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Antonella Valeria Penati *Editor*

In-Home Medication

Integrating Multidisciplinary Perspectives in Design-Driven Pharma Practices

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In-Home Medication

Integrating Multidisciplinary Perspectives in Design-Driven Pharma Practices

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ISSN 2198-7300 ISSN 2198-7319 (electronic)
Research for Development
ISBN 978-3-031-53293-1 ISBN 978-3-031-53294-8 (eBook)
https://doi.org/10.1007/978-3-031-53294-8

Politecnico di Milano

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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Chapter 9
The Future Digital Pharmacological Prescriptions Between Therapy Adherence and Integrated Healthcare Personal Plans

Giuseppe Andreoni

Abstract The medical prescription is a most used and common tool to deliver clinical instructions for healthcare actions to the patient and among all the clinical actors involved in the process. Today this informative process is implemented by a paper sheet different in each country for format and content. In Italy it contains a limited set of instructions and mainly reports administrative data, so missing the main function to provide information and to act as a *pro-memoria* tool (about therapy parameters like dosage, assumption plan, interactions) for the patients. This is a factor affecting therapeutical adherence and, consequently, efficacy. New digital technologies offer the new e-health services to empower patients, caregivers, and clinical operators in the frame of the 5-P medicine for a more personalized and accurate approach. This process should involve also the first step towards health which is represented by the access to healthcare and the consequent prescription (pharmaceutical or diagnostic or therapeutical). This chapter discusses the current situation of processes driven by medical prescriptions, their formats, and their expected evolution in the frame of the new digital medicine vision.

9.1 Introduction

The medical prescription is a very common tool to deliver clinical instructions for healthcare actions: diagnostic examination, specialistic consultation for diagnosis or rehabilitation, pharmaceutical indication. Its scope is specifically informative, both for the patient and for the final clinical actor: the specialist for the consultation, the pharmacist for the medicine delivery to the patient, the administrative officer and the technical biomedical operator at the hospital for the diagnostic or rehabilitative interventions. The pharmacological therapy represents the most common and diffused healthcare practice in the world, treating both chronic and time-limited

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A. V. Penati (ed.), *In-Home Medication*, Research for Development,
https://doi.org/10.1007/978-3-031-53294-8_9

pathologies. It is generally driven to the patient through a prescription of the general practitioner (GP) for common and low complexity pathologies or of a specialist doctor (SD): the first one verbally explains the assumption mode and frequency and deliver a standard health recipe which the patient goes to the pharmacy with to buy/receive the medication; the SD provides the report of the visit with the prescription and this is to be asked again to the GP. In some cases, for low complexity and common pathologies a self-medication is also frequent, according to personal experience and symptoms understanding. This common process should be optimized considering the 5P medicine vision (Pravettoni and Triberti 2020), meaning the proposed strategy to improve the clinical efficacy and efficiency in health and economic sense by a Preventive, Predictive, Personalized, Participatory and Pluri-expert approach that leads the process towards the Precision Medicine (Fig. 9.1). In this way we can also try to minimize the impact of the non-adherence to pharmacological therapy thanks to the so-called patient empowerment and her/his active participation to the process (Andreoni et al. 2022).

The correct prescription, at the right time, with the correct medication, for the exact patient, correct dose (personalized vs standard amount in the package), correct dosage (amount per day/week), correct assumption over time (assumption typology and distribution of assumption per day/week), correct duration (medication assumption and washout) is the perfect "pathway to health". This process and the patient empowerment towards the full understanding of the pathology, of the therapy and of the correct therapeutical plan, need new and more efficient tools for

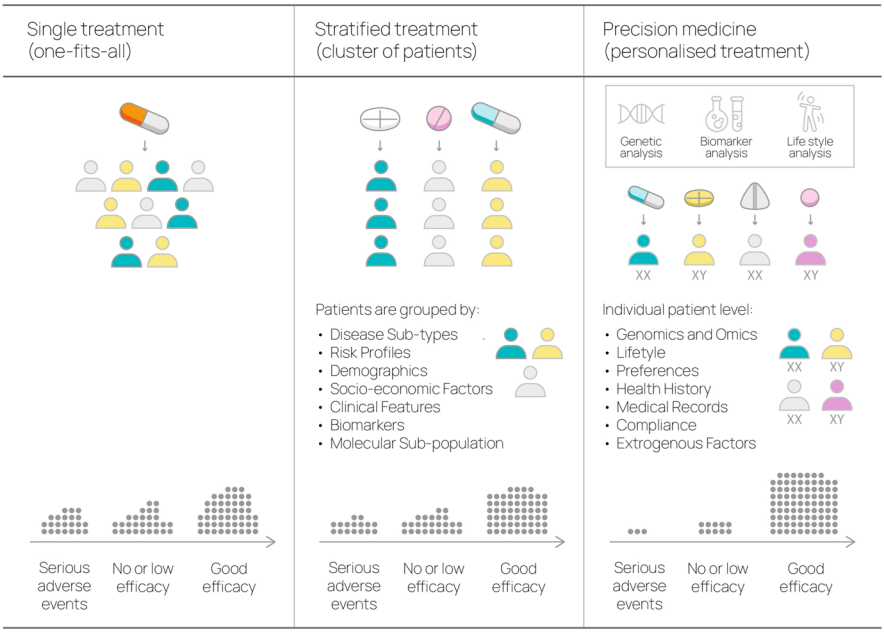


Fig. 9.1 The evolution of the medicine

the complete communication among and the involved actors (e.g., patient, doctor, pharmacist, nurse, therapist, familiar caregiver, etc.) in the very different paths that could be activated.

9.2 The Medical Prescription

9.2.1 The Communication in the Medical Prescription

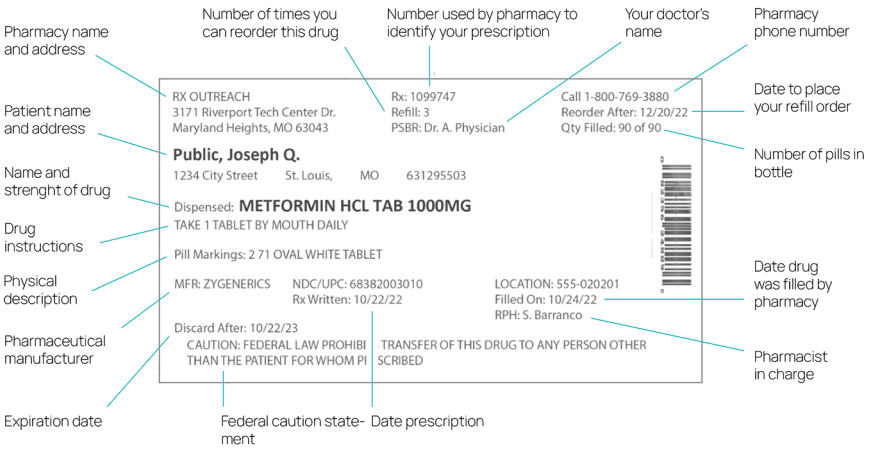
In pharmaceutical therapies the most common tool is the medical prescription. This process is done by a verbal and written transmission of information from the medical doctor to the patient and or eventually her/his familiar caregiver. Indeed, the correct and complete communication is the first step toward therapy adherence. But Kessels (2003) demonstrated that the verbal component of the process is not sufficient: memory for medical information is often poor and inaccurate, especially when the patient is old or anxious (Kessels 2003) Patients tend to focus on diagnosis-related information and fail to register instructions on treatment. Sinbukhova et al. (2021) recently recorded that patients were able to remember correctly 24.8% of medical information on the next day after consultation by a neurosurgeon on average (Sinbukhova et al. 2021) The main factors affecting the correct communication were anxiety and depression with negative correlation to the level of information assimilated by patients: the higher level of anxiety and depression before surgery led to decrease remembering of medical information by the patients. Their conclusion was that is necessary to increase remembering of medical information by patients because of it is allowing to improve the results of treatment.

Simple and specific instructions are better recalled than general statements (Kessels 2003). The written prescription should complement this process. In fact, patients can be helped to remember medical information by use of explicit categorization techniques. In addition, spoken information should be supported with written or visual material. Visual communication aids are especially effective in low-literacy patients, but again Kessels (2003) found that video or multimedia techniques do not improve memory performance or adherence to therapy. Laws et al. (2018) studied the factors associated with patient recall of key information in ambulatory specialty care visits; their findings showed forty-nine percent of decisions and recommendations were recalled accurately without prompting; 36% recalled with a prompt; 15% recalled erroneously or not at all (Laws et al. 2018) Provider behaviours hypothesized to be associated with patient recall, such as open-questioning and "teach back", were rare. Findings suggest that patient recall could be enhanced if providers were to use more of the techniques to encourage patient engagement, such as open questioning, agenda setting, and teach-back; and limit the amount of information to be remembered in a single visit based on an assessment of patients' ability to recall.

9.2.2 *The Format of the Medical Prescription*

The medical prescription has no common international standard format. Each country has a different situation for information that this medical document shall contain and provide.

For example, in the USA it is a very informative module (Fig. 9.2a) that must include several items (Kenny and Preuss 2022). In the USA there are five different levels of scheduling for medications (I–V), with schedule I, having the tightest controls, and V, being the least restrictive. Schedule II medicines are the highest level of misuse potential medications that may be prescribed by a clinician; these medicines



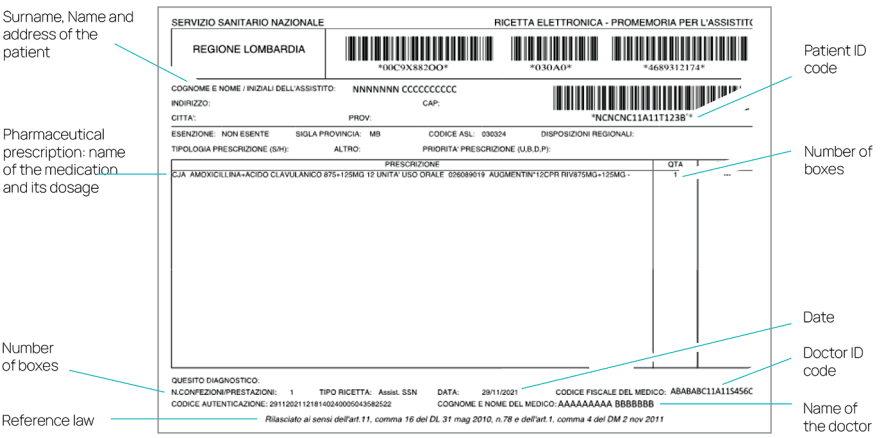


Fig. 9.2 Different formats in medical prescription: (**a**) the version adopted in USA (above) with very detailed contents; (**b**) the Italian format (below) as simple indication of the pharmaceutical treatment

traditionally were only allowed to be filled by paper prescription but today they are prescribable via electronic prescribing of controlled substances (EPCS). Schedule III-V medications may be prescribed by a clinician via traditional paper prescription, by a verbal order over the phone, or using the EPCS system. Practitioners may still write and sign prescriptions for schedule II–V medications if they choose; verbal orders to the pharmacist are only permitted for schedule III–V medications. In case of EPCS, it should also record the following information in the prescription: name of the pharmacy who is receiving the prescription, its telephone number and address.

In Italy, the medical prescription is a more and administrative ticket (Fig. 9.2b), namely standardized sheet where only simple information is given about the medication to be given to the patient by the pharmacist as prescribed by the doctor (usually the GP or sometimes directly the SD), so missing most of the relevant information. This communication problem is exacerbated in case of polypharmaceutical prescription at the same time. With the increase of aging population this condition is becoming quite common. In Italy, in 2017, Valent (2019) recorded that 63.7% of the general population received at least one medicine prescription, and 25,218 persons were co-prescribed ≥5 medications at least once (Valent 2019). The prevalence of co-prescriptions among persons ≥65 years was 31.7%. 20,793 persons used ≥60 defined daily doses of ≥5 medications. The prevalence of all these phenomena was much higher in the elderly than in children and adults. The number of comorbidities significantly affected all types of polypharmacy. We can assume that this situation could be similar in most of the European and western countries with a similar social structure: from this the prevalence of polypharmacy is high, particularly among the elderly.

In the US, the implementation of electronic prescribing has significantly reduced the number of medication errors from a prescription standpoint (legibility, dosage, frequency, etc.) (Kaldy 2016; Volpe et al. 2016). The definition of a set of requirements for the prescriptions was a standpoint. For a pharmacist to dispense a controlled substance, the prescription must include specific information to be considered valid: Date of issue, Patient's name and address, Patient's date of birth, Clinician name, address, DEA number, Medicine name, Medicine strength, Dosage form, Quantity prescribed, Directions for use, Number of refills, Signature of prescriber.

9.2.3 Adherence to Medical Prescription

Polypharmacy is one of the most important risk factors for the onset of adverse medicine reactions, with a consequent impact in terms of increased hospital admissions, increased costs, and mortality. The management and the therapy for chronic diseases is a typical example of polypharmacy and poor adherence. Therapy management is even more difficult when the condition is chronic and therefore implies a constant relationship with the disease throughout one's life.

In a specific report of WHO (2003a), the estimate of adherence in patients suffering from chronic diseases is only 50%, in developed countries; while the impact of low adherence in developing countries was assumed to be even higher, given the scarcity of health resources and inequalities in access to health care (Quaderni SIF 2017). For adhesion or adherence to therapy it is meant the active compliance of the patient at doctor's recommendations regarding times, doses, and frequency of intake of the medicine for the entire course of therapy. More adherence means reduced risk of hospitalization, reduced complications associated with the disease and with lower entity, greater safety, and efficacy of treatments and even reduction of costs for therapies.

Even today, data from studies and literature confirm that adherence to chronic therapies remains an emerging and current problem. 80% of people over 65 suffer from heart failure, respiratory insufficiency, sleep disorders, diabetes, obesity, depression, dementia, hypertension, which often occur simultaneously in the same individual (Ministero della Salute 2017). By 2020, chronic diseases will represent about 80% of all diseases in the world, for the management of which about 70–80% of global resources will be committed.

The National Institute for Health and Care Excellence (NICE) with respect to adherence in chronicity, underlines that there is a high risk of error in taking treatments, especially in the presence of polypharmacotherapy and multimorbidity. WHO estimates indicate that between 30% and 50% of prescribed medicines are not taken as they should (WHO 2003a). Additionally, between 30% and 70% of patients make a mistake or inadvertently switch medications, especially when switching from one regimen or treatment area to another. In the guide, NICE underlines the importance of shared decision and the involvement of the person, as an essential component of evidence-based medicine.

A report commissioned by the Department of Health has revealed that in UK between 5% and 8% of unplanned hospital admissions are due to problems related to the use of medicines and, on preventable adverse events that can be attributed to one or more specific errors (Frontier Economics 2014). Therapeutical adherence is also affected by poor communication. Adherence is more detailed defined as:

> The degree to which a person's behaviour—in taking medications, following a diet and/or making changes to one's lifestyle—corresponds to the recommendations agreed with health care providers.

This definition considers the attitude of the person to comply with the recommendations of the healthcare professional, in all those behaviours that contribute to full adherence to the treatment path, from pharmacological or follow-up prescriptions, to dietary indications, to suggestions for a change in lifestyle (WHO 2003b). When the communication between the clinician and the patient is imperfect, the latter is exposed to adherence error. Poor adherence produces important impacts both from a clinical point of view, and therefore from the health of the community, but also from the point of view of the sustainability of health systems, a growing problem in many countries. It is in fact the main cause of non-effectiveness of pharmacological therapies and is associated with an increase in healthcare interventions, morbidity,

and mortality, representing damage both for patients and for the healthcare system and for society. Some studies revealed that 30–50% of adults in America do not adequately follow the prescriptions of long-lasting medicines, with waste of about 100 billion dollars a year and the patient at greatest risk of non-adherence is represented by the elderly in polytherapy (Marcum et al. 2013; Iuga and McGuire 2014). The pharmacological prescription for acute problems (antibiotic therapy) is followed by 3/4 of the patients while if the therapy lasts 10 days, only 1/4 of the patients completes the cycle.

Furthermore, these studies confirm that therapeutic non-adherence is particularly critical in patients with long-term therapies and polytherapy, with all the consequences that may derive from a discontinuity of the treatment (compromised efficacy of the therapy) (WHO 2003b). This is very often due to the psychological and emotional condition of the chronic patient which translates into discomfort, loss of trust, demotivation with respect to the efficacy/benefits of the treatment or due to the complexity of managing the therapy.

9.3 The New Model: Towards Territorial and Personalized Healthcare

To achieve Precision Medicine a structural reform of the healthcare system and its services is needed. The pandemic period demonstrated the need of the exploitation of two main elements.

- The Precision Medicine is targeted to the individual patient and for this it requires the deep knowledge of this patient; data are essential but not exhaustive. The prolonged and comprehensive knowledge about the patient's health and history and about the social environment where she/he lives is needed for a global and efficient approach. Only a clinical operator close to the patient can engage with her/him this kind of trusted relationship to have a full diagnostic, therapeutical or rehabilitation adherence. On this the new concept of Clinical Pathways are rapidly being adopted.
- The territorial medicine is the near presence of services and resources available to the patient in her/his own environment or town (Andreoni 2023). These services need a proper management tool to be activated. The medical prescription should evolve to a service enabling tool, integrating all the necessary information to identify all the actions and their parameters for the best delivery of the proper, personalized care intervention. At the same time, a comprehensive and intuitive Electronic Health Record should be developed and available for the recording and the integration of these data, actions, and outcomes, not for administrative purposes but as factors, parameters, and indexes of an individual health model (Kamel Boulos and Zhang 2021).

The Clinical Pathways define the best diagnostic, treatment or rehabilitative process for a specific pathology, or a clinical problem based on the best technical-scientific knowledge and in relation to the available resources. They allow the Healthcare System to outline, the best practicable approach for the best result for the patient and for the optimization of resources within the healthcare organization. The purpose of the clinical pathways is to define a homogeneous, structured, integrated, and multidisciplinary pathway for the management of the pathology/condition being treated, optimize the network of services and trying to meet the needs of patients, ensure during all stages the continuity of care, promote communication and discussion between the professionals involved. They can describe the entire patient care pathway (Diagnostic Therapeutic Assistance Pathway—PDTA) or one or more phases of the path itself (Diagnostic Therapeutic Pathway—PDT; Integrated Care Pathway—PIC), but always providing the integration between hospital and territorial services (Ministero della Salute 2017). Through this structured protocol the healthcare system aims to guarantee: the reproducibility of actions but in a personalized care plan, the indicators needed to monitor the outcomes and clinical and management level, the uniformity of services provided to all patients, the reduction of the extraordinary events; the integration of the clinical service to the patient with shared communication among all the involved actors, the definition of patient management plan with well identified and clear roles for the actors involved in the process and creating awareness and trust in the patient. And awareness and trust mean empowerment of the patient and the adoption of an active role in co-managing her/his own health, the increase the adherence to the clinical actions by the patient and her/his best achievement of therapeutic targets (with lower expenditure). This patient empowerment strategy is struggling to establish itself because it is linked to the relationship with the treating doctor and with health professionals, which should evolve towards a less asymmetrical model, with the patient called to be an increasingly active part in decisions relating to your health. For this reason, in the next future the education of the patient and her/his caregivers represents one of the most important products of the empowerment process.

In this light, and with these premises, the medical prescription sheet should evolve from an administrative document to a service-enabling document, to a tool describing in a complete, comprehensive, and intuitive format the personal Clinical Pathway for a unique and identified subject in a well-defined health environment with its players (GP, SD, other clinical operators, familiar caregivers, etc.).

9.4 The New Health E-Prescription

This process needs to be integrated into the continuous technological evolution of products and services. Today the technology offers connected devices and mobile terminals, multimodal communication, apps and webapps providing several and different services. Also in medicine, this revolution has opened new perspectives to be fully exploited: smartphone and related apps allows access and consultation of the

Electronic Health Record (and of health digital twins which is the new frontier of health data integration), tele-visit, ubiquitous monitoring of health parameters, up to e-administration of clinical events (Kamel Boulos and Zhang 2021).

In this perspective, also the medical prescription must evolve towards a more mature and evolute format. It has the potentiality to become an active service tool not simply a static administrative ticket. The e-prescription should be co-designed to implement the explicit and implicit needs for a multimodal system for communication, education, reminder, adherence monitoring and other functionalities.

This new e-prescription should be a shared, cloud resident e-document connecting and to be updated by all the actors, each one with the own proper role and different authorization levels: the patient, the GP, the SD, the pharmacist, the rehabilitation operator or the technical for the imaging examination. In other word it should become a single common tool for many services. It is not to be confused with the Electronics Health Record: this is the complete personal health database, while the e-prescription is related and could drive a single, even complex, process. In this way the traditional step-by-step procedure or transfer of the material medical prescription (from the GP to the patient, from the patient to the hospital for the examination or to the pharmacist for the collection of the medicines or to the SD and other options) is translated into a new process, integrated and processed in the cloud and managed by the mobile terminals of the patient, the GP, the pharmacist and so on in relation to the service. To provide a personalized, aware, trusted, and clear process to the patient and her/his familiar caregiver, all the actors should be involved in the co-design process to integrate in this new format the proper information and needed service description with its parameters (for instance, from a simple pharmaceutical prescription to a complex technological examination).

Some possible services that the new e-prescription could enable or embed can be the following suggestions:

- link to multi-media instructions for supporting the correct assumption even for simple situations (even simple but frequent questions like: *can I break the pill before intake? Should I drink only water, or can I drink other liquids?* etc.);
- link to the national pharmaceutical agency and specific webpage, to retrieve all the information about the prescribed medicine, such as active principle, the other ingredients, the possible interactions with other medicines, the different dosages available and any other important recommendations, to maximize adherence and efficacy;
- link to the clinical studies and their full outcomes, pre- and post-market registries of efficacy or adverse events, for a complete awareness about the treatment;
- the generation of a calendar and its download on the mobile device for the complete treatment plan and related reminder;
- the generation of a calendar and its download on the mobile device for examination or rehabilitation sessions;
- link to e-administration services like the procedures and access to online resources for bookings, payments, and other services (GP or Hospital or territorial points).

In this development UX/UI design methodologies could play a very relevant role, supporting access, usability, content readability, intuitive implementation of complex processes of prescription able to avoid errors or misunderstandings that in medicine are so dangerous or increasing adherence that is so necessary.

9.5 Conclusion

The organization of a new healthcare systems and structure after the pandemic emergency is asking the adoption of more efficient and quick tools in the clinical practice and organization. Not only complex task should be redesigned and improved but even starting from the paper-based, static, and poor of information medical prescription is a great kick-off towards the future of healthcare.

The e-prescription shall be integrated in the health information systems: communication is the cornerstone of integrated management and care networks, an indispensable element between the various operators, between the various services, between the different levels (territory/hospital), as well as a central factor of the patient's relationship of trust and his empowerment process. The new technologies available (audio-visual communication, telemedicine, etc.) seem to be able to help facilitate communication and improve assistance in terms of effectiveness and efficiency. The main technological requirement is the interoperability with respect to the various platform and operative systems and its connectivity. The main user requirements are usability and content intuitiveness so to implement an error-free process among all the actors. The main service requirement is the integration so to have a structured continuous process along with the clinical and the administrative procedures. The development of this new format for the medical prescription could be a strategic choice in improving our healthcare services, in saving time, saving costs, increasing efficiency and, above all, the quality of life and our health.[1]

References

Andreoni G (2023) Capsules of health in the city. In: Anzani A, Scullica F (eds) The city of care, Springer series in design and innovation, vol 26. Springer, Cham. https://doi.org/10.1007/978-3-031-14608-4_10

Andreoni G, Caiani EG, Castaldini N (2022) Digital health services through patient empowerment: classification, current state and preliminary impact assessment by health pod systems. Appl Sci 12:359. https://doi.org/10.3390/app12010359

Frontier Economics (2014) Exploring the costs of unsafe care in the NHS: A Report Prepared for the Department of Health. London. Available online: https://www.frontier-economics.com/

[1] The author wants to sincerely thank Dr. Erio Morcelli, for the extensive discussion to understand the evolution of the new territorial health scenario, of the introduction of the PDTA with their expected impact, and of the new roles for prescription in the view of a General Practitioner.

media/2459/exploring-the-costs-of-unsafe-care-in-the-nhs-frontier-report-2-2-2-2.pdf. Last accessed on 15 Jan 2023

Iuga AO, McGuire MJ (2014) Adherence and health care costs. Risk Manag Healthc Policy 7:35–44. https://doi.org/10.2147/RMHP.S19801

Kaldy J (2016) Controlled substances add new layer to E-prescribing. Consult Pharm 31(4):200–206

Kamel Boulos MN, Zhang P (2021) Digital twins: from personalised medicine to precision public health. J Pers Med 11(745). https://doi.org/10.3390/jpm11080745

Kenny BJ, Preuss CV (2022) Pharmacy prescription requirements. [Updated 24 Sep 2022]. In: StatPearls [internet]. StatPearls Publishing, Treasure Island. 2023 January. Available from: https://www.ncbi.nlm.nih.gov/books/NBK538424/?report=classic

Kessels RPC (2003) Patients' memory for medical information. J R Soc Med 96:219–222

Laws MB, Lee Y, Taubin T, Rogers WH, Wilson IB (2018) Factors associated with patient recall of key information in ambulatory specialty care visits: results of an innovative methodology. PLoS One 13(2):e0191940. https://doi.org/10.1371/journal.pone.0191940

Marcum ZA, Sevick MA, Handler SM (2013) Medication nonadherence: a diagnosable and treatable medical condition. JAMA 309(20):2105–2106. https://doi.org/10.1001/jama.2013.4638

Ministero della Salute (2017) Direzione Generale della Programmazione Sanitaria. Piano Nazionale della Cronicità. Available online: https://www.salute.gov.it/imgs/C_17_pubblicazioni_2584_allegato.pdf. Last accessed on 15 Jan 2023

Pravettoni G, Triberti SA (2020) "P5" approach to healthcare and health technology. In: Pravettoni G, Triberti S (eds) P5 eHealth: an agenda for the health technologies of the future. Springer, Cham

Quaderni della SIF—Società Italiana di Farmacologia (gennaio 2017) Anno XIII n. 42. https://www.sifweb.org/pubblicazioni/quaderni-della-sif

Sinbukhova EV, Shimanskiy VN, Tanyashin SV, Shevchenko KV, Poshataev VK, Abdurakhimov FD, Lubnin AY (2021) Remembering what the doctor said: how much of medical information will the patient remember? Russ J Neurosurg 23:50–60. https://doi.org/10.17650/1683-3295-2021-23-4-50-60

Valent F (2019) Polypharmacy in the general population of a Northern Italian area: analysis of administrative data. Annali Istituto Superiore di Sanità 55(3):233–239. https://doi.org/10.4415/ANN_19_03_06

Volpe CR, Melo EM, Aguiar LB, Pinho DL, Stival MM (2016) Risk factors for medication errors in the electronic and manual prescription. Rev Lat Am Enfermagem 24:e2742

World Health Organization (WHO) (2003a) Report on medication adherence, Geneva

World Health Organization (WHO) (2003b) Adherence to long term therapies: evidence for action, Geneva