Treatment Adherence and Clinical Outcomes: Closing the Gap with Technology-Mediated Interventions

Introduction

Prescribed therapies are generally based upon clinical trials and experience showing that specific treatments may improve patients' clinical status and prevent deterioration and/or delay disease progression. It is assumed that benefit is realized in proportion to a patient's treatment adherence (TA) and that poor adherence may result in clinical deterioration. Poor TA affects far more than the health and well-being of individual patients. Negative consequences extend to patient's families, healthcare teams, healthcare delivery systems, third-party payers and drug and device manufacturers. Given the rapidly rising costs of healthcare and possibly preventable poor outcomes, new approaches are needed to close the gap between non-adherence and suboptimal outcomes. Technology-mediated interventions (TMI), although still evolving, show great potential to impact the TA/outcomes gap.

Treatment non-adherence: A persistent challenge

Non-adherence to prescribed treatments is a worldwide phenomenon that has been widely recognized for more than 50 years.[1, 2] Adherence denotes the ability or willingness of a patient to correctly perform prescribed therapies. Although opinions vary, non-adherence is generally defined as taking medications or performing treatments less than 80% of the time.[3, 4] Despite major efforts to mitigate this problem, TA rates remain stubbornly variable and persistently low.[3] Poor TA may be responsible for the considerable discrepancy between current treatment success rates and those thought to be achievable. High levels of non-adherence have immense effects on individual and population-level health outcomes and costs.[5] Ineffective treatment attributed to deficient TA is associated with increased morbidity, disease related complications, hospitalizations, and health care expenditures.[6] Estimates suggest that non-adherence costs the U.S. health care system around $100 billion annually.[7, 8] Benefits resulting from improved self-management of chronic diseases could produce a dramatic cost savings.

Barriers to TA

Exhaustive literature reviews have been undertaken to identify the causes of poor TA. Reasons for non-adherence are complex and highly individual. Barriers may be classified broadly as real or perceived obstacles arising from psychosocial, technical, health and socioeconomic factors.[3,4,9-15] In self-reported interviews and questionnaires, most patients and/or families report barriers and disincentives drawn from several of these categories. In a recent study to understand obstacles to adherence among adolescents with CF, Sawicki et al. recruited 20 patient/parent pairs to participate in a one-time interview session. Barriers cited included time pressures, awareness of disease trajectory, competing priorities, privacy issues, and lack of perceived consequences. These findings are consistent with those identified in previous studies. Based upon analysis of interview data, several facilitators for improvement emerged:

- Understanding the importance of treatment components
- Building strong relationships with health care teams

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- Establishing structured treatment routines
- Strengthening skills to promote independent self-care

Successful approaches include:

- Programs tailored to minimize incompatibilities between treatment requirements and lifestyle
- Flexibility and compromise
- Respect for patient preferences and health beliefs
- Mutual patient/family and healthcare team commitment
- Shared planning and decision-making

Treatment Adherence: Impact on health outcomes

Adherence to prescribed treatments is associated with measureable health and economic outcomes in numerous acute and chronic conditions.[5] Highly adherent patients are shown to have less disease-related morbidity, fewer symptoms, less functional impairment, lower rates of healthcare utilization, reduced need for rescue medications and, importantly, better quality of life (QOL).[16-18] In a first-of-its kind study designed to link TA with quantitative health outcomes, Eakin et al. followed 95 CF patients for 12 months while estimating TA based on medication refill data.[17] They found that TA is a significant predictor of declining lung function and pulmonary exacerbation (PE):

- Patients with TA at or above 80% maintained baseline pulmonary function and had no pulmonary exacerbations, defined as need for IV antibiotic therapy, over the study period.
- Patients with moderate (50-80%) and poor (< 50%) TA had declining trends in their baseline lung function.
- Patients with moderate or poor TA had PE episodes at a rate of 1-2 (23.2%) and 3 or more (16.8%).

Traditional TA Interventions

While it is clear that TA leads to better outcomes, it is also clear that common strategies and interventions to improve adherence have yielded generally disappointing results.[3] Available TA data is notoriously untrustworthy.[2, 12, 18, 19] Traditional methods to capture adherence data, including patient, caregiver or doctor/healthcare team or insurance questionnaires, telephone or in-clinic interviews, are both subjective and difficult to interpret. In particular, in self-reported information, the prevalence of deliberate or inadvertent false reporting is considerable.[19] When self-reported data is compared to direct measures of TA, such as biomarkers of medication blood levels, significant disparities are commonly detected. Such objective measures show that patients who report non-adherence are likely to have responded accurately. However, those who exaggerate or falsify information are identified by contradictory lab results.[14] Poor adherence has serious health and economic consequences. This problem must be resolved before outcomes can be significantly improved.

Technology-Mediated Interventions (TMI)

Recent systematic reviews of the adherence of CF patients to their home treatment programs have noted that TA data captured via electronic monitoring is significantly and consistently lower than self-reported information.[3, 14] Currently, a variety of electronic monitoring technologies and telecommunication systems are in stages of research, development and beta-testing. Some have been successfully integrated into management of chronic diseases.[2] The creation of such systems, classified generically as technology-mediated interventions (TMI), demonstrates great potential to mitigate the persistent challenges of poor TA. Technology that promotes active patient participation involving real-time feedback can motivate TA, support timely care plan modifications, improve clinical outcomes and reduce overall healthcare costs.[21-24] Three basic varieties of TMI

are described in the literature.[2] These include programs focusing upon education and/or counseling, self-monitoring and/or feedback and electronic reminders. In a study by Cox, et al, use of an internet-based program to graphically represent participation in physical activity among recently hospitalized CF patients demonstrated both feasibility and acceptability.[20] TMI is still in early stages of clinical use and deficiencies in study design and implementation, as well as equipment-related technological problems, have weakened the quality of published studies. However, many of these studies demonstrated encouraging outcome trends.

TMI Linked to Improved TA and/or Clinical Outcomes

A number of recent studies show that the use of targeted TMI programs can produce significant improvements in TA. Fourteen of thirty-eight TMI studies evaluated by Mistry, et al showed improvements in both TA and clinical outcomes.[2] Examples include:

- Antonicelli, et al. (2008) studied the effects of home telemonitoring in 57 elderly patients with congestive heart failure (CHF) by comparison with a randomized group receiving usual care. After 12 months of participation, home telemonitoring was associated with improvements in the composite endpoint of mortality or rate of hospitalizations (P = 0.006), a better compliance with therapy, more frequent use of beta-blockers and statins, lower total cholesterol level and better reported health perception.[21]

- Lester, et al (2010) used mobile phone communication between health-care workers and patients starting antiretroviral therapy in Kenya led to improvement in drug adherence and suppression of plasma HIV-1 RNA load. After 12 months, patients who received and responded to SMS support had significantly improved ART adherence and rates of viral suppression compared with the control.[22]

- El Miedany, et al. (2012) performed a double blind randomized controlled study to evaluate the feasibility and effect of visual feedback (VF) on TA in patients with early inflammatory arthritis (EA). At 6 months, the VF group showed significantly greater adherence to medication and positive effect on pain score and disease activity.[23]

Although none of the studies showing improved TA followed by better outcomes discuss reduced healthcare costs, such savings may be cautiously inferred. Study limitations, including technical difficulties with TMI platforms, provide guidance for designing more rigorous future studies.

Summary

TMI strategies to improve TA remain in early stages of development. Thus far, their utility and cost-effectiveness cannot be fairly assessed. High quality studies are needed to better assess feasibility and outcomes. However, the preponderance of early evidence supports the potential for TMI to strengthen TA and improve the gap between prescribed therapies and clinical and economic outcomes. Despite limitations, these studies suggest that when important technical and methodological problems are solved, greater treatment adherence may be possible.

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