



Rhinitis: adherence to treatment and new technologies

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Purpose of review

Nonadherence to treatment is a major issue in approximately 50% of patients suffering from chronic diseases. The availability of new technologies could represent a possible way to improve patients' engagement and adherence in a real-life setting. Research and technology tools made available or in process of being made available to patients with allergic diseases and their physicians could potentially improve the management of these disease in daily life by improving adherence. In this review, we sought to outline many of the recent advances in these technological approaches.

Recent findings

Short Message Service (SMS) reminder, social networks, wearable devices, mobile applications (Apps), monitoring systems of inhaled device use, often presented as 'serious game' are changing the way of approaching to chronic disease, such as rhinitis, management.

Summary

Studies of the role played by various technologies in improving adherence to treatment in rhinitis are still limited as compared with other diseases such as asthma, but the results are encouraging. Further studies in this area may lead to the discovery of novel management approaches that is easy to be integrated in patients' daily life.

Keywords

adherence, allergic rhinitis, mobile health, new technologies

INTRODUCTION

Adherence to treatment remains important for successful management of diseases. The problem of nonadherence to treatment is reported in approximately 50% of patients suffering from chronic diseases, leading to unsatisfactory health outcomes, lower patients' well being, and increased direct and indirect costs [1]. Reasons for nonadherence are complex and multifaceted [2]: they depend on the interactions between different factors related to the patient (i.e. age, psychological traits, knowledge about disease and treatment, disease awareness, and lifestyle), the disease (i.e. chronicity, symptoms' characteristics, and presence of comorbidity), the treatment (i.e. number of daily doses to take, side-effects turn-out, difficulties in drug assumption, external characteristics of the drug itself), and the doctor-patient relationship (i.e. quality of communication, level of sharing and satisfaction). As a consequence, it is necessary to adopt complex and multifaceted strategies to overcome this problem. In this perspective, the availability of new technologies

may represent a valid tool to promote patient engagement and improve adherence.

The last decade has witnessed an amazing advancement in technologies. Nowadays, we have portable carry on computers with performances similar to a calculator that, a few years ago, would have occupied a large room [3]. Furthermore, the reduction of cost of electronic gadgets makes it affordable for a large sample of worldwide

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Curr Opin Allergy Clin Immunol 2017, 17:23–27

DOI:10.1097/ACI.0000000000000331

KEY POINTS

- The technologic development provides tools that are nowadays accessible to a large percentage of the population.
- The availability of easy to use, low cost, widespread technology offer the potential for changing the overall process of care.
- People may communicate and share data and information in real time with the healthcare staff and with other patients.
- Technologies and innovations which we can use or will be available soon may represent a valid help to better manage the respiratory allergic diseases, and to overtake the barriers to adherence.

population. We are therefore in the middle of the so-called era of ‘mobile revolution’: in other words, the widespread use of mobile tools (smartphones, tablets, and wearable devices) with a connection to the WEB.

Recent data (<http://www.tsw.it/digital-marketing>) have demonstrated that Internet users reached 3.4 billion accounting for 46% of the global population; 3.8 billion people own at least a mobile tool. In fact last year there has been a 10% increase in the number of registered Internet users with respect to 2015. This phenomenon is not limited to the most younger: in Italy, for example, the percentage of those in the age group of 65–75 years old that surf Internet has risen from 3.9% in 2005 to 25.6% in 2015 (<http://www.senioritalia.it/2016/04/anziani-istat>). It has been estimated that, in 2017, the number of smartphones will be greater than the total global human population, with a relevant diffusion also in the developing countries [4,5].

The functions of smartphones go beyond the possibility to phone and use messages. In fact, they have incorporated different sophisticated tools (media players, camera and video cameras, Global Positioning System – GPS - tracker, near field communication – NFC-technology, gravity sensor level meter) that increase their potentiality of use.

Today, as a result of wireless Internet and mobile broadband, smartphones guarantee high-speed data access, cloud-based platform access and e-mail handling. They may connect with other electronic devices thanks to Bluetooth technology or Wi-Fi, with possibility to transfer data between devices. Moreover, ease of interface high-resolution touch screen and web browser permit displaying also standard web pages and mobile-optimized website, making the smartphone a powerful tool [6“].

A key innovation related to the availability of new technologies has been the rapid diffusion of social media platforms (i.e. Facebook, Twitter, WhatsApp, and Instagram). They consist in Web 2.0 Internet-based applications that allow users to create their own profiles, to be inserted in a social network, and to share text, photos, videos on a social networks with other individuals and groups of the own network.

The availability of easy to use, low cost, widespread technology, has modified every aspect of our life, therefore the management of health-related problems. New terms, such as ‘mobile-health’ or ‘m-health’, are now used referring to the large and increasing set of mobile health applications with a variety of functions.

The World Health Organization (WHO) underlined that m-health encloses the potential for changing the overall process of care at planetary level [7“].

We are assisting, both on the part of the media that from consumers, to a growing interest in the use of new technologies applied to health.

The availability of ever sensitive, powerful, manageable devices and the Internet penetration have high potential to physicians, patients, and health-care in general. In fact, it may be useful for promoting healthy behaviors and lifestyles, monitor, track, collect and transmit data in real time, facilitating the doctor–patient communication, increasing the level of sharing and cooperation between the patient and health professionals, offering the patient-specific tools for self-management of health, improving the efficiency of the health system, expanding the opportunities of access to care, encouraging the personalization of medical intervention, allowing the use of new research methods.

This growing process may be considered a real metamorphosis, which is changing radically the way to make a diagnosis and the strategies for the long-term management of chronic diseases. The boundaries between the doctor and the patient’s home could be eliminated: the doctor can, as effectively written by Asch *et al.* [8] ‘turn around the patient’, that is, he can have full availability of information, in real time, on the behaviors and health status of the patient. This chance represents real change of the common routine in which patient usually spends only a few hours of his life in contact with the medical staff. In the traditional scenario, the doctor’s consult involves registering and analyzing the results of clinical and instrumental examinations, asking questions to patients, and making the choices on the basis of the collated information. He has not, however, direct and real-time access to a number of everyday patient behaviors (adherence to

treatment, food habits, level of physical activity, smoking status, sleep, etc.) that are relevant to optimize the health management (adherence to treatment, food habits, physical activity, smoking status, and sleep). Moreover, he cannot detect changes in the clinical picture and symptoms.

The technology allows overcoming this obstacle, easily and reliably, by using tools that are nowadays accessible to a large percentage of the population.

The potential power of new technologies for public health is intrinsic to their nature: people may communicate and share data and information in real time with the healthcare staff and with other patients.

The means offered by this scenario are intriguing, and should be seen with relation to the noticeable changes in the healthcare landscape. The increase in chronic diseases due to the progressive ageing involves the growth of the direct and indirect costs and difficulties of care sustainability. It therefore becomes necessary to rethink and redesign interventions and services, seeking greater appropriateness at all stages of the care process. In parallel, there is a need for a medicine of precision, that includes a custom action on the basis of genetic information and clinical data of each patient [9].

RHINITIS, TECHNOLOGY AND ADHERENCE TO TREATMENT

Research and technology have made available to patients and their physicians several tools to improve the management of allergic disorders in daily life. An overview of the more recent literature about the use of leading innovative technology to improve adherence in allergic rhinitis (AR) patients is provided.

Electronic communication and social media

The utility of a simple intervention with Short Message Service (SMS) reminder to improve adherence in patients with AR has been recently explored, both in adults and in children.

In a randomized controlled trial, 50 outpatients with AR were assigned to receive or not to receive a daily SMS reminder to take intranasal corticosteroid treatment for 30 days. At the end of the study [10¹¹], self-reported adherence, clinical attendance rate and symptoms improvement were significantly higher in the SMS group than in the control group.

Similarly, a higher adherence to nasal corticosteroid treatment was demonstrated in among 30 children and adolescents with AR, compared with a control group, receiving SMS alerts inviting them to

record their symptoms and medication on an e-health platform [11¹²].

The results of recent studies suggest that social networks may play a role in allergic disease surveillance and management. These issues may indirectly support the adherence, by improving the level of awareness, knowledge and promoting and effective physician–patients partnership.

A study conducted in USA had the aim to explore the potential of Twitter as a source of information on allergic diseases prevalence, starting from the observation that Twitter users suffering from AR may write tweets that include symptoms and names of drugs they take for the treatment of AR. A total of 43 467 tweets consistent with the AR case definition and a total of 17 987 tweets that include a name of an antihistamine were obtained in the selected period (February–September 2013). US pollen counts showed high correlation both with tweets reporting AR complaints and with tweets that mentioned an antihistamine [12¹³].

The American Academy of Allergy, Asthma, and Immunology (AAAAI) and the magazine Allergic Living hosted #Allergyready, springtime Twitters chat on 26 March 2015. For 1 h, people who want to learn more about allergies were invited to discuss about topics related to AR. The chat reached over 1 million accounts and made more than 6.8 million impressions [13].

Moreover, Twitter represents a useful method to rapidly disseminate health-related information. It is used by allergists and immunologists to share in the scientific community the latest news and papers, and the accounts of scientific societies, journals and physicians have thousands of followers. The number of tweets sent during AAAAI annual meetings increased by 547% between 2012 ($n=1481$) and 2015 ($n=9584$) [14¹⁵]. By ‘tweeting the meeting’, an activity that is officially supported by the professional organizations, physicians who cannot attend a congress have the possibility to share the more relevant topics following the hashtag stream from the meeting.

Wearable devices

The wearable devices (bracelets, watches, bandages, and bands) through the use of special sensors are able to detect and monitor-specific physical parameters (heart rate, respiratory sounds), level of physical activity (number of steps performed, number of hours of inactivity) and sleep (total hours of sleep, REM sleep, nocturnal awakenings, and snoring).

As a result the availability of low-power processors which use lithium batteries provides various

wireless connections, access to the Internet, and can use different sensors and biosensors. These represent a good opportunity to monitor the patients in real life in a passive and nonintrusive manner, to provide information to the management of their disease, to help them to achieve and maintain a healthy lifestyle [15].

Recently, the various phases of development of a wearable sensor which allows correlating exposure to the environment and the patient's physiological data allowed understanding the impact of an increased level of ozone and allergens concentration on upper and lower airways function [16^o]. No specific studies about the use of wearable devices for improving adherence and management of AR are yet available.

The apps

Mobile applications (known by the abbreviation 'apps') for health are software applications dedicated to mobile-type devices (smartphones and tablets), whose function is to monitor symptoms, clinical parameters, patient's behaviors (i.e. physical activities, sleep) and environmental factors (i.e. pollen counts). They allow patients to communicate with their healthcare professional or with other patients. Moreover, they permit receiving information about the illness and to serve as reminders (i.e. remind the patient to take the therapy or make a scheduled visit control).

The results of a recent audit [17] show that, just in a period of 2 years, it has changed the availability and the features of the apps developed for allergic patients. For example, in the period between 2011 and 2013, the number of apps for asthma has more than doubled, from 93 to 191. In the same period, there is almost an even doubling of the number of free applications available (from 33 to 64%) and a reduction in the cost. Most of the apps are being developed in the US in English, but in the period under consideration increased from 13 to 21 the number of countries in which they were developed.

A worldwide consortium recently proposed an integrated plan to introduce the mobile health technology in the management of AR. MASK-rhinitis (MACVIA-ARIA Sentinel Network for allergic rhinitis) is a novel simple method that, thanks to a clinical decision support system (CDSS), is able to combine three tools for the electronic monitoring AR: a cell phone-based daily visual analogue scale (VAS) assessment of disease control, a validate questionnaire, CARAT (Control of Allergic Rhinitis and AsthmaTest) and e-Allergy screening (premedical system of early diagnosis of allergy based on online tools). By a cell phone, the patient is geolocalized. At the predicted

time of the pollen season, the patient receives an SMS and an e-mail indicating that he should monitor VAS daily by using the touch screen. All the information is sent to a CDSS. MASK-aerobiology is monitored daily and CARAT is available at the onset of the pollen season and thereafter every 2 weeks. MASK-rhinitis also provides information to patients and to the media with regard to the pollen season, optimal management allergy, clinical trials, research, and climate evaluation [18^o].

Technology applied to inhaler device

Inhaled therapy is the cornerstone of asthma and rhinitis. Taking medication by inhalation means it is possible to deliver high concentrations of the active drug in the target organ, allowing obtaining the desired effects limiting the systemic exposure and side-effects. However, this route of administration could be associated with a low rate of long-term adherence and to handling errors in devices use.

For this reason, since the mid-80s, monitoring systems applied to devices for asthma treatment have been developed, which over the years have become increasingly sophisticated [19,20] providing audiovisual signals to remind the patient to take the medication or allowing the physician to monitor adherence and to detect where the patient is and when he is taking his medicine. Furthermore, if the tools are associated with a wireless connection, it will be possible to identify the locations where triggers are present or rescue drugs are consumed making preventable the symptoms onset or further clarifying the relationship between allergen exposure and rhinitis/asthma attack.

Modern technology will allow us to monitor the inhalation competence of the patient [21]. There are indeed devices allowing detecting whether the canister has been properly stirred before taking the medication or the inhalation time with regard of the inspiratory effort or phase; others are able to activate the device when the patient's inspiratory effort is optimal. The available data on technology applied to inhaler device still derive from studies on asthma treatment. The efficacy of monitoring systems for nasal spray is conceived and they should be useful to detect medication misuse or overuse.

The key news

Sophisticated tools are already available from a technological point of view, but a simplified use is needed. Most recently proposed are 'serious games' [22] which enable involving the patients in the care process and help them to understand and better manage their disease. Games are goal-oriented,

stimulating, motivating and offering an immersive experience. They can be used to improve attitudes and self-effectiveness for health behavior change. They have been used in asthma as a tool to improve adherence [23], but no studies are available for AR.

CONCLUSION

As aptly pointed out in a document by a National Bioethics Committee (http://presidenza.governo.it/bioetica/pareri_abstract/Mobile-health.pdf), technologies and innovations which we can use or will be available soon are relevant in order to improve public and individual health. They are easy to implement and offer real opportunities to improve chronic disease management, increase the appropriateness of treatment choices, lower costs, keeping the patient at the center of the care process.

Acknowledgements

None.

Financial support and sponsorship

None.

Conflicts of interest

There are no conflicts of interest.

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