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SUPPLEMENT ARTICLE

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Digital allergology: Towards a clinical decision support system for allergen immunotherapy

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Abstract

Mobile health is the "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices." For example, mobile apps (such as MASK-Air, Allergy. Monitor, Pollen, and others) have proven useful in the management of patients with allergic rhinitis. These apps can be used in the context of broader clinical decision support systems (CDSS) for enhancing allergy-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve allergy care. A CDSS targeted to control rhinitis with drugs and other interventions guiding the patient in his/her self- and doctor-driven management is currently being produced and investigated by the MACVIA network. Another one, called @IT-2020, is targeted to support etiologic diagnostics and allergen immunotherapy (AIT) prescriptions for patients with seasonal allergic rhinitis. Intensive investigation is necessary to better define the advantages and limitations of mobile-health technology in allergology and establish guidelines for their proper use in daily practice in the context of a rapidly evolving European regulatory environment.

KEYWORDS

allergy diagnostics, clinical decision support, digital health, disease management, mobile health

1 | THE DIGITAL HEALTH TRANSFORMATION

According to the World Health Organization (WHO), mobile health is defined as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices."[1] According to the 71st World Health Assembly in Geneva (2018), mobile wireless technologies have the potential to revolutionize the interaction of populations with national health services. They improve quality and coverage of care, increase the access to health information, services, and skills, thus promoting positive changes in health behaviors and preventing the onset of acute and chronic diseases.

The WHO Director General recommended Member States to identify standardized approaches for applying digital health in their health systems and services. Several aspects of traditional health care will be changed by the digital health revolution: (a)

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The point of care is no longer the clinic or laboratory, but the patient; (b) the approach to care is based rather on the individual patient than on a population of patients with similar disease; (c) the traditional hierarchy between doctor and patient (doctor as an authority) based on prescriptions and orders is replaced by a collaboration based on a partnership (doctor as a guide); (d) the patients' data are their own property, not that of any institution; (e) decisions will be based rather on limitless data analysis than on the doctors' experience only; (f) the doctor is not isolated in an ivory tower, but interacts publicly with the patients via social media; and (g) the costs of care are diminished.[2]

2 | DIGITAL HEALTH IN ALLERGOLOGY

Digital health may also have a very positive impact on allergic patients. A position paper by the American College of Allergology, Asthma and Immunology (ACAAI) stated that allergic patients, especially those living in rural or remote areas, benefit from telemedicine. Consequently, a better patient-doctor collaboration, easy access, and adherence to allergists' consultation and prescription become possible.[3] However, the document points out the need of improved regulations and certification programs, high attention to data protection, and the development of adequate reimbursement systems.[3] Recently, a Task Force of the European Academy of Allergy and Clinical Immunology (EAACI) published a position paper on "Mobile Health & Allergy."[4] The study group examined over 130 allergy-related apps and reported on the role of mHealth technologies in allergic rhinoconjunctivitis and asthma, atopic dermatitis, chronic urticaria as well as food allergies, anaphylaxis, drug, and venom allergies.[4]

3 | APPS FOR ALLERGIC RHINITIS

Although many apps are dedicated to allergic rhinitis, only few have been used in studies published in peer-reviewed international journals.[4] A very large collaborative network focused on rhinitis and its treatment is accumulating evidence through the worldwide use of *MASK-Air* (*MASK* stands for Mobile Airways Sentinel Network). This electronic clinical diary assesses nasal, ocular and asthma symptoms, as well as work impairment and global health via visual analogue scales (VAS).[5] *MASK-Air* has already accumulated real-life data from a large number of patients worldwide, whose analysis has led to innovative knowledge on productivity at work, innovative patterns of treatment, and new allergic disease phenotypes.[6] Another app, called *Allergy.Monitor*, is dedicated more specifically to the measurement of symptoms and medication intake of patients and their correlation with local pollen concentrations.[7] It has been instrumental to improve disease awareness and adherence to daily therapy with nasal corticosteroids in children with grass pollen allergy.[8]

Key message

Mobile apps can be used in the context of broader clinical decision support systems (CDSS) for enhancing allergy-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve allergy care delivery.

4 | CLINICAL DECISION SUPPORT SYSTEMS (CDSS)

According to HIMSS (Healthcare Information and Management Systems Society), a "CDSS is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information to improve health and healthcare delivery."[9] The origins of CDSS date back to the 1960s, an example how this field of medicine has initially developed slowly, and now, in the era of the internet develops much faster.[10]

A CDSS is generally composed of three elements: A) data; B) algorithms; and C) reporting: (Figure 1).

- The data may come not only from the patient, but also from the environment the patient is exposed to and the community he/she is living in. The patient's data include information from his/her past and current clinical history, results of investigations

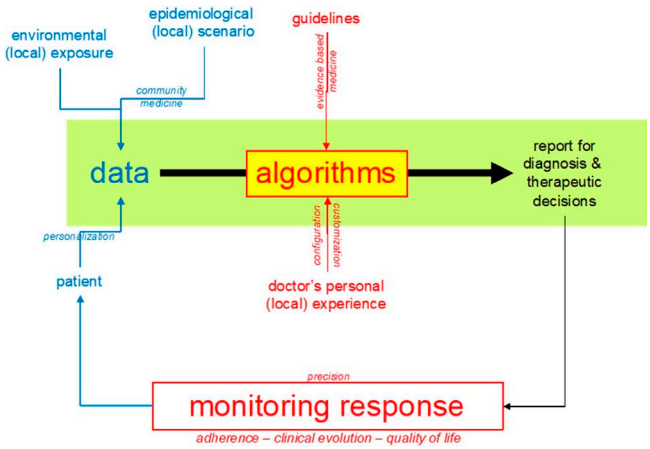

FIGURE 1 General concepts of a clinical decision support system. Three elements compose a CDSS: (a) data—from the patient and also from the environment (to which the patient is exposed and from the community in which he is living); (b) algorithm—mathematical formulas (simple or complex) that take the data and generating reports; and (c) reports—can be delivered as a written report, a suggestion of further diagnostic examinations, a therapeutic plan to the operator (ie, the doctor) as a suggestion to be considered for his/her actual diagnostic or therapeutic decision [Colour figure can be viewed at wileyonlinelibrary.com]

and examinations prescribed by the doctor, and data acquired through monitoring of his symptoms and medication (clinical diary).

- The algorithms are, in most simple terms, mathematical formula (simple or complex) using the data and generating reports, suggesting diagnostic interpretations, or therapeutic decisions. These algorithms can be rigid or flexible and can be anchored in or based on clinical guidelines. Flexible algorithms can be modulated or fine-tuned by the operator (ie, the doctor) who can adjust thresholds, decision cut-points, and lists of the parameters to be taken into consideration, according to his/her own experience. Fine-tuning can be applied to the local patient population or to individual patients.
- The reporting system can appear as a written report, a suggestion of further diagnostic examinations, or a therapeutic plan and is directed to the operator (ie, the doctor) as a suggestion to be considered for the actual diagnostic or therapeutic decision.

A CDSS can also incorporate a reiteration process, consisting in further monitoring of the patient, for example, once the therapy has been started to register the patient's response to treatment. A new application of algorithms enables further reporting.[10]

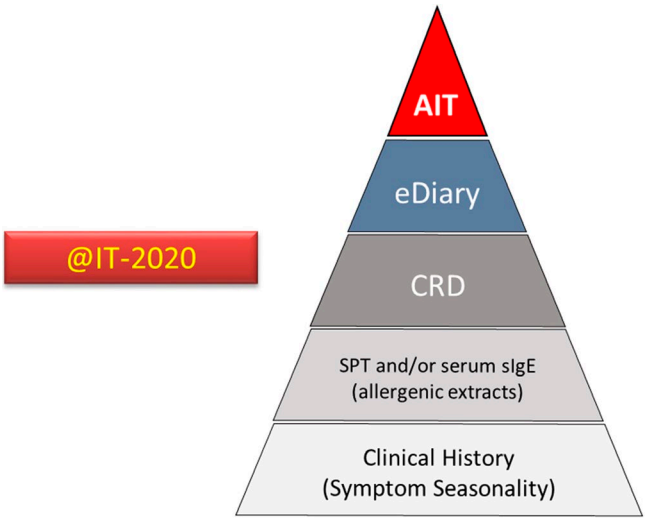

FIGURE 2 @IT-2020 is a CDSS system based on several steps in a diagnostic workup: collection of clinical history, pollen calendar information, determination of allergic sensitization with allergen-extracts, component-resolved diagnostics, and clinical monitoring through an electronic diary. Algorithms used in each of these steps are based on international guidelines including ARIA, GINA, and EAACI guidelines for SPT, molecular IgE assays, and pollen season definitions. The CDSS is flexible and customizable as the different steps can be used in various combinations and sequences and the thresholds for decisions adapted to the doctor's targets and the local epidemiological and environmental conditions [Colour figure can be viewed at wileyonlinelibrary.com]

5 | CDSS FOR ALLERGIC RHINITIS

A CDSS for rhinitis, including allergic rhinitis, has been produced by the MACVIA network and is the object of active investigation.[11] This CDSS is targeted to control rhinitis with drugs and other interventions and guide the patient in his/her self- and doctor-driven management.[11] Another CDSS, called @IT-2020 (Figure 2), is exclusively dedicated to seasonal allergic rhinitis and to the prescription of allergen immunotherapy. @IT-2020 is based on the collection of clinical history, pollen calendar information, determination of allergic sensitization with allergen-extracts, component-resolved diagnostics, and clinical monitoring through an electronic diary. Algorithms are based on international guidelines including ARIA, GINA, and EAACI guidelines for SPT, molecular IgE assays, and pollen season definitions. This CDSS system guides the doctor through the different steps of the diagnostic workup and, on the basis of the electronic clinical diary and pollen counts, provides evidence on the frequency and intensity of the patient's allergic symptoms during the season of those pollens, whose genuine IgE sensitization has been proven by component-resolved diagnostics. Each element of this CDSS is being validated, and the CDSS itself is tested in a large international project called @IT-2020 currently in progress in seven Southern European countries.

6 | PERSPECTIVES AND CONCLUSIONS

Overall, the role of doctors, in particular allergists, and their interaction with their patients, will be progressively altered with the increasing use of digital opportunities in order to improve patient care. WHO, ACAAI, EAACI, and other relevant international organizations have recognized the advent of the mHealth era in medicine and allergology. This novel area requires regulation and intensive investigation to better define the advantages and limitations of mobile health technology in allergy and establish guidelines for their proper use in daily allergy practice.

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CONFLICT OF INTEREST

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