	
	Ravitch procedure	241,400	30	570	600	5	
	Total	512,200[e]	89[f]	1711[f]	1800[f]	5[e]	<.001
Scope							
	Bronchoscopy	9,204,000	62	538	600	10	
	Mediastinoscopy	764,000	52	548	600	9	
	Thoracoscopy	1,576,000	46	554	600	8	
	Total	1,576,000[e]	160[f]	1640[f]	1800[f]	9[e]	.26
Grand total		2,027,000[e]	940[f]	11027[f]	11967[f]	8[e](2-16)	<.001

[a]HON: Health On the Net.

[b]HONcode+: HON-accredited website.

[c]HONcode−: not HON-accredited website.

[d]HONcode%: percentage of HON-accredited websites, calculated by ([HONcode+]/[total websites]); where, total websites=(HONcode+)+(HONcode−).

[e]Median.

[f]Sum.

Figure 1. Column graph of median percentage of Health On the Net (HON)–accredited sites for all keywords arranged according to language. Each keyword was searched on native Google search engine of respective countries. The graph indicates the median percentage of HON-accredited websites.

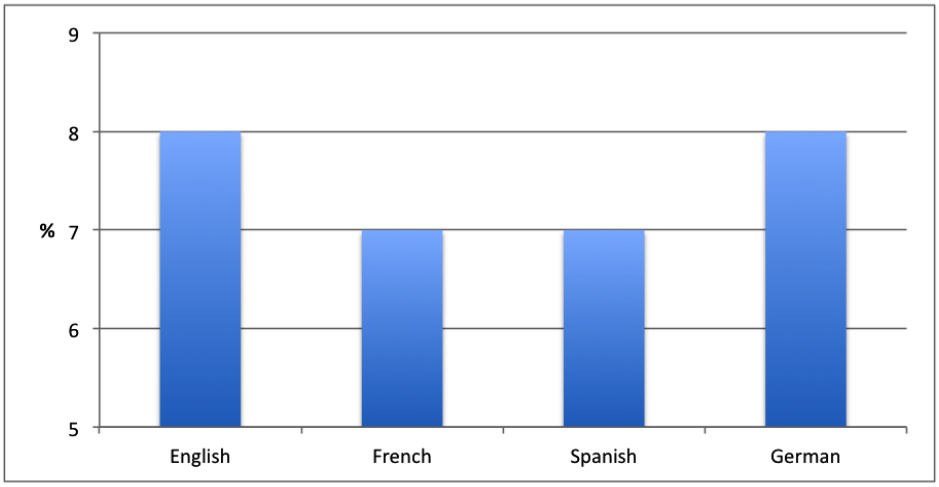

Figure 2. Clustered column graph of percentage of Health On the Net (HON)–accredited websites for keywords arranged by tertiles. The color “blue” indicates percentage HON-accredited websites in first tertile, “red” indicates percentage HON-accredited websites in second tertile, and “green” indicates percentage HON-accredited websites in third tertile.

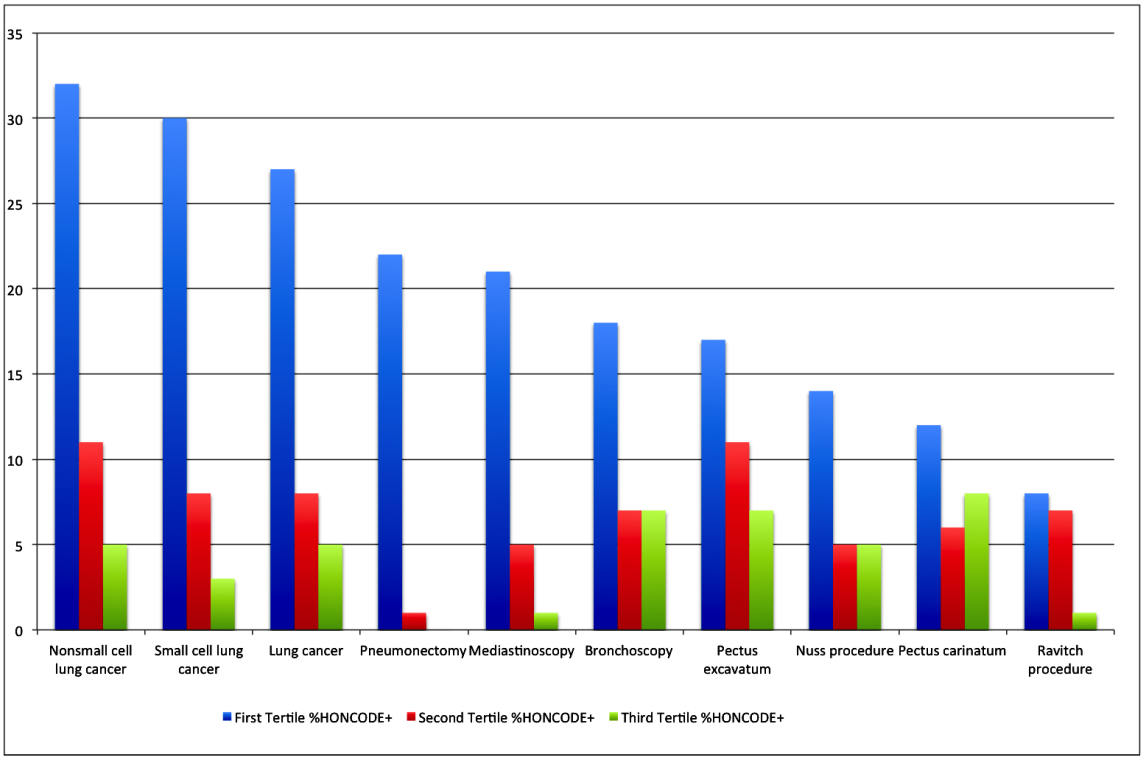

Table 2. Percentage of HON-accredited websites by language.

Category	Search terms	English			French			German			Spanish			*P* value
		+[a]	–[b]	%[c]	+	–	%	+	–	%	+	–	%	
Anatomy														
	Pectus carinatum	13	137	9	14	136	9	12	138	8	10	140	7	.80
	Pectus excavatum	17	133	11	19	131	13	16	140	7	16	134	11	
	Total	30[e]	270[e]	10[d]	33[e]	267[e]	11[d]	28[e]	278[e]	8[d]	26[e]	274[e]	9[d]	
Approach														
	Thoracotomy	14	136	9	10	140	7	11	139	7	11	139	7	
	Total	14[e]	136[e]	9[d]	10[e]	140[e]	7[d]	11[e]	139[e]	7[d]	11[e]	139[e]	7[d]	.84
Cancer														
	Lung cancer	20	130	13	19	131	13	20	130	13	20	130	13	
	Nonsmall cell lung cancer	32	118	21	24	126	16	18	132	12	22	128	15	
	Small cell lung cancer	27	123	18	19	131	13	18	132	12	16	134	11	
	Total	79[e]	371[e]	18[d]	62[e]	388[e]	13[d]	56[e]	394[e]	12[d]	58[e]	392[e]	13[d]	.11
Endoscopy														
	VATS	4	146	2	7	143	5	7	143	5	7	143	5	
	Video-assisted thoracic surgery	11	139	7	10	140	7	10	140	7	10	140	7	
	Total	15[e]	285[e]	5[d]	17[e]	283[e]	6[d]	17[e]	283[e]	6[d]	17[e]	283[e]	6[d]	.98
Imaging														
	EBUS	5	145	3	3	147	2	2	148	1	5	145	3	
	Endobronchial ultrasound	6	144	4	6	144	4	6	144	4	6	144	4	
	Total	11[e]	289[e]	4[d]	9[e]	291[e]	3[d]	8[e]	292[e]	5[d]	11[e]	289[e]	4[d]	.87
Lungsurg														
	Lung lobectomy	11	139	7	13	137	9	11	139	7	13	137	9	
	Lung resection	9	141	6	9	141	6	6	144	4	8	142	5	
	Lung wedge resection	9	141	6	11	139	7	11	139	7	13	137	9	
	Pneumonectomy	13	137	9	10	122	7	12	123	8	9	141	6	
	Total	42[e]	558[e]	7[d]	43[e]	539[e]	7[d]	40[e]	545[e]	7[d]	43[e]	557[e]	8[d]	.99
Surganatomy														
	Lorenz bar repair	3	147	2	3	147	2	3	147	2	3	147	2	
	Nuss procedure	9	141	6	13	137	9	14	136	9	11	139	7	
	Ravitch procedure	6	144	4	9	141	6	8	142	5	7	143	5	
	Total	18[e]	432[e]	4[d]	25[e]	425[e]	6[d]	25[e]	425[e]	5[d]	21[e]	429[e]	5[d]	.65
Scope														
	Bronchoscopy	18	132	12	15	135	10	13	137	9	16	134	11	
	Mediastinoscopy	14	136	9	12	138	8	13	137	9	13	137	9	
	Thoracoscopy	12	138	8	11	139	7	12	138	8	11	139	7	
	Total	44[e]	406[e]	9[d]	38[e]	412[e]	8[d]	38[e]	412[e]	9[d]	40[e]	410[e]	9[d]	.88
Grand total		253[e]	2747[e]	8[d]	237[e]	2745[e]	7[d]	223[e]	2762[e]	8[d]	227[e]	2773[e]	7[d]	.76

[a]+: HON-accredited website.

[b]−: not HON-accredited website.

[c]%: percentage of HON-accredited websites, calculated by ([HONcode+]/[total websites]), where, total websites=(HONcode+)+(HONcode−).

[d]Median.

[e]Sum.

Table 3. Percentage of HON-accredited websites by tertile.

Category	Search term	HON[a]-accredited									*P* value
		Tertile 1 (sites 1-50)			Tertile 2 (sites 51-100)			Tertile 3 (sites 101-150)			
		+[b]	−[c]	%[d]	+	−	%	+	−	%	
Anatomy											
	Pectus carinatum	23	177	12	11	189	6	15	185	8	.08
	Pectus excavatum	33	167	17	22	178	11	13	187	7	<.001
Approach											
	Thoracotomy	28	172	14	18	182	9	0	200	0	<.001
Cancer											
	Lung cancer	54	146	27	16	184	8	9	191	5	<.001
	Nonsmall cell lung cancer	64	136	32	22	178	11	10	190	5	<.001
	Small cell lung cancer	59	141	30	16	184	8	5	195	3	<.001
Endoscopy											
	VATS	12	188	6	5	195	3	9	191	5	.23
	Video-assisted thoracic surgery	30	170	15	6	194	3	4	196	2	<.001
Imaging											
	EBUS	3	197	2	4	196	2	8	192	4	.24
	Endobronchial ultrasound	19	181	10	4	196	2	1	199	1	<.001
Lungsurg											
	Lung lobectomy	31	169	16	4	196	2	13	187	7	<.001
	Lung resection	20	180	10	9	191	5	3	197	2	<.001
	Lung wedge resection	21	179	11	16	184	8	7	193	4	.02
	Pneumonectomy	43	157	22	1	199	1	0	167	0	<.001
Surganatomy											
	Lorenz bar repair	12	188	6	0	200	0	0	200	0	<.001
	Nuss procedure	28	172	14	9	191	5	10	190	5	<.001
	Ravitch procedure	15	185	8	13	187	7	2	198	1	<.001
Scope											
	Bronchoscopy	35	165	18	13	187	7	14	186	7	<.001
	Mediastinoscopy	41	159	21	9	191	5	2	198	1	<.001
	Thoracoscopy	37	163	19	7	193	4	2	198	1	<.001
Grand total		608[f]	3392[f]	15[e]	205[f]	3795[f]	5[e]	127[f]	3840[f]	3[e]	<.001

[a]HON: Health On the Net.

[b]+: HON-accredited website.

[c]−: not HON-accredited website.

[d](%): percentage of HON-accredited websites.

[e]Median.

[f]Sum.

Quality Control

For the first 150 “lung cancer” (English) results, we found that 20 sites were accredited by the HON toolbar and 130 were not. We found that 6.9% (9/130) of those nonaccredited sites met HON criteria when assessed manually and 13.2% (79/600) of cancer-related thoracic surgery websites are HON-accredited.

Logistic Regression Examining Variables Associated With HON Status

Odds ratios calculated by search term, language, tertile, and between groups, highlighted significant differences (Table 4). For language, English compared with French, German, or Spanish was just as likely to return an accredited site. The second tertile of websites (51-100) assessed were more likely than the third tertile (101-150) to have accredited sites.

Table 4. Odds ratio and 95% CI. Illustration of odds ratio of a search having HON-accreditation in relation to referent. The higher the ratio, the less likely a search term has HON-accreditation. The lower the ratio, the more likely a search term has HON-accreditation.

Effect on HONcode status	Odds ratio	95% CI
Search terms		
Excavatum	1.00 (referent)	
Bronchoscopy	1.116	0.767-1.622
EBUS	5.239	2.940-9.334
Endobronchial ultrasound	3.197	1.964-5.207
Lorenz bar repair	6.598	3.512-12.394
Lung cancer	0.834	0.584-1.191
Lung lobectomy	1.498	1.007-2.229
Lung resection	2.347	1.505-3.662
Lung wedge resection	1.652	1.100-2.481
Mediastinoscopy	1.368	0.926-2.020
Nonsmall cell lung cancer	0.653	0.463-0.922
Nuss procedure	1.534	1.029-2.288
Pneumonectomy	1.612	1.073-2.422
Ravitch procedure	2.517	1.599-3.962
Small cell lung cancer	0.821	0.576-1.172
Thoracoscopy	1.572	1.052-2.349
Thoracotomy	1.572	1.052-2.349
VATS	2.936	1.826-4.720
Video-assisted thoracic surgery	1.838	1.211-2.788
Carinatum	1.464	0.985-3.960
Websites[a]		
First tertile (0-50)	1.00 (referent)	
Second tertile (51-100)	3.354	2.840-3.960
Third tertile (101-150)	5.522	4.531-6.730
Language		
English	1.00 (referent)	
French	1.076	0.889-1.303
German	1.155	0.951-1.402
Spanish	1.134	0.935-1.375

[a]Sum.

Table 5. Website sponsor analysis.

Search term	Lawyer, (%)	Non-profit, (%)	Government or education, (%)	Commercial, (%)	Thoracic specialists or professional organizations, (%)	Books, articles, references, (%)	Other health care professionals, (%)	Others (social media, forums, personal websites, newspapers), (%)	Unrelated, (%)	*P* value
Carinatum	0 (0)	13 (9)	48 (32)	17 (11)	10 (7)	51 (34)	3 (2)	8 (5)	0 (0)	.35
Excavatum	0 (0)	12 (8)	61 (41)	11 (7)	7 (5)	53 (35)	0 (0)	6 (4)	0 (0)	
Thoracotomy	0 (0)	7 (5)	38 (25)	4 (3)	6 (4)	83 (55)	0 (0)	12 (8)	0 (0)	N/A
Lung cancer	0 (0)	23 (15)	48 (32)	3 (2)	3 (2)	52 (35)	0 (0)	21 (14)	0 (0)	<.001
Nonsmall cell lung cancer	0 (0)	18 (12)	40 (27)	8 (5)	1 (1)	79 (53)	0 (0)	4 (3)	0 (0)	
Small cell lung cancer	1 (1)	10 (7)	49 (33)	6 (4)	2 (1)	75 (50)	0 (0)	7 (5)	0 (0)	
VATS	0 (0)	4 (3)	38 (25)	5 (3)	6 (4)	23 (15)	0 (0)	2 (1)	72 (48)	.001
Video-assisted thoracic surgery	0 (0)	2 (1)	79 (53)	4 (3)	7 (5)	58 (39)	0 (0)	2 (1)	0 (0)	
EBUS	0 (0)	1 (1)	30 (20)	11 (7)	5 (3)	34 (23)	0 (0)	1 (1)	68 (45)	<.001
Endobronchial ultrasound	0 (0)	2 (1)	53 (35)	6 (4)	6 (4)	76 (51)	0 (0)	7 (5)	0 (0)	
Lung lobectomy	1 (1)	9 (6)	44 (29)	4 (3)	5 (3)	70 (47)	0 (0)	17 (11)	0 (0)	.001
Lung resection	0 (0)	4 (3)	35 (23)	2 (1)	5 (3)	101 (67)	0 (0)	3 (2)	0 (0)	
Lung wedge resection	0 (0)	14 (9)	33 (22)	2 (1)	5 (3)	86 (57)	0 (0)	10 (7)	0 (0)	
Pneumonectomy	1 (1)	6 (4)	17 (11)	2 (1)	4 (3)	109 (73)	0 (0)	11 (7)	0 (0)	
Lorenz bar repair	4 (3)	3 (2)	13 (9)	5 (3)	2 (1)	72 (48)	0 (0)	3 (2)	48 (32)	<.001
Nuss procedure	0 (0)	5 (3)	29 (19)	2 (1)	5 (3)	84 (56)	0 (0)	25 (17)	0 (0)	
Ravitch procedure	1 (1)	4 (3)	40 (27)	9 (6)	3 (2)	66 (44)	0 (0)	27 (18)	0 (0)	
Bronchoscopy	0 (0)	4 (3)	58 (39)	12 (8)	9 (6)	62 (41)	0 (0)	5 (3)	0 (0)	<.001
Mediastinoscopy	0 (0)	6 (4)	38 (25)	6 (4)	4 (3)	87 (58)	0 (0))	9 (6)	0 (0)	
Thoracoscopy	1 (1)	2 (1)	30 (20)	15 (10)	5 (3)	78 (52)	0 (0)	19 (13)	0 (0)	
Total mean (mean %)	9 (<1)	149 (5)	821 (27)	134 (4)	100 (3)	1399 (47)	3 (<1)	199 (7)	188 (6)	<.001

Analysis of Website Sponsors

The sponsor analysis of the 150 websites in English (Table 5) indicated that the most commonly encountered sponsors were “books, articles, and references” (47.1%, 1399/2967) followed by “government or education” (27.7%, 821/2967), “others (social media, forums, personal websites, newspapers” (6.7%, 199/2967), “nonprofit organizations” (5.0%, 149/2967), “commercial” (4.5%, 134/2967), and “thoracic specialists or professional organizations” (3.4%, 100/2967). “Lawyer” (<1%, 9/2967) and “other health care professionals” (<1%, 3/2967) sponsored far less sites. A small percentage (6.3%, 188/2967) of sponsor websites were unrelated to medicine.

Search terms with a larger percentage of “government or education” or “books, articles, and references” were the terms with a larger percentage of HON-accredited websites: “lung cancer,” “nonsmall cell lung cancer,” “small cell lung cancer” with *P* value <.001; “lung lobectomy,” “lung resection,” and “lung wedge resection” with *P* value .001; “pneumonectomy,” “bronchoscopy,” and “thoracoscopy” with *P* value .001.

Discussion

Principal Findings

The aim of this study was to quantify information quality on thoracic surgery-related websites on the Internet. Clinicians may become aware of the lack of quality information regarding thoracic surgery and help to educate patients about the pitfalls of information on the Internet, and direct them to better quality websites.

In summary, the total number of websites for keyword searches varies considerably. The total percentage of HON-accredited websites was markedly low across all search terms. There were minimal linguistic differences in HON-accredited websites, with HON-accredited websites most likely to appear in the first tertile. Nearly half of the websites were books, articles, or references, whereas nearly one-third were governmental or educational.

Comparison With Prior Work

The Internet has developed into an accessible source of health information for everyone. Health websites are guides for patients wanting to better understand their conditions [26]. Web-based health information was sought by 72% of adult Internet users over the last few years [27], a number predicted to grow. Clinicians directing patients to reliable information has many benefits: improving patient-doctor relationships, reinforcing consultation discussions, assisting informed decision-making, providing education before and after events, and helping patients seek appropriate consultation for sensitive topics (eg, urology, gynecology).

There is a stark discrepancy between reliable health information and quality resources that disseminate it. The number of websites providing accurate information for thoracic surgery is not ideal. Only 13% of cancer-related thoracic surgery websites overall were HON-accredited. This is less than in our previous studies, uro-oncology websites [6] in 2009 and surgical oncology websites in 2012 [18], which each returned 18% of oncology-related HON-accredited websites. Similarly, there were 15% of HON-accredited gynecological oncology-related websites [20]. Worse still, only 9% of benign prostate hyperplasia websites were HON-accredited [19]. This reflects our hypothesis that reliable, high-quality health information on the Internet is lacking, specifically for thoracic surgery as well as in a broader context. In the latter study [19], only 7% of nononcology-related websites such as “surgical treatments” were HON-accredited. This figure is comparable with our 10% “Lungsurg” HON-accredited websites. These results are concerning because they imply that patients will encounter unreliable information about their condition, regardless of cancer type. Evidently, this makes website assessment difficult for patients and clinicians alike, potentially leading to distrust of Internet thoracic surgery resources.

It has previously been acknowledged that website quality differs by language [10,11,14]. In our study, whereas English language searches returned more websites overall, both German and English searches returned 8% HON-accredited sites, and French and Spanish searches returned 7% HON-accredited sites. Thoracic surgery information is far more uniform across languages than results from our previous studies [6,18-20], albeit still alarmingly low. It is evident that there is a paucity of high quality, comprehensive information on thoracic surgery available around the world on the Internet, regardless of language. Similarly, HON-accredited websites are more likely to appear in the first tertile overall than in the second or third tertiles. This tertile discrepancy was expected since the Google algorithm generally places the most relevant websites first. Further analysis into the proportion of HON-accredited websites on the first page compared with the first tertile overall may yield interesting results, since it has been known that patients rarely move past the first search page.

Websites also act as a conduit for advertising. Health information is increasingly being controlled by marketing and commercial interests, taking advantage of a significant proportion of the population searching for health information [28]. Consequently, unbiased views are sacrificed for the type of health information offered. However, the majority of sponsors in this study were composed of (1) academic books, articles, and references and (2) government or education. The absence of commercial bodies or marketing in this area implies that thoracic surgery information might not be biased or skewed for marketing purposes, compared with other medical fields previously analyzed [6,18-20]. Notably, the search terms with these sponsors were those with more website results and more HON-accredited websites. This suggests a conscious effort to provide high quality information for these conditions and procedures. Although our study only revealed 1% of websites sponsored by lawyers, a search performed in the United States may show otherwise. This illustrates the unpredictable nature of the Internet.

HONcode is a simple means by which a clinician or patient can objectively correlate a website with high quality information. Compared with other instruments for evaluating website quality, it appears to be a straightforward, valuable tool, and fulfills its goal of identifying reliable health websites [29]. However, HONcode is by no means the only way to rate quality. The DISCERN instrument [30] and LIDA tool [31] are freely available online, designed to help users evaluate the quality of health information on the Internet. The ODPHP’s National Quality Health Website Survey instrument provides a sophisticated method to assess website quality, though is quite time-consuming and subjective [32]. Thus, compared with other, more intensive search tools, HONcode can be used to access reliable information easily by patients and clinicians, who have no prior experience or knowledge. Furthermore, it has been previously shown that website affiliation with HONcode is a significant predictor for scientific information quality [23]. Due to the growing number of websites, the HONcode certification seal is now obtained by voluntary application. However, many high quality websites lack the HONcode seal. In our study, 6% of websites in the control term could have met the criteria and this is consistent with prior research [6,18-20]. Currently, no studies evaluate awareness of HON certification in organizations and patients. Hence, shortcomings of HON may include voluntary application and lack of public awareness. Patients may bypass trustworthy websites, whereas organizations may

not actively apply for HON certification. In a wider context, there is a notable lack of congruence of criteria between health information quality assessment tools [33]. Future research may be needed to streamline assessment tools, or streamline health website guidelines so that quality information is standardized. However, this is out of the scope of this paper. More immediately, further research is required to anal awareness of HON. Depending on these results, appropriate steps could then be taken to help clinicians, patients, and organizations to be exposed to HONcode, enabling access to reliable sources of information.

Limitations

It must be said that HONcode is a predictive indictor for high quality websites, which has its drawbacks. Thus, a proportion of websites with objectively high quality information may not fulfill HONcode criteria, and vice versa. As of 2015, HONcode certification is provided as a paid service. This can distort the validity of website information with HONcode criteria.

An inherent limitation of this study involves the search terms used. It cannot be guaranteed that patients would use these terms in their own research of their condition. It is in dispute whether informal search terms would yield websites with better quality information. Conversely, it may result in unrelated website results. However, given that the search terms used in this study are the most formal and objective, informal search terms would likely defer to pages with the formal terms by the Google search algorithm. One solution to this limitation is to encourage clinicians to use the formal medical terms for their patients, thereby empowering patients to research their condition better, ultimately resulting in greater patient education.

As with any Internet study, its dynamic and diverse character produces inherent limitations. In our study, we only performed searches in Melbourne, Australia. It would be interesting to perform multiple searches at various times and locations, analyzing any differences found. “Google” is the most popular search engine (http://searchenginewatch.com), having been used in other studies [10]. However, studies have also shown the impact of social media and health-related videos on YouTube on health care [34]. As these media are not appropriately standardized for health promotion and education, these studies highlight the need for caution among users. Search engines rely on language filters to determine sites returned, but Google enables a multilingual approach. A key advantage of Google may be for clinicians and patients who speak the languages analyzed here, which have a low number of accredited websites. Google translate may provide people with wider access to information online, though quality may vary. The impact of the validity of HON certification once a website has been translated by Google was not investigated in this study.

Conclusions

In conclusion, clinicians must appreciate the lack of validated information of most thoracic surgery websites. Discrepancies are apparent in quality and number of websites between search terms, tertiles, and language. Awareness of this lack of quality can facilitate clinicians in educating patients by using the formal medical term to empower patients to research their condition more comprehensively and thus gain a greater level of understanding. Clinicians must be proactive in identifying and directing patients to trustworthy and accurate information on websites. HONcode is an uncomplicated search tool and can serve as the vanguard to detect appropriate and trustworthy websites.

Authors' Contributions

MD was involved in data collection, data analysis, and manuscript writing and editing. RA helped in data analysis. SB and NL were involved in manuscript writing and editing.

Conflicts of Interest

None declared.

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Abbreviations

HON: Health On the Net
HONcode: toolbar function for website accreditation recognition by HON principles
IRB: Institutional Review Board
PoHONA: percentage of HON-accredited sites
WHO: World Health Organization

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Original Paper

Dupuytren Disease: Is There Enough Comprehensive Patient Information on the Internet?

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Abstract

Background: Dupuytren disease is a chronic nonmalign fibroproliferative disorder that causes finger contractures via proliferation of new tissue under the glabrous skin of the hand, resulting in multiple functional limitations for the patient. As many surgical therapy options exist, patients suffering from this condition actively search for information in their environment before consulting a health professional.

Objective: As little is known about the quality of Web-based patient information, the aim of this study was to conduct its systematic evaluation using a validated tool.

Methods: A total of 118 websites were included, and qualitative and quantitative assessment was performed using the modified Ensuring Quality Information for Patients (EQIP) tool. This standardized and reproducible tool consists of 36 items to assess available information in three categories: contents, identification, and structure data. Scientific data with restricted access, duplicates, and irrelevant websites were not included.

Results: Only 32 websites addressed more than 19 items, and the scores did not significantly differ among the website developers. The median number of items from the EQIP tool was 16, with the top websites addressing 28 out of 36 items. The quality of the newly developed websites did not increase with passing time.

Conclusions: This study revealed several shortcomings in the quality of Web-based information available for patients suffering from Dupuytren disease. In the world of continuously growing and instantly available Web-based information, it is the health providers' negligence of the last two decades that there are very few good quality, informative, and educative websites that could be recommended to patients.

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KEYWORDS

congenital hand deformity; Internet; patient education

Introduction

Dupuytren disease was named after a French surgeon who first described and operated on it in the early thirties of the 19th century [1]. It is a chronic nonmalign fibroproliferative disorder that causes finger contractures by affecting the palmar aponeurosis of the hand. For the patient, it is associated with multiple functional limitations of the hand [2]. Usually the

metacarpophalangeal- (MCP) and proximal interphalangeal- (PIP) joints in the fingers are involved [3]. Less frequently, Dupuytren disease affects other parts of the body, for example, soles of the feet and penis [4]. Typically it consists in progressive formation of fibrous nodules and cords, leading finally to a flexion contracture. As this condition is quite common, reaching an overall incidence of approximately 5% and 20% at the age of over 65 years [5], there are lots of patients actively searching the Internet for possible therapy options and for aids in decision making before consultation with a health professional [6]. Therefore, comprehensive and easily available patient information is an issue of great interest in community health. The Internet is a constantly growing medium containing all kinds of information instantly available for every user and medical information is no exception. However, the Internet is also an uncontrolled space without any guarantee of the correctness of the information presented. Thus, a website developer is solely responsible to provide accurate, professional, and objective medical information [7]. The International Patient Decision Aid Standards (IPDAS) collaboration has established international guidelines for the development of health care decision aids using the Web-based Delphi consensus process [8,9], which were revised in 2013 and converted to a checklist consisting of 44 items [10]. Another validated instrument to assess the quality of patient decision aids is the Ensuring Quality Information for Patients (EQIP) instrument [11]. This tool, in the form of a checklist, was further expanded to meet the IPDAS criteria and the guidelines of patient information appraisal of the British Medical Association [12]. The EQIP instrument has successfully been used by many authors [13-18].

The aim of this study was to systematically evaluate the available Web-based information for patients with Dupuytren disease. The few existing papers on this topic report the quality of the available patient information to be poor [19,20]. To the best of our knowledge, an assessment of such information using a validated tool has never been done.

Methods

Eligibility, Information Sources, and Website Selection

Different combinations of the key words "Dupuytren's contracture," "Dupuytren's surgery," and "Dupuytren's therapy" were used to identify websites in English only by 5 most popular [21] search engines: Google, Bing, Yahoo, Ask, and AOL. The geographic option in the search engines was switched off to avoid selection bias. For further assessment, we selected the first 100 search results for each search engine based on the assumption that Internet users limit their search to a number far below 100 [15]. To the selected 500 websites, the following noninclusion criteria were applied: websites not specific for Dupuytren disease, those related to articles in scientific journals, duplicates, and websites in language other than English. This resulted in the selection of 118 websites for further assessment.

Patient Information Evaluation Instrument

To assess each website, we used the modified EQIP tool [12], which is a checklist consisting of 36 items and evaluates data in three different categories: (1) content data, (2) identification data, and (3) structure data (Table 1).

The EQIP tool was developed by rating the quality of 73 documents describing medical care procedures used at the University Hospital of Geneva, Switzerland. The assessment rules were defined on 25 documents, and two assessors independently rated the remaining 48 documents. The interrater reliability was very good (kappa statistic=.84), and the intraclass correlation coefficient was as high as .95 [16]. Although the EQIP tool included a 4-option rating scale of "yes," "partly yes," "no," and "NA" (not applicable) in its native form, we decided to use its modified version with a binary scale of "yes" versus "no" or "NA" (ie, no score) after Melloul et al [15]. This is because the answer "partly yes" is, in our opinion, too subjective. Furthermore, there is evidence that associates this answer with low dependability in the assessment of website content [22].

Data Assessment

The data were independently assessed by three investigators and divergent results were defined by consensus. The obtained data were entered into a Web-based platform built on the open source content management system Drupal (version 7) [23], which guaranteed a standardized and complete data entry. According to the origin of the information, the 118 websites were categorized into 8 groups: (1) academic center, (2) encyclopedia, (3) hospital, (4) industry, (5) news service (the press), (6) practitioner, (7) professional society, and (8) patient group. Another classification was performed regarding the country of origin of the websites: (1) Australia, (2) Azerbaijan, (3) Canada, (4) France, (5) Germany, (6) New Zealand, (7) Singapore, (8) United Kingdom, and (9) United States.

Morbidity Risks Associated With Surgical Treatment of Dupuytren Disease

To assess these risks, items 9 and 10 were applied (Table 1). Item 9 evaluates the description of qualitative risks and side effects or complications of surgical interventions (eg, if the risk of postoperative complications is mentioned on the website). Item 10 assesses the description of the quantitative risks of surgical techniques.

Statistical Methods

Proportions derived from nominal variables were compared with Fisher or chi-square tests and continuous variables were compared with the Student *t* test or 1-way analysis of variance (ANOVA) test, where applicable. All *P* values were 2-sided and considered statistically significant when $P<.05$. According to the 36 items of the expanded EQIP tool, all 118 websites were scored from 0 to 36. Each item was given equal weight of importance. The 75th quartile was arbitrarily used as a cut-off point to differentiate high-score websites from low-score ones, and we dichotomized the obtained EQIP score as previously performed by Melloul [15]. Statistical analysis was performed with SPSS version 22 for Mac (IBM Corp).

Table 1. Overall results of the included websites according to the modified Ensuring Quality Information for Patients (EQIP) Instrument.

Data	Item	Criteria	Yes, n (%)	No, n (%)	Does not apply, n (%)
Content data					
	1	Initial definition of which subjects will be covered	43 (36.4)	75 (63.6)	0 (0)
	2	Coverage of the previously defined subjects (NA[a]if the answer is "no" for item 1)	43 (36.4)	75 (63.6)	0 (0)
	3	Description of the medical problem	115 (97.5)	3 (2.5)	0 (0)
	4	Definition of the purpose of the surgical intervention	103 (87.3)	15 (12.7)	0 (0)
	5	Description of treatment alternatives	86 (72.9)	32 (27.1)	0 (0)
	6	Description of the sequence of the surgical procedure	59 (50.0)	59 (50.0)	0 (0)
	7	Description of the qualitative benefits to the recipient	58 (49.2)	60 (50.8)	0 (0)
	8	Description of the quantitative benefits to the recipient	11 (9.3)	107 (90.7)	0 (0)
	9	Description of the qualitative risks and side effects	66 (55.9)	52 (44.1)	0 (0)
	10	Description of the quantitative risks and side effects	23 (19.5)	95 (80.5)	0 (0)
	11	Addressing quality-of-life issues	64 (54.2)	54 (45.8)	0 (0)
	12	Description of how complications are handled	10 (8.5)	108 (91.5)	0 (0)
	13	Description of the precautions that the patient may take	25 (21.2)	93 (78.8)	0 (0)
	14	Mention of alert signs that the patient may detect	20 (16.9)	98 (83.1)	0 (0)
	15	Addressing medical intervention costs and insurance issues	9 (7.6)	109 (92.4)	0 (0)
	16	Specific contact details for hospital services	48 (40.7)	70 (59.3)	0 (0)
	17	Specific details of other sources of reliable information or support	47 (39.8)	71 (60.2)	0 (0)
	18	Coverage of all relevant issues for the topic (summary item for all content criteria)	0 (0)	118 (100)	0 (0)
Identification data					
	19	Date of issue or revision	52 (44.1)	66 (55.9)	0 (0)
	20	Logo of the issuing body	111 (94.1)	7 (5.9)	0 (0)
	21	Names of the persons or entities that produced the document	37 (31.4)	81 (68.6)	0 (0)
	22	Names of the persons or entities that financed the document	1 (0.8)	117 (99.2)	0 (0)
	23	Short bibliography of the evidence-based data used in the document	37 (31.4)	81 (68.6)	0 (0)
	24	Statement about whether and how patients were involved or consulted in the document's production	51 (43.2)	67 (56.8)	0 (0)
Structure data					
	25	Use of everyday language and explanation of complex words or jargon	111 (94.1)	7 (5.9)	0 (0)
	26	Use of generic names for all medications or products (NA if no medications described)	35 (29.7)	83 (70.3)	0 (0)
	27	Use of short sentences (<15 words on average)	109 (92.4)	9 (7.6)	0 (0)
	28	Personal address to the reader	33 (28.0)	85 (72.0)	0 (0)
	29	Respectful tone	118 (100)	0 (0)	0 (0)
	30	Clear information (no ambiguities or contradictions)	116 (98.3)	2 (1.7)	0 (0)
	31	Balanced information on risks and benefits	16 (13.6)	102 (86.4)	0 (0)
	32	Presentation of information in a logical order	115 (97.5)	3 (2.5)	0 (0)

Data	Item	Criteria	Yes, n (%)	No, n (%)	Does not apply, n (%)
	33	Satisfactory design and layout (excluding figures or graphs)	91 (77.1)	27 (22.9)	0 (0)
	34	Clear and relevant figures or graphs (NA if absent)	21 (17.8)	97 (82.2)	0 (0)
	35	Inclusion of a named space for the reader's note or questions	3 (2.5)	115 (97.5)	0 (0)
	36	Inclusion of a printed consent form contrary to recommendations (NA if not from hospitals)	2 (1.7)	116 (98.3)	0 (0)

[a]NA: not applicable.

Results

Websites Containing Information on Dupuytren Disease

After screening 500 eligible websites, 118 websites were included for qualitative and quantitative analysis with the expanded EQIP tool. The criteria for noninclusion were duplicates and noneligible Web contents.

Country of Origin and Source of Patient Information

More than two-thirds (75.4%, 88/118) of all websites originated from the United States, followed by the United Kingdom (14.4%, 16/118). Canada was represented in 3.4% (4/118). Additionally, 23.6% (21/89) of the 89 US websites were rated as high-score websites, which made 65.6% of all (n=32) high-score websites (Figure 1).

Fifty-three websites (44.9%, 53/118) were developed by professional societies, which thus represent the most frequent source of information on Dupuytren disease. Practitioners were the source number 2 with 26 websites (22%, 26/118; Figure 2**)**.

Figure 1. Box plot presenting website scoring based on the modified Ensuring Quality Information for Patients (EQIP) tool depending on country of origin. The horizontal thick line within the box plot represents the median. The upper line of the box plot represents the 75th percentile, whereas the lower the 25th percentile. The upper whisker line represents the maximum value, whereas the lower the minimum value. Outliers are shown as circles.

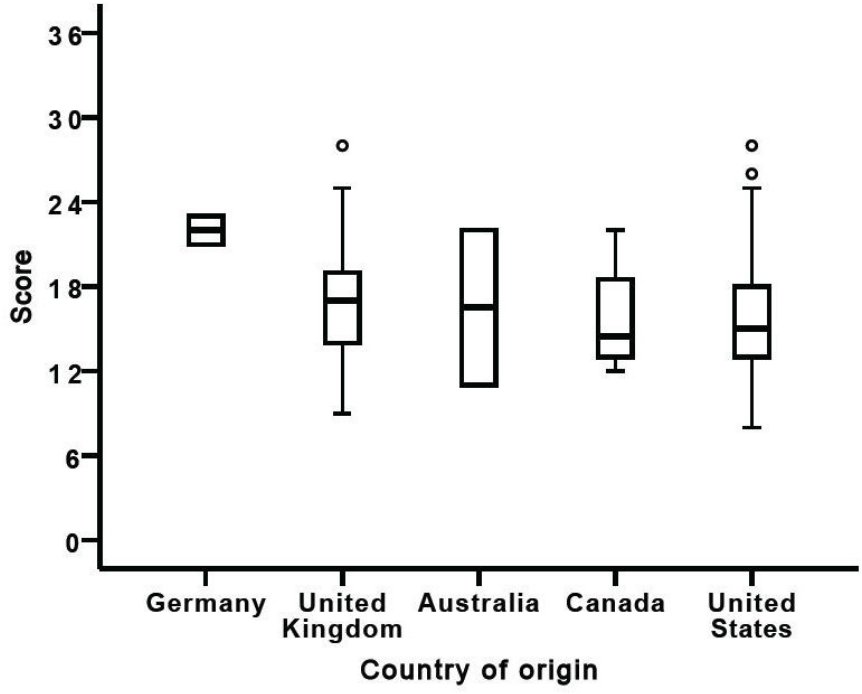
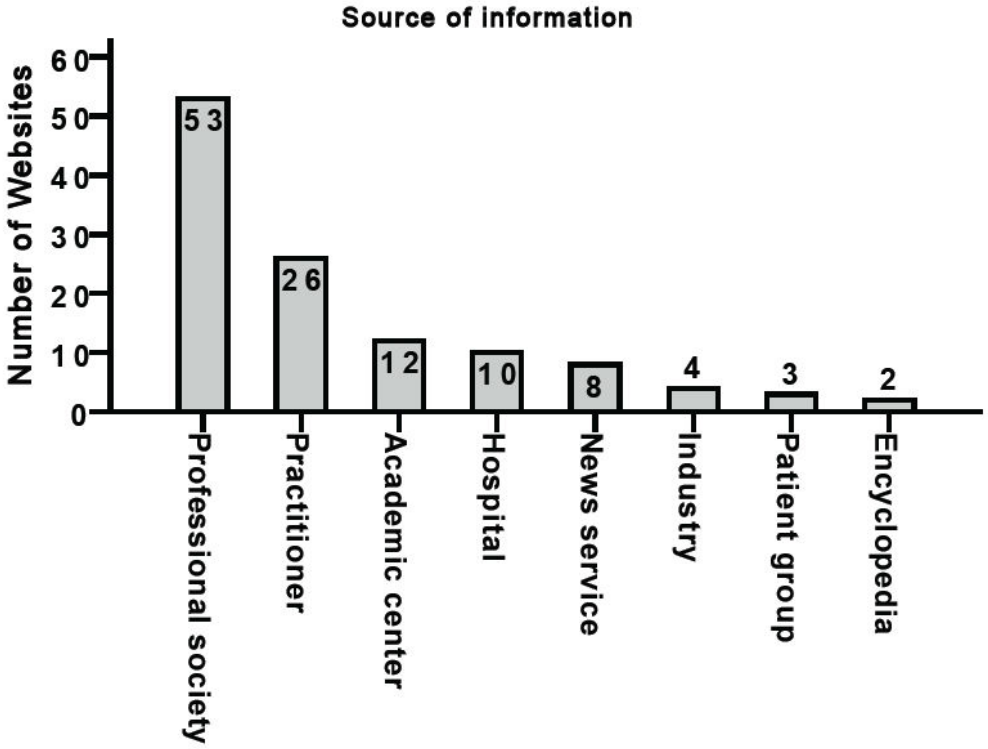


Figure 2. Distribution of the total 118 evaluated websites depending on source of information.



Ensuring Quality Information for Patients (EQIP) Score Achieved

The median website score obtained from the EQIP tool was 16 points (interquartile range, IQR: 13-19). The lowest score of 8 points was achieved by one website and the highest score of 28 points by two websites. None of the screened websites provided information on all 36 items of the modified EQIP tool. When the source of medical patient information was concerned, there was no statistically significant difference between scores obtained by different website developers (Figure 3).

Websites above the 75th percentile (with the score of 19 or more) were defined as high-score websites, in contrast to low-score websites (obtaining 18 points or less). A high score was achieved by 32 websites (27.1%, 32/118) and a low score by 86 websites (72.9%, 86/118) **(**Figure 4**).**

Top Rated Websites

We defined a top rated website with a score above the 95th percentile (Table 2**)**. The top rated websites came from the United Kingdom (n=2) and from the United States (n=4). The highest score reported was 28, ex aequo from a British professional society and from an American professional society.

Figure 3. Box plot presenting website scoring based on the modified Ensuring Quality Information for Patients (EQIP) tool depending on source of information.

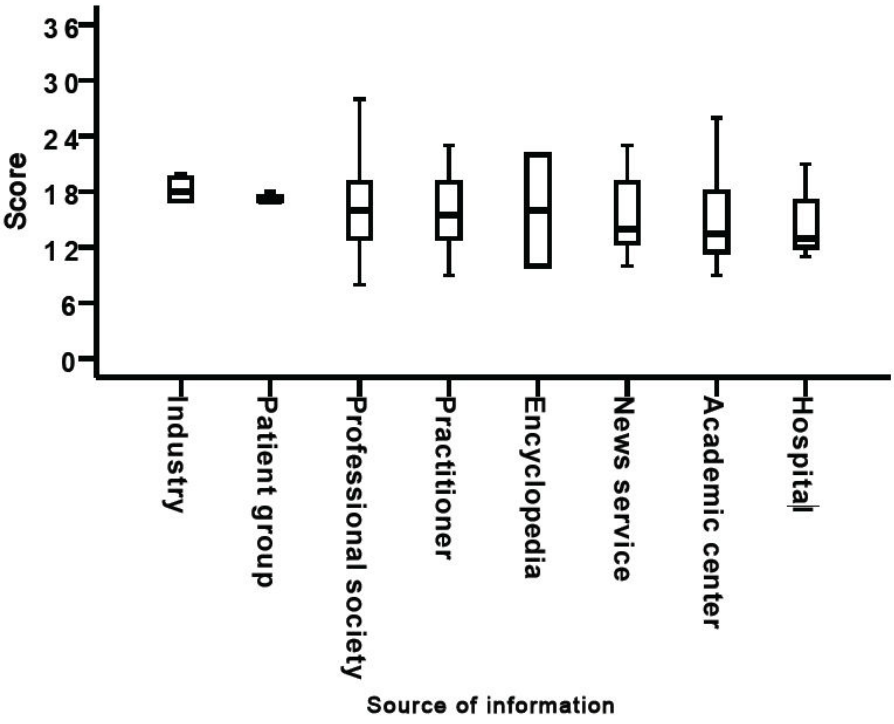


Figure 4. Histogram presenting the number of websites (Y=vertical axis) and their scores according to the modified Ensuring Quality Information for Patients (EQIP) instrument (X=horizontal axis).

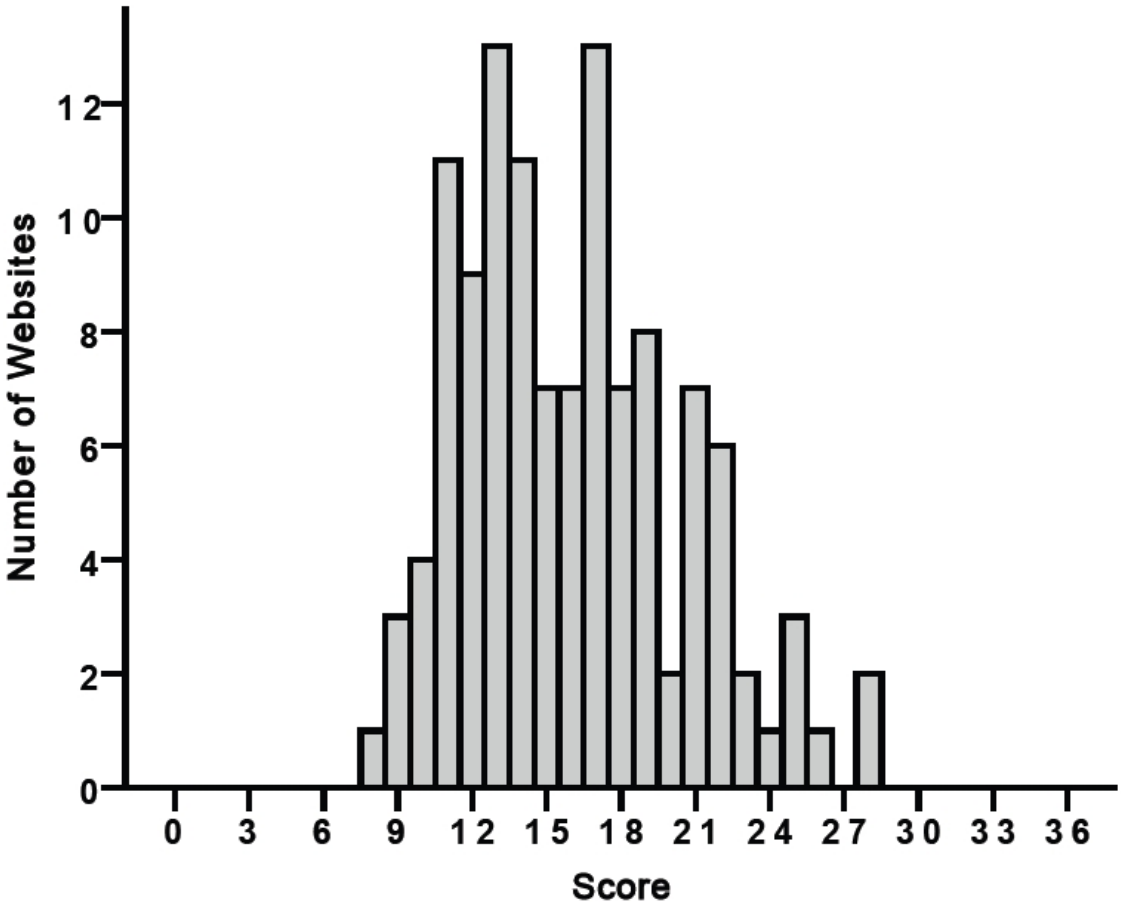
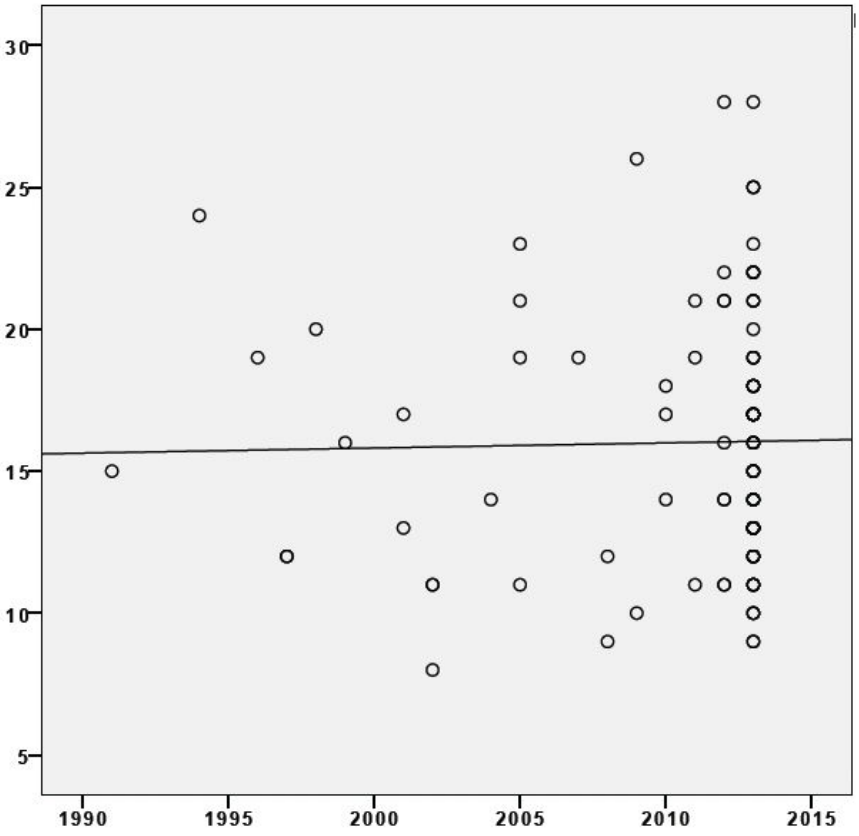


Table 2. The top rated websites (>95th percentile) according to the modified Ensuring Quality Information for Patients (EQIP).

Ranking	Website	Country of origin	Source of information	Score
1	http://dupuytrens-society.org/index.html	United Kingdom	Professional society	28
1	http://www.cig0.com/healthwellness/hw/medical-topics/dupuytrens-disease-ue4602	United States	Professional society	28
2	http://depts.washington.edu/uwhand/Therapy/dupuytrens.php	United States	Academic center	26
3	http://www.emedicinehealth.com/dupuytrens_disease-health/article_em.htm	United States	Professional society	25
3	http://www.nhs.uk/conditions/Dupuytrens-contracture/Pages/Introduction.aspx	United Kingdom	Professional society	25
3	http://www.orthop.washington.edu/?q=patient-care/hand/dupuytrens-disease.html-0	United States	Academic center	25

Figure 5. Scatter plot with the year of website publication on the horizontal axis (X) and their scores awarded by the modified Ensuring Quality Information for Patients (EQIP) instrument on the vertical axis (Y). The solid line represents the mean EQIP score of the websites.



Year of Publication

More than two-thirds (68.6%, 81/118) of the websites screened were published in 2013 in contrast to 37 websites published from 1990 to 2012. Within the passing time, the EQIP-based quality of the newly introduced websites did not increase significantly, as shown in Figure 5.

Discussion

Principal Findings

The most important findings of the study were, first, that the overall quality of patient information on Dupuytren disease evaluated with a validated tool was poor. Second, the source of medical patient information did not influence the scores obtained by the websites. Third, none of the screened websites provided information on all 36 items of the modified EQIP tool, and the high-score websites represented only a quarter of the screened websites. Finally, the quality of the newly developed websites did not increase with passing time.

The Internet presents a global, easily accessible, and unlimited source of any kind of information, and medical issues is one of the most searched topics. It is also an uncontrolled space, allowing anyone to put any kind of information out there, and also that of unknown accuracy. This may expose patients to the risk of getting wrong information and impact their further therapeutic decisions. These concerns led various authors to investigate the accuracy of the medical information for patients in different medical disciplines. [15,16,24-26]

The systematic evaluation of the quality of Internet information on Dupuytren disease is sporadically present in the literature in contrast to the information on other common hand pathologies.

Sproule et al [19] conducted in 2003 an evaluation of 172 websites containing medical information on 3 common hand pathologies such as Dupuytren disease, carpal tunnel syndrome, and trigger finger. The published patient information was evaluated for completeness and accuracy using a scoring system developed by the authors. The findings of that study in terms of those two evaluation criteria showed substantial shortcomings in most websites. In contrast to the methodology of our study, Sproule et al did not use a validated evaluation scoring system.

Almost a decade later, Kelly et al [20] performed an Internet search of "Dupuytren's disease" using the most popular search engines. The identified websites were scored using the DISCERN scoring system [27] and the Journal of American Medical Association (JAMA) benchmark criteria [28]. Compared with other common hand pathologies examined in that study, the quality of the Internet information on Dupuytren disease measured by DISCERN and JAMA criteria was better, but nevertheless, the study revealed a small number of websites that could be recommended to patients to support their decision making in the therapeutic process. The used evaluation tool—the DISCERN instrument—was developed by an expert panel and comprises 16 criteria for judging the quality of written consumer health information on treatment choices. Although the instrument requires some subjectivity for rating certain criteria, its developers claim it to be reliable and valid [27], and this could be verified by other authors. [29-31] In contrast to the EQIP instrument, the DISCERN evaluates information on treatment choices but does not evaluate readability or design aspects of the written materials. In our opinion, the EQIP is a more comprehensive and practical tool to evaluate the large, constantly growing volume of patient information produced within the health service. It helps also to make decisions about the urgency of any revisions that are needed to be made to written information in order to prioritize limited resources and minimize costs [11].

This study shows that private institutions did not provide less quality of information in comparison with academic nonprofit oriented website developers. Since the market of hand surgery, especially in the private setting, is consumer-oriented and strongly relies on marketing and advertising tools in an increasing crowded field of providers, physicians tend to advertise their services with complete patient information. This tempts the physician to take marketing action of selling his "products" and to influence the patient's interest. However, economic issues should never yield to medical responsibilities and ethics.

Limitations

This study has some limitations. First, due to the assumption that English is spoken as the first or second language in most developed countries, only websites developed in English were included; therefore, the quality of websites published in other languages remains unknown. The same can refer to the selection of search engines. Second, this work was done according to the statistical popularity of the search engines [21]; nevertheless, the use of other search engines could have revealed other interesting websites. Third, the Internet is a highly dynamic and constantly growing medium, and an evaluation of 118 websites at one point of time can represent only a snapshot of the information provided on the Web. Finally, there were limitations in the assessment instrument itself. The modified EQIP tool and its scoring system was not designed to assess websites referring specifically to Dupuytren disease but rather to assess patient information regarding any kind of medical treatment, which could have led to interpretation bias.

Conclusions

The evaluation of the present Web-based patient information on Dupuytren disease using a validated tool revealed substantial shortcomings and lacked standardization of its quality. The health care providers are the first to blame for this condition because in their obligation to provide a patient with an accurate and complete information, they did not stay up to date and recognize the potentials and hazards of this continuously growing medium—the Internet.

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Conflicts of Interest

None declared.

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Abbreviations

EQIP: Ensuring Quality Information for Patients
IPDAS: International Patient Decision Aid Standards
IQR: interquartile range

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Original Paper

Assessing the Performance of a Modified LACE Index (LACE-rt) to Predict Unplanned Readmission After Discharge in a Community Teaching Hospital

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Abstract

Background: The LACE index was designed to predict early death or unplanned readmission after discharge from hospital to the community. However, implementing the LACE tool in real time in a teaching hospital required practical unavoidable modifications.

Objective: The purpose of this study was to validate the implementation of a modified LACE index (LACE-rt) and test its ability to predict readmission risk using data in a hospital setting.

Methods: Data from the Canadian Institute for Health Information's Discharge Abstract Database (DAD), the National Ambulatory Care Reporting System (NACRS), and the hospital electronic medical record for one large community hospital in Toronto, Canada, were used in this study. A total of 3855 admissions from September 2013 to July 2014 were analyzed (N=3855) using descriptive statistics, regression analysis, and receiver operating characteristic analysis. Prospectively collected data from DAD and NACRS were linked to inpatient data.

Results: The LACE-rt index was a fair test to predict readmission risk (C statistic=.632). A LACE-rt score of 10 is a good threshold to differentiate between patients with low and high readmission risk; the high-risk patients are 2.648 times more likely to be readmitted than those at low risk. The introduction of LACE-rt had no significant impact on readmission reduction.

Conclusions: The LACE-rt is a fair tool for identifying those at risk of readmission. A collaborative cross-sectoral effort that includes those in charge of providing community-based care is needed to reduce readmission rates. An eHealth solution could play a major role in streamlining this collaboration.

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KEYWORDS

patient readmission; hospital readmissions; health services; quality improvement; quality of health care; cost savings; eHealth; medical informatics

Introduction

Unplanned hospital readmission has been a major challenge in health care worldwide [1]. In the United States, as of 2012, the Hospital Readmissions Reduction Program has been measuring hospital readmission rates and penalizes hospitals with excessive readmission rates [2]. In Canada, 8.5% of patients are readmitted within a month of their discharge [3]. Medical patients have the highest rate of readmission (13%), followed by surgical and

pediatric patients (6.5%). The financial consequence of readmission is estimated at Can $1.8 billion [4]. Recent studies suggest that 9%-59% of unplanned readmissions are preventable when appropriate measures are instituted [5-7]. Postdischarge interventions are effective [8]; however, they are resource intensive and costly. Identifying patients associated with higher risk of readmission may be a more cost-effective way to reduce readmissions. Rather than focusing on readmission risk factors for specific medical conditions as others have done [9,10], van Walraven and colleagues [11] developed the "LACE" index, a cross-conditions tool that predicts early death or unplanned readmission after discharge from hospital. The LACE index is composed of data on " *L* ength of stay" in the hospital during the current admission, " *A* cuity of admission" (acute or not), " *C* omorbidity of patient" (measured using the Charlson comorbidity index) [12,13], and " *E* mergency department use" in the 6-month period before the current admission. In teaching settings, van Walraven et al [11] reported that a 1-point increase in the LACE score increased the odds of unplanned readmission by 18% and the odds of early death by 29%. Other work, also in teaching settings, found that patients identified as high-risk patients using the LACE tool (LACE score≥10) were readmitted twice as often as other patients and had slightly longer lengths of stay [14]. Mixon et al [15] reported that the LACE index is a better predictor of readmission than measures of patient self-reported preparedness for discharge.

Other tools addressing hospital readmission, such as the UK Nuffield Trust model [16] and the Scottish Patients at Risk of Readmission (SPARRA) [17], exist. The UK Nuffield Trust model was developed in the United Kingdom to identify patients at highest risk of emergency admission and is based on 88 variables extracted from complete hospital and general practitioners' systems. SPARRA is a predictive risk stratification tool developed in Scotland to evaluate a person's risk of being admitted to hospital as an emergency inpatient within the next year. SPARRA holds promise for (1) jurisdictions where resources are devoted to a preventive approach to patient management across the health system and (2) health systems with linked datasets from general practice, home and community care settings, pharmacies, and other settings that allow risk scores to be calculated for large portions of a population [18]. Many jurisdictions continue to face considerable barriers to this level of system and data integration. In such jurisdictions, focusing on reducing readmission using the LACE-rt index remains viable.

While van Walraven et al developed LACE based on a secondary analysis of a multicenter, prospective cohort study of patients in 11 hospitals, our study examined the use of a modified LACE index (LACE-rt) tailored for use in real time in an active setting in the general medicine unit at a large community teaching hospital in Toronto. In order to use the LACE tool in real time to help identify those discharged patients who are at higher risk of readmission, some practical unavoidable modifications had to be made to the LACE index. Accordingly, the purpose of this study was to implement a modified LACE index in a real-time setting (hence the name LACE-rt) and examine its reliability as well as its ability to discriminate between high- and low-risk patients.

Methods

Data Sources and Study Population

The hospital is a community teaching hospital with 426 acute care beds. Secondary data covering the period September 2013 to July 2014 were obtained from the hospital. A total of 3 datasets were provided:

1. Inpatient information extracted from the Canadian Institute for Health Information's Discharge Abstract Database (DAD); it included patient identifier, encounter identifier, admission and discharge dates, location of admission, and basic demographic information such as age and sex.
2. Emergency department visit data extracted from the National Ambulatory Care Reporting System (NACRS).
3. "LACE-rt" related information extracted from the hospital electronic medical record.

Inclusion Criteria

The data included 7676 admissions from 6332 patients. Among these admissions, we selected those who were admitted to 1 of the 4 medicine units that implemented LACE-rt (Stroke, Acute Geriatrics, Cardiology, and Respirology and Gastrointestinal) and were assessed by a nurse using the LACE-rt tool before being discharged to home, another hospital, or a long-term care facility. The total number of admissions analyzed in our study was 3855 (N=3855).

The LACE-rt Score

The "L" value is calculated differently in LACE-rt than in the original LACE index. When managers at the hospital decided to implement the LACE index, they faced the practical challenge of needing to start preparing for discharge as soon as the patient is admitted; waiting until the discharge day to compute the "L" score would delay discharge planning, making the original LACE approach untenable from a practical standpoint. In LACE-rt the managers therefore decided to compute "L" based on the patient's length of stay during the previous (instead of current) acute care admission within the last 30 days.

The attributes L, A, C, and E are computed in the same way in LACE-rt and the original LACE; their corresponding values and points are provided in Table 1. For attribute L, the value column displays the length of stay in days, during the previous admission (LACE-rt) or the current one (original LACE). For attribute A, the value column displays *yes* for acute admissions, *no* otherwise. For attribute C, the value column displays the Charlson comorbidity index score. For attribute E, the value column displays the number of visits to the emergency department within the last 6 months. To each attribute's value correspond a number of points. The sum of all points assigned to L, A, C, and E constitutes a LACE index (LACE-rt or original LACE).

The Charlson comorbidity score (C) is calculated as follows: 1 point for history of myocardial infarction, peripheral vascular disease, cerebrovascular disease, or diabetes without complications; 2 points for congestive heart failure, chronic obstructive pulmonary disease, mild liver disease or cancer, diabetes with end-organ damage, and any tumor (including

lymphoma or leukemia); 3 points for dementia or connective tissue disease; 4 points for moderate to severe liver disease or human immunodeficiency virus infection; and 6 points for metastatic cancer.

Both the original LACE index and the LACE-rt index scores range from 0 to 19, where a higher score indicates an increased chance of readmission or early death (Table 1).

Table 1. The LACE and LACE-rt index attributes and the corresponding values and points.

Attribute	Value	Points
Length of stay[a], days	<1	0
	1	1
	2	2
	3	3
	4-6	4
	7-13	5
	≥14	7
Acute (emergent) admission	Yes	3
	No	0
Comorbidity (Charlson comorbidity index score)	0	0
	1	1
	2	2
	3	3
	≥4	5
Emergency department visit (within the last 6 months)	0	0
	1	1
	2	2
	3	3
	≥4	4

[a]LACE: during the current admission (van Walraven et al); LACE-rt: during the last 30 days.

In this study, nurses checked the hospital's electronic patient chart to estimate the values for "L," "A," "C," and "E," then entered those values into a software interface that computes the patient's LACE-rt score. However, discussion with staff suggested that the extraction and recording of the "L," "E," and "C" values are often done quickly.

Calculations

To check the data entry accuracy for the "L" and "E" components in our dataset, we computed "L" and "E" using the DAD and NACRS data, respectively, and compared the calculations from the administrative data with those values entered manually by the nurses. Even though we had a rationale for investigating the accuracy of "C," this was not feasible as it would have required a complex time-consuming clinical assessment.

Outcome Variables

According to Statistics Canada, "non-elective return to an acute care hospital for any cause is counted as a readmission if it occurs within 30 days of the index episode of inpatient care" [19]. Similarly, we have defined an "unplanned hospital readmission" as an urgent rehospitalization of the patient within 30 days of discharge, excluding patient's elective readmission to the hospital. Thus, the formula for calculating the readmission rate is computed as shown in Figure 1.

Figure 1. Readmission rate formula.

$$\text{Readmission Rate} = \frac{\text{Total urgent readmissions within the 30 days following an admission}}{\text{Total elective and urgent admissions}}$$

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics 22 (IBM Corporation). Descriptive statistical analysis was carried out describing the population's basic demographic characteristics. On the basis of previous literature, patients with LACE-rt score of 10 or higher were defined as a high-risk group and those with a score lower than 10 were defined as the low-risk group [14]. The readmission rates of these 2 groups were then compared using chi-square analysis. To further

support the chi-square analysis and to measure the difference between the low- and high-risk groups, a binary logistic regression analysis was carried out to compare the odds ratio of LACE-rt scores ≥10 and LACE-rt scores <10 in relation to readmission. The odds ratio gave the magnitude of the difference between low- and high-risk groups. Accuracy of the LACE-rt score in predicting readmission was assessed using receiver operating characteristic (ROC) analysis and the C statistic. The C statistic measures the discriminatory power of a prediction model [20]; it reflects the probability that the measure (in this case the LACE-rt index) is higher for a case (ie, a readmission) than for a noncase [21].

This project obtained ethical approval from the hospital Research Ethics Board and all researchers obtained the "Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans Course on Research Ethics" certificate (TCPS 2: CORE).

Results

Descriptive Statistics

Descriptive statistics (Table 2) showed that during the period of study (September 2013 and July 2014), 51.78% of hospital admissions were female patients. During the same period, most patients admitted to hospital were elderly. Almost half of the admitted patients were 80 years of age or older, and more than 80% of the patients were 60 years of age or older. The mean age was 74.29 years.

Table 2. Descriptive statistics: patients' sex and age groups.

Hospital admission characteristics (N=3855)	Value	Count (%)
Sex	Male	1859 (48.22)
	Female	1996 (51.78)
Age, years	Mean age	74.29
	<20	10 (0.26)
	20-29	82 (2.13)
	30-39	99 (2.57)
	40-49	182 (4.72)
	50-59	346 (8.98)
	60-69	484 (12.56)
	70-79	763 (19.79)
	≥80	1889 (49.00)

Table 3 describes our sample for each of the LACE-rt elements. A total of 94% of patients were admitted for less than 1 week and 5.9% remained in hospital for more than 1 week; however, the majority (2559/3855, 66.38%) stayed for less than 1 day. Of the admissions, 95.77% were not acute. On the Charlson comorbidity index, 30.06% of patients scored zero, 25.40% scored 1, and almost 45% scored 2 or more. A total of 27.34% of patients were seen in the emergency department at least twice in the 6-month period before the index admission.

Table 3. Descriptive statistics: LACE-rt elements and their corresponding frequencies.

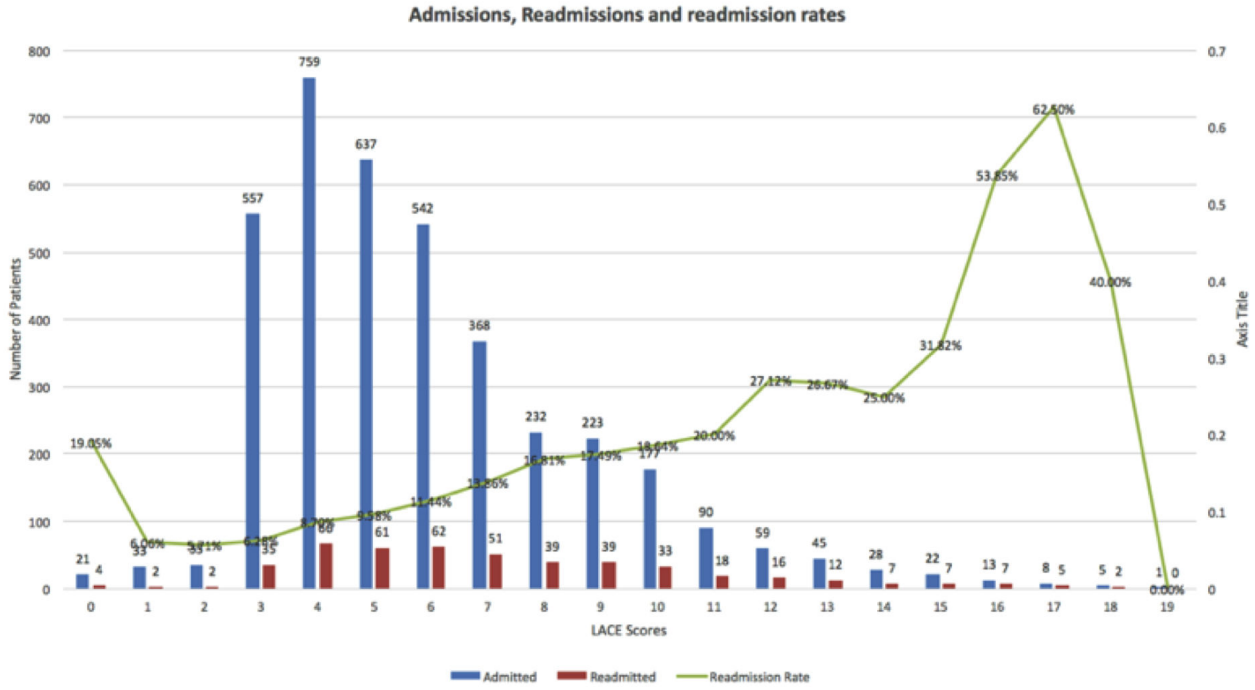
LACE-rt elements (N=3855)	Value	Count (%)
Length of stay in the last 30 days	Less than 1 day	2559 (66.38)
	1 day	648 (16.81)
	2 days	148 (3.84)
	3 days	94 (2.44)
	4-6 days	179 (4.64)
	7-13 days	134 (3.48)
	≥14 days	93 (2.41)
Acute (emergent) admission	Yes	163 (4.23)
	No	3692 (95.77)
Comorbidity (Charlson comorbidity index score)	0	1159 (30.06)
	1	979 (25.40)
	2	625 (16.21)
	3	559 (14.50)
	≥4	533 (13.83)
Emergency department visit (within the last 6 months)	0 visits	1776 (46.07)
	1 visit	1025 (26.59)
	2 visits	541 (14.03)
	3 visits	246 (6.38)
	≥4 visits	267 (6.93)

Readmission Rates

Differences between the high- and low-risk groups were compared in a cross-tabulation. The readmission rate for the low-risk group was 10.6% compared with 23.9% for the high-risk group. The chi-square analysis indicated that there is a statistically significant difference between the 2 groups (χ^2_1=65.5, N=3855, *P*<.001).

Figure 2 shows readmission rates for the range of LACE-rt scores. There is a sharp decrease at LACE-rt scores 18 and 19; however, there are a very small number of patients for these 2 scores (7 and 1, respectively).

Figure 2. Readmission rates by LACE-rt scores.



Predictive Power of LACE-rt at the Hospital: High-Risk Versus Low-Risk Patients

The binary logistic regression analysis revealed an odds ratio Exp(B)=2.648, *P*<.001, which indicated that the patients in the high-risk group are 2.65 times more likely to be readmitted than those in the low-risk group. Data revealed that some patients with a low LACE-rt score were being readmitted. We examined whether reducing the LACE-rt threshold from 10 to 8 would have better predictive power by allowing us to capture more of the high-risk patients. The logistic regression results showed that LACE-rt would have less predictive power with a threshold of 8 (odds ratio Exp(B)=2.43).

Readmission Rates by Age Groups and Sex

Of the readmissions, 11.9% were for female patients and 12.4% were for male patients. An analysis of the readmission rates by sex indicated that there is no significant difference between the 2 groups (χ^2_1=.3, *P*=.60).

An analysis of the readmission rates by age groups indicated that the readmission rates were 10%, 7.3%, 5.1%, 11.0%, 7.2%, 11.2%, 11.4%, and 14.3% for the age groups <20 years, 20s, 30s, 40s, 50s, 60s, 70, and ≥80 years, respectively (χ^2=23.6, *P*<.001). However, looking at readmitted patients alone, 57.7% of them were of age 80 years or older, 18.6% were in their 70s, and 11.5% were in their 60s—in total, close to 90% of readmitted patients were aged 60 years or older.

Readmissions Before and After the LACE-rt Implementation

We used the nonparametric Mann-Whitney *U* test to assess whether the introduction of the LACE-rt tool had any impact on readmission rates. There was no significant difference in readmission rates between the period before the LACE-rt and after the LACE-rt implementation (*U*=126,000, *P*=.23).

Receiver Operating Characteristic Analysis

To assess the accuracy of the LACE-rt index in predicting readmission, we conducted an ROC curve analysis. The ROC analysis was statistically significant (*P*<.001). The C statistic for the LACE-rt index as a predictor of readmission was .632 (95% CI 0.604-0.659). A C statistic value between .8 and .89 indicates an excellent test, a value between .7 and .79 indicates a good test, and a value between .51 and .69 indicates a poor test [20]. In previous studies, C statistic values of .6 [22] and .65 [23] were reported as indicating a fair test; consequently, it is safe to state that in our hospital environment LACE index was found to be a fair test in predicting readmission.

Discussion

Principal Findings

Our results suggest that the LACE-rt index can predict readmission with a reasonable degree of accuracy and that a threshold of 10 is useful for differentiating between patients who are at high versus low risk of readmission. Our results further showed that the readmission rates at the hospital are 10.6% and 23.9% for the low-risk and high-risk groups, respectively. These results are consistent with Gruneir and colleagues [14] who found readmission rates of 9% and 19% for low-risk and high-risk patients, respectively, using the same LACE cutoff.

Current discussion of readmissions in the literature often focuses on demographic and socioeconomic status (SES) factors that explain readmission in specified populations (eg, patients with congestive heart failure). However, demographic and SES predictors are not routinely collected by hospitals; moreover, hospitals would benefit more from tools that work across multiple conditions rather than tools that are specific to certain health conditions. Van Walraven and colleagues recently improved the predictive power of LACE by incorporating age and sex into LACE+ [24]. We suggest that hospitals might collect additional demographic and SES data at the time of admission to better understand which factors are most highly associated with readmission. Such an approach would allow hospitals to use a modified LACE tool, in real time, to identify discharged patients at higher risk of readmission.

The original LACE index required a modification in order to implement it in a hospital setting. As mentioned above, the "Length of stay" could not be implemented in the manner originally designed and had to be modified to measure patients' length of stay in the last 30 days instead of during the current admission. However, our results suggest that the LACE-rt index remains useful for identifying patients at high risk of readmission. In our sample, higher LACE-rt scores were associated with higher readmission rates. Moreover, the chi-square analysis indicated that patients with a LACE-rt score of ≥10 were significantly more likely to be readmitted than those with a LACE-rt score of <10. This is particularly interesting given no demographic or SES factors were used in these analyses—although most admitted patients we studied were elderly, the LACE-rt tool was still able to distinguish between the high- and low-risk groups.

The ROC analysis showed a C statistic that is lower than the one found in the population studied by van Walraven et al (C statistic .684, 95% CI 0.679-0.691) [11]. The lower C statistic value means that the LACE-rt index had poorer performance in our hospital population than in the population studied by van Walraven et al. This difference in performance is expected, as the characteristics of the 2 populations differed; our population had a mean age of 74.29 years compared with 61.3 years in the population studied by van Walraven et al and LACE index is known to perform poorer in older populations [22,23,25].

Our analysis showed that the LACE-rt implementation itself had no effect on readmission rates. Although hospitals can use the LACE-rt tool to identify patients at high risk of readmission, it is unlikely that use of this type of tool *alone* will reduce readmission rates. Reducing readmission requires intervention and it is an endeavor that likely needs to extend beyond the hospital setting to include coordination with other stakeholders such as family caregivers and other sectors including primary care and agencies responsible for providing home- and community-based care [26]. Processes that may promote such coordination include health informatics solutions that can support the coordination process, including communication among the stakeholders as well as follow-up care and

monitoring. Addressing avoidable readmissions will also require policies that support a collective cross-sectoral effort, such as sufficient budgeting for community- and home-based health services, availability of long-term care beds, and eHealth solutions. eHealth solutions such as Web-based communities [27-31] or telemonitoring applications [32-34] for patients with chronic diseases currently being tested to keep patients healthy at home may be helpful for curbing readmission rates.

Limitations

Our study was not able to take early death into account. Patients who died would appear as patients with no readmission in our dataset. It is therefore likely that our data underestimate actual readmission rates. The fact that we were only able to examine readmissions to the same hospital further contributes to underestimation of our readmission rates.

These limitations should not detract from the purpose of this study, which was to examine utility of the LACE-rt index as a tool for quality improvement. Indeed, methodological concerns related to the measurement of readmission rates have led to suggestions that readmission data are better suited to quality improvement than accountability purposes [35].

Conclusions

Our main research aim was to examine the extent to which the LACE-rt index could be used as a predictor of readmission in real time in a large community hospital setting. Our results suggest the LACE-rt index can be practically applied and is a good predictor of readmission. We suggest exploring ways to incorporate basic demographic and socioeconomic data into the tool. We already know that geography has an impact on patient's health [36]. Incorporation of simple geographic location data for admitted patients could shed light on the underlying socioeconomic and sociocultural factors that influence readmissions. Finally, collaborative, cross-sectoral approaches that capitalize on innovative eHealth solutions are required so that we can intervene in the system to reduce costly, often avoidable, and potentially harmful readmissions.

Conflicts of Interest

None declared.

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Abbreviations

DAD: Discharge Abstract Database
NACRS: National Ambulatory Care Reporting System
ROC: receiver operating characteristic
SES: socioeconomic status
SPARRA: Scottish Patients at Risk of Readmission

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