Navigators for medicine: evolution of online point-of-care evidence-based services

Lorenzo Moja

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Lorenzo Moja, Rita Banzi

Italian Cochrane Centre, Mario Negri Institute for Pharmacological Research, Milan, Italy.

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In the quiet, green countryside outside Milan one foggy morning a few years back, I was driving along an isolated road. There Miss Murer, one of my patients, was eagerly awaiting my arrival. But long before I was anywhere near the remote property, I was already lost. Beside me a roughly folded map was helpfully leading me away from familiar landmarks. Inhabitants kindly provided directions, but only confused what my sense of direction had left. This was a recurrent situation in my life, until "Sat-navs" became available. These have a clear purpose: to give complete driving directions with the least possible risk of getting lost. In a few years they have become very popular. Innovative features are offered on top of essential information: travel time between destinations, real-time traffic updates, 3D views, to name a few. Now I'm not worried any more when a patient calls me asking for a visit and proudly announces the name of a neighbourhood I never heard of. I need something similar to avoid losing my direction when a doubt comes to my mind in clinical practice: information services I can trust, that provide relevant and reliable information when I'm searching for a correct diagnosis or treatment. However, there is a vital difference: being lost does not kill people, being lost in clinical practice may do.

Developing information services at the point of care

Doctors rely on many online information sources to satisfy their information needs: from primary published evidence such as bibliographic and journal databases (e.g. Pubmed) to secondary sources such as systematic reviews and clinical practice guidelines.[1] Unluckily, the interaction between the clinician and these information sources is largely inefficient, requiring a sum of skills to refine the question and reduce the amount of irrelevant information. It is annoying that it can take several minutes to find the desired information but only a few seconds to incorporate it into the medical decision analysis.

Busy exploiting the opportunity to create efficient information services to support the clinical decision workflow of physicians, publishers have invested a remarkable amount of energy in properly orchestrating collections of high-quality online information sources that are critically appraised, synthesized, and delivered in a user-friendly manner. To sustain the added value of these innovative tools, the marketing management of some publishers claims that their use would be appropriate when clinicians and patients interact, at the point of care. The marketing suggestion is powerful: contents conveying a clear and concise message about what to do within the context of a provider-patient dyad become worldwide popular as point-of-care services.

We can distinguish two families of point-of-care information services: the first simply collect and organize relevant and synthesized information sources (e.g. meta-lists, search engines); the second elaborate this information into original and structured contents (summaries, synopses). Both draw

on two pillars of evidence-based information mastery: filtering and organizing. Medical literature is selected for relevance and validity (filtering) and presented in a quick, easy, accessible form (organizing). Following Haynes' classification, these services are set at the tip of the pyramidal 6S model [2-4]: comprehensive and sophisticated information tools (systems, summaries) built up on a systematic assembly of the evidence (synthesis, synopsis). Although Haynes gives a thorough perspective of the layer differences in his model, services may overflow between layers, may evolve from one layer to another, or peculiar elements may be attributed to more than one layer.

The innovative aspect of these information services relies on how contents are engineered *to be used* at the point of care. Point-of-care information can be logically grouped around common medical scenarios and translated into sets of actions- what to do -related to diagnosis, treatment and management. Two examples of how these services mime the natural thought flow for treatment and diagnosis are presented in Figures 1 and 2, respectively. These sets of actions result in structured lists of items including a summary, definition and key therapeutic and diagnostic steps specific to the patient scenario. Software and interface are the core components of point-of-care service architecture: they should be able to naturally adapt contents to the clinical workflow (i.e. provide the first-line options, then the alternatives), minimising the number of clicks required to reach information and providing the information in real time. Traditional educational contents, paper-based books, are abandoned to adopt new media (i.e. smartphone) that push the portability of information and the drive-by consultation (i.e. Skyscape). The quality of point-of-care services indeed depends on two broad dimensions: accessibility and value of information.[5] Ideally, these information resources should excel in both dimensions.

Evaluation of point-of-care information services

At the end of 2008, at least 18 products that could be classified as evidence-based practice point-of-care summaries were available at different costs (from free of charge up to US$495).[6] As for all research, the quality of point-of-care products needs to be evaluated to ensure their real usefulness for clinical practitioners and, given the plethora of point-of-care services, the only way to obtain conclusive evidence regarding on the real utility and practicality of one product over the other is to compare two or more products directly.

Few articles comparing point-of-care services have been published. Most were aimed at assessing the user's satisfaction and how well different online information services answered questions arising in daily clinical work (Table 1).[5, 7-13] Keeping in mind that any user-centred evaluation to identify the best product can be biased by previous beliefs and habits of a specific service, nevertheless some services, such as UptoDate, were often ranked high. A mixture of general and

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medical search engines (AltaVista, WebDoctor, MedLine), meta-lists (MD Consult, STATRef!), secondary literature (The Cochrane Library) and point-of- care summaries (Micromedex, UptoDate, Clinical Evidence, Dynamed) was compared. Asking doctors to rate these information services, with different aims achieved through different information and technological solutions, is clearly deceptive. Systematic reviews are an immediate example of this limitation: although Cochrane reviews are long, technical and sometimes hard to read, summaries, systems, and other downstream products are largely based on them. In other words, systematic reviews should be viewed as evidence sources that feed point-of-care services rather than point-of-care services themselves. The results from these studies should be analysed with caution. An inappropriate comparison influences the apparent effectiveness of point-of-care services, but also satisfaction and practical details such as time for successful task realisation. Even seemingly straightforward information services have inherent complexities that can bedevil well-designed comparative research.

Beside user- or experience/satisfaction evaluation, research has looked into content-centered evaluation. The pioneering study by Wyatt et al. offered a wide view on the quality of a variety of computer-based evidence services used by oncologists. [14] Authors suggested quality dimensions that can be vital for preferring one online information service over another: what kind of information is included, update frequency, editorial space, and how information is identified and assembled. Focusing on online evidence-based practice point-of-care summaries, Banzi et al. recently reviewed information services at the point-of-care to evaluate their content and editorial policy.[6] Selection of quality dimensions (Table 2) was informed by evidence, whenever possible. For some quality indicators, such as the literature retrieval process and updating, criteria were borrowed from research on good systematic review reporting methods [15], assuming that these apply equally to further synthesised information tools. Other dimensions, such as authors' conflict of interest and peer review, come from peer-reviewed medical journals' policies, and their quality has been extensively debated.[16-18] Services not addressing these quality dimensions were assumed to be associated with an increased risk of bias or scarce reliability.

Only few products satisfied the quality criteria: Clinical Evidence, Dynamed, eMedicine, EBMGuidelines, and UpToDate were at the top of our ranking but none of them excelled in all criteria. For instance, one service was outstanding in its editorial and evidence-based methodology but scored at the very bottom of our ranking for the number of conditions covered. The quality of these products was indeed variable but is likely to be progressively reaching more satisfactory standards. The key methodological limitation in content evaluation is the large subjectivity in choosing quality features and-more challenging-assigning their relative weights if the final aim is to rank products.

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The choice of one product over another depends both on the properties of the service and the preference of users, according to the personal weight attached to different dimensions. The more complete and customisable to different settings and needs is the product the more successful it will be. However, even the most innovative information system must rely on transparent and valid contents. For this reason besides efforts to improve the technology of information vehicles, sound evidence should always be preferred during the development of product content.

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Point-of-care services forecast

Given the immaturity of point-of-care services, it is challenging to predict how they will affect clinicians. We must take account of several elements that could act interactively, potentially transform the medical profession. In this imaginative model we assume that pressure from patients, insurances and national health systems to adopt evidence-based medicine, boost the reliability of medical decisions, and align practitioners' remuneration with performance metrics and quality indicators will continue. We also assume that local contexts will influence the clinical workflow, with additional micro-legal and organisational requirements. Finally, treatment innovations and best-practice major advances will be increasingly difficult to manage by a single health professional with limited time to access the whole published knowledge. This scenario challenges the medical profession as doctors alone, no matter how wise and up-to-date they may be, can miss important elements integrating evidence-based medicine, performance metrics, reimbursements, legal requirements, professional experience and patient agenda.

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Clinical workflow based on tacit, collectively reinforced guidelines, internalised (mindlines) is regarded as anachronistic.[19] To migrate toward evidence-based knowledge and quality improvement, clinical decision-making needs to be backed by information systems, such as point-of-care services. Some countries are reacting more than others to the integration of information systems into the clinical workflow. Finland's experience with Evidence-Based Medicine electronic Decision Support (EBMeDS) shows the spread of point-of-care services among health care professionals accustomed to using online evidence.[20] The terrain appears to be ready for more evolved health information technology: computerized information and clinical decision support (i.e. reminders) linked to electronic health records have the potential to improve the effectiveness and the efficiency of health care providers.

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Role of publishers

Several editorial groups and public health organisations have shown a vivacious interest in point-of-care information services, attracted by high profitable gains and/or significant value creation. The

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publishers' mission is changing: the traditional medical journal publishing trials and reviews in general or specialists formats is perceived as too static and remote from practice. Now publishers are re-focusing their efforts toward "information hubs" in which several information kits widely connected with other informatics systems (e.g. search engines, decision support, computerised order entry, electronic health records, learning interfaces) can be assembled. Healthcare professionals and providers should start to perceive the function of publishing differently, with publishers as rendering services and vendors. Alongside resounding marketing claims, point-of-care products should improve the transparent and accurate reporting of strengths and weaknesses of the information summaries and services they provide. [6] Publishers should find a balance between information consumed at the point of care - necessarily distilled, unnecessarily simplistic - and fidelity to a cumulative and extended approach to information. Final users should value both dimensions: the action "what to do" and the reference content "why we do". An information service proposed by an authoritative and well-known publisher is not a guarantee itself of optimal service, even if "brand" still plays a key role. Start-up companies mostly connecting clinical databases, with a limited publishing tradition, should demonstrates to account for the complexity behind the clinical decision-making.

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Table 1: Studies evaluating online information services' ability to answer clinical questions.

Reference	Physicians' specialty	Electronic information services evaluated	Best-ranked electronic information services
Ely 1999, 2005 [5, 9]	Internists, paediatricians, GPs	Choose by clinicians	UptoDate, MDConsult, E-pocrates, Micromedex
Graber 1999[13]	GPs	MDConsult, HotBot, Excite, Hardin MD, Medical World Search, AltaVista, HON, Yahoo/health, Medscape, WebCrawler, Achoo, WebDoctor, Medical Matrix, Medguide, Sixsenses, MedWeb, Sleuth, MD Gateway, Medaccess	MDConsult
Alper 2001 [7]	GPs	MDConsult, DynaMed, MAXX, MDChoice.com, American Family Physician, SUM search, Medical Metrix, Primary Care Clinical Practice Guidelines, Medscape, WebDoctor, Virtual Hospital, ClinWeb, TRIP)	STAT!Ref, MD Consult
Campbell 2006 [10]	Physicians, pharmacists, medical informatics students	ACP's PIER, Micromedex-Diseasedex, FirstConsult, InfoRetriever, UptoDate	UptoDate
D'Alessandro 2004 [8]	paediatricians	GeneralPediatrics.com, MDConsult, Medline, Micromedex	GeneralPediatrics.com, MDConsult,
McKibbon 2006 [12]	GPs	Medline, Internet, Cochrane Database of Systematic Reviews, MD Consult, Ovid Evidence Based Medicine Reviews, UptoDate, InfoPOEMs, Lancet, Clinical Evidence	None
McCord 2007 [11]	Family medicine residents	ePocrates, Griffith's 5-Minute Clinical Consult, UpToDate	UpToDate

Table 2: Quality criteria to evaluate the content and editorial policy of evidence-based practice point-of-care summaries (adapted from [6])

Editorial quality	Evidence-based methodology
Authorship: clear indication of the author(s) of a specific content reported in the output. Reviewing process: detailed description of the procedures aimed at assessing and ensuring the scientific quality of output (review process by external peer reviewers and/or by editors). Updating: frequency of content updating (continuously, periodically, once a year, etc). Authors' conflict of interests: whether a formal policy on authors' commercial conflict of interests is implemented and this information is reported. Commercial support: to what extent commercial support and advertising are accepted in the content development policy	Literature search/surveillance: whether contents are written on the basis of a specific systematic literature search based on explicit search strategies and aimed at identifying relevant and valid articles or if systematic tracking of the relevant and valid articles based on predefined sample of leading journal and journal review services is utilized. Cumulative vs. discretionary approach: whether content is preferably written on the basis of systematic reviews rather than other publications. Critical appraisal methodology: the use of standard and transparent methods to assess articles' validity. Grading of evidence quality: if a formal system is implemented to grade the level of evidence. Cite expert opinions: if statements based on experts' opinions are easily recognizable compared to study data and results.

Figure 1: mimic of an hypothetical thought flow targeting the treatment for acne vulgaris (adapted from BestPractice, http://bestpractice.bmj.com/best-practice/welcome.html)

Figure 2: mimic of an hypothetical thought flow targeting the diagnosis of obstructive sleep apnea (adapted from Dynamed, http://www.ebscohost.com/dynamed/)

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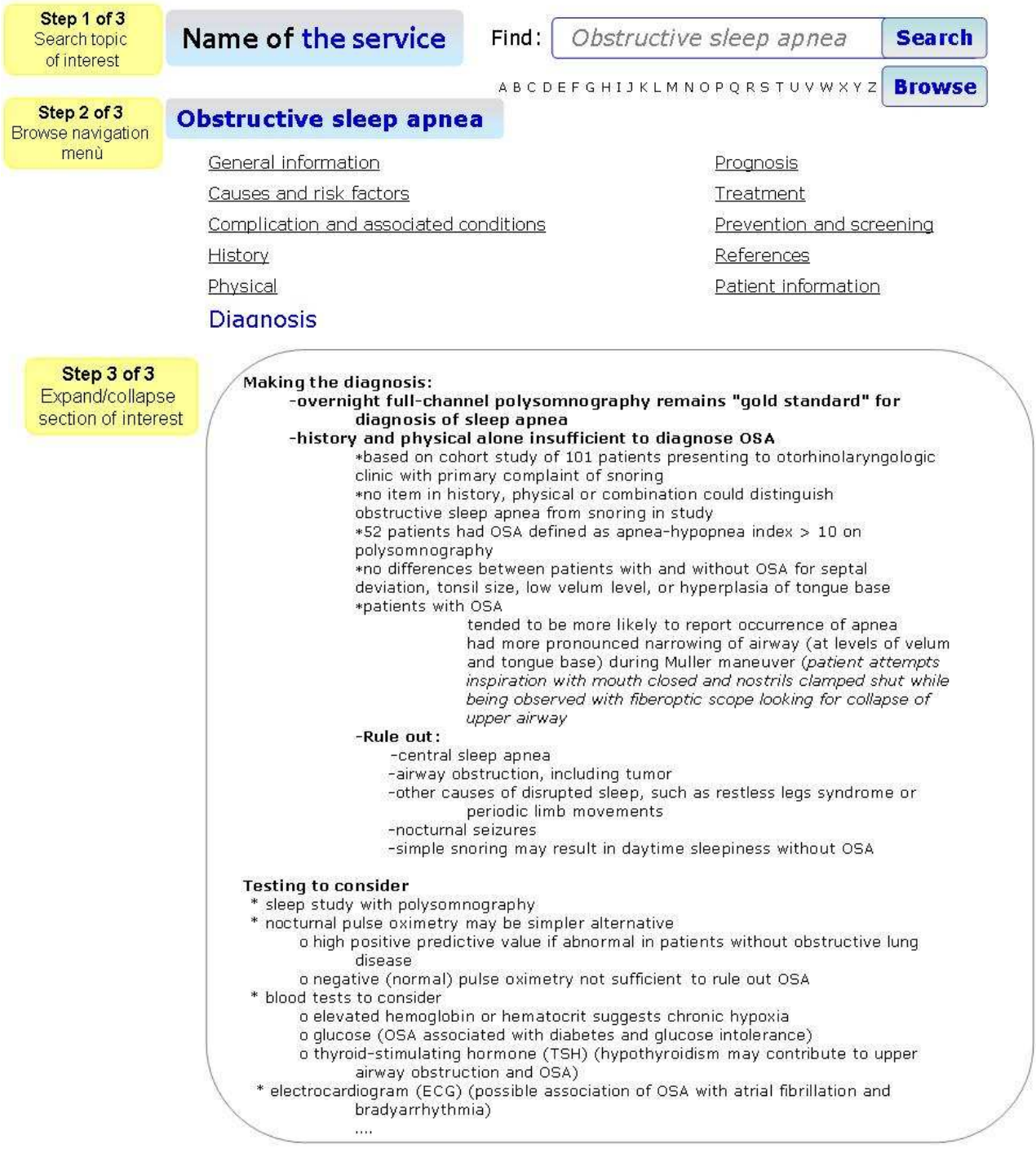
Step 1 of 3
Search topic of interest
Name of the service
Find:
Obstructive sleep apnea
Search
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Browse
Step 2 of 3
Browse navigation menù
Obstructive sleep apnea
General information
Causes and risk factors
Complication and associated conditions
History
Physical
Prognosis
Treatment
Prevention and screening
References
Patient information
Diagnosis
Step 3 of 3
Expand/collapse section of interest
Making the diagnosis:
-overnight full-channel polysomnography remains "gold standard" for diagnosis of sleep apnea
-history and physical alone insufficient to diagnose OSA
*based on cohort study of 101 patients presenting to otorhinolaryngologic clinic with primary complaint of snoring
*no item in history, physical or combination could distinguish obstructive sleep apnea from snoring in study
*52 patients had OSA defined as apnea-hypopnea index > 10 on polysomnography
*no differences between patients with and without OSA for septal deviation, tonsil size, low velum level, or hyperplasia of tongue base
*patients with OSA
tended to be more likely to report occurrence of apnea
had more pronounced narrowing of airway (at levels of velum and tongue base) during Muller maneuver (patient attempts inspiration with mouth closed and nostrils clamped shut while being observed with fiberoptic scope looking for collapse of upper airway
-Rule out:
-central sleep apnea
-airway obstruction, including tumor
-other causes of disrupted sleep, such as restless legs syndrome or periodic limb movements
-nocturnal seizures
-simple snoring may result in daytime sleepiness without OSA
Testing to consider
* sleep study with polysomnography
* nocturnal pulse oximetry may be simpler alternative
o high positive predictive value if abnormal in patients without obstructive lung disease
o negative (normal) pulse oximetry not sufficient to rule out OSA
* blood tests to consider
o elevated hemoglobin or hematocrit suggests chronic hypoxia
o glucose (OSA associated with diabetes and glucose intolerance)
o thyroid-stimulating hormone (TSH) (hypothyroidism may contribute to upper airway obstruction and OSA)
* electrocardiogram (ECG) (possible association of OSA with atrial fibrillation and bradyarrhythmia)
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