herence instruments, with limited evidence supporting their use. This underscores the need for a minimal set of standardized measurement properties (66). It is hence evident that a practical validated tool to measure medication adherence is needed. Arnet et al. developed and validated a novel questionnaire named 15-STARS (Screening Tool for AdheRence to medicineS). The objective was to create a self-report instrument specifically assessing medication non-adherence. This tool is designed to meet several criteria: quick to complete; suitable for ambulatory patients; relevant to the adherence implementation phase; capable of identifying personalized, changeable factors behind non-adherence; and incorporating a numerical assessment of adherence. The 15-STARS questionnaire demonstrated good acceptability, low rates of missing responses, and satisfactory validity and reliability with acceptable psychometric properties (64).

Interventions – the way forward

The effectiveness of interventions in healthcare is greatly enhanced by frequent patient interactions, particularly those focused on adherence. A study by Gregoriano et al. showed significant improvements in adherence among asthma and COPD patients due to patient-tailored support, which included audio reminders and feedback on the intake patterns of inhaled medication, as well as regular support calls for non-adherent patients. This method is more effective than the limited, predefined follow-up appointments often used in other studies. Furthermore, a randomized clinical trial by Sulaiman et al. confirmed these findings, demonstrating that repeated feedback significantly improved inhaler adherence (67). In a systematic review comparing interventions, Torres-Robles et al. highlighted that, over the past decade, diverse interventions demonstrated positive effects on medication adherence and clinical outcomes (68). Effective adherence interventions have been associated with positive results, including achieving viral suppression in HIV patients (69), lowering lipid levels and total cholesterol in individuals taking lipid-lowering medications (70), reducing HbA1c levels, decreasing hospitalizations, and lowering all-cause mortality in patients with diabetes mellitus (71). The incorporation of technical components, involving gadgets, instruments, or systems that facilitate medication intake, can enhance medication adherence. These interventions are helpful for individuals with memory issues or busy social lives that may otherwise limit their ability to adhere to medication routines (68).

One of the valuable interventions in supporting patient adherence in medication management, particularly in primary care settings, is multidrug punch cards. These tools are designed to organize and dispense multiple medications, thereby enhancing adherence and safety. In their study, Boeni et al. demonstrated that multidrug punch cards led to high patient satisfaction and improved adherence. Particularly beneficial for older adults managing polypharmacy, these cards enhanced medication safety and ease of use, with their success being influenced by trust in healthcare professionals and individual patient experiences. The study encourages healthcare professionals to actively recommend these cards to patients with complex medication routines, highlighting their importance in improving patient outcomes in primary care (51). The use of medication charts in daily practice with a focus on 'patients', 'process', and 'terms and conditions' has been recognized by both physicians and pharmacists as beneficial. In a narrative systematic review by Dietrich et al., patients with a medication chart showed an increase in medication adherence from 86 % to 93 %, as measured by pill counting, compared to those without a medication chart. These charts are particularly valuable at transitions of care, such as at hospital discharge or when being moved to a different care facility. Medication charts typically list all of a patient's current medications, including prescription and over-the-counter drugs. They are designed to be handed over to the patient as a hardcopy and serve as an informative tool for both patients and healthcare providers, such as doctors, nurses, and pharmacists. For patients, one of their roles is that of an extra reminder tool. Healthcare providers find medication charts beneficial for enhancing record quality and achieving better interdisciplinary cooperation. It is essential, particularly for patients with polypharmacy, that the data on the chart is accurate and up to date to maximize its benefits (72).

The findings of Marquis et al. reveal that approximately 9 % of polypharmacy patients experience ongoing swallowing difficulties, often leading to intentional non-adherence. These issues, related to specific medications rather than the number of tablets, underscore a lack of awareness among healthcare professionals. The study points out the importance of an intervention which systematically addresses swallowing difficulties in primary care to enhance medication management and patient care (73). Last but not least, healthcare professionals should be aware of the Hawthorne effect. The Hawthorne effect is defined as a phenomenon where individuals modify or improve an aspect of their behavior in response to their awareness of being observed or having their behavior assessed. This change is often influenced by the individual's beliefs about the researcher's expectations, as well as factors such as conformity and social desirability (74).

Healthcare systems and role of pharmacist

Fragmented healthcare systems create obstacles to medication adherence due to compromised healthcare coordination and limiting patient access to care. The limited availability of health information technology restricts a physician's access to patient information across different care settings, potentially compromising patient care. In an overburdened healthcare system, clinicians often have limited time with each patient, which may delay assessments of medication-taking behaviors. Considering the significant impact of medication adherence on patient well-being, healthcare systems need to adapt to prioritize its importance. Systemic changes should be implemented to ensure that adequate time is dedicated to discussing medication adherence. In response to time constraints, there may be a shift towards employing a team-based healthcare framework. This model involves the training of non-physician personnel to undertake tasks conventionally performed by physici-