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Assessing adherence to dermatology treatments: a review of self-report and electronic measures

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Background: Nonadherence to prescribed medications is a common problem in dermatology, and assessing adherence can be difficult. Electronic monitors are not always practical, but self-report measures may be less reliable.

Purpose: To review the literature for self-report instruments and electronic monitors used to measure medication adherence in patients with chronic disease.

Methods: A PubMed literature search was conducted using the terms 'scale,' 'measure,' 'self-report,' 'electronic,' and 'medication adherence.' Relevant articles were reviewed and selected if they addressed self-report or electronic measures of adherence in chronic disease.

Results: Eleven self-report instruments for the measurement of adherence were identified. Four were validated using electronic monitors. All produced an estimate of adherence that correlated with actual behavior, although this correlation was not strong for any of the measures. None of the scales was tested in patients who had dermatologic disease and/or used topical medications. Several electronic monitoring systems were identified, including pill counts, pharmacy refill logs, and the Medication Event Monitoring System (MEMS®). Validity was higher among electronic monitoring systems compared with self-report measures.

Conclusion: While several self-report measures of adherence have been validated in chronic disease populations, their relevance in dermatology patients has not been studied. A dermatology-specific instrument for the measurement of adherence would contribute to improved outcomes; until such a tool exists, researchers and clinicians should consider nonadherence as a possible factor in skin disease that is not responsive to treatment. Electronic monitoring provides the most reliable means of measuring adherence, and may provide additional clues to identify barriers to adherence.

Key words: compliance – assessment – MEMS – surveys

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Adherence to prescribed medication regimens is a major contributor to the successful treatment of dermatologic problems. Higher levels of adherence have been linked to better outcomes in both atopic dermatitis and psoriasis, and this relationship likely pertains with many other types of skin disease (1, 2). Unfortunately, roughly one-third to one-half of the patients prescribed medications for a dermatologic complaint are nonadherent (3). Identifying individuals who do not adhere to treatment recommendations is an important way to improve patient outcomes.

Accurate and reliable measurement of adherence behavior is difficult. Many approaches to measuring adherence have been described, including patient self-report, physician estimates, pharmacy refill information, pill counts, serologic drug concentrations, physiologic outcomes, and electronic monitoring (4). Of these methods, electronic monitoring may provide the best estimate of patient adherence (5, 6). The medication electronic monitoring system (MEMS) is an example of a device that can document actual use patterns by recording the date and times at which medication bottles or tubes are opened (5). Although the method has been used successfully, measuring adherence using MEMS is expensive and not always practical (4). Self-report measures have the advantage of being relatively quick, inexpensive, and easy to use (7). Furthermore, such measures can have the added benefit of identifying barriers to adherence that may be amenable to intervention (8).

This review summarizes existing self-report and electronic measures to detect or predict nonadherence and evaluates their utility in dermatology.

Methods

A PubMed literature search was conducted to identify relevant articles using the terms 'scale,' 'measure,' 'screening,' 'electronic,' and 'medication adherence.' Over 500 articles were reviewed and selected if they addressed self-report or electronic measures of medication adherence in chronic disease. These measures could be relevant for chronic disease in general or specific conditions. Articles were chosen that described the scales currently used in clinical or research practice or reported newly developed scales. Bibliographies were cross-referenced when applicable. Only English-language articles were included. Articles were excluded if (1) adherence was measured using a method other than self-report or electronic; (2) questions were so specific to the disease for which the measure was developed that they could not be adapted for use in other disciplines (e.g. measures developed for patients with psychosis); (3) the measure included only one item; or (4) the measure assessed reasons for nonadherence without providing an estimate of adherence.

Results

Self-report measures

Eleven measures of self-reported adherence to medication were selected for review. These measures were selected because they attempted to assess adherence in patients with chronic disease and also had data to demonstrate their ability to predict adherence. Although they were all designed for the same purpose, there was considerable variation between measures (Table 1). All measures were designed to be completed by patients, with the length of the questionnaires ranging from 4 to 30 items. The format of the measures varied. While most used dichotomous yes/no answers or three to eight-point response scales, the MASRI included a visual analog scale and the Brief Medication Questionnaire required patients to write the names and dosing schedules for each of their medications. The ASRQ asked patients to identify themselves with one of six descriptions of patient adherence behavior.

With the exception of the Beliefs about Medicines Questionnaire and the SOC, all of the measures reported were tested initially in a population of patients with a single, specific chronic disease. None of the measures specifically addressed dermatologic conditions. Of the measures reviewed, Morisky's four-item scale, first used in hypertensive patients, has been used most extensively in other diseases; however, no published validation of the measure in non-hypertensive patients was found in the literature. Part A of the MASRI was tested in a population of 55 systemic lupus erythematous patients using pharmacy refill information and was shown to have a sensitivity of 61–67% and a specificity of 65–68% (17). The only measures for which generalizability without modification would be difficult are the Brief Medication Questionnaire and ASRQ, in which questions refer specifically to the pills taken and the bottles in which they were dispensed, and the Admitted Nonadherence and Risk for Nonadherence measures, in which some questions are applicable only to asthma patients.

Electronic measures

The ability of self-report measures to capture actual adherence behavior was evaluated using a variety of methods. Four instruments – the ASRQ, Brief Medication Questionnaire, MASRI, and SOC – used MEMS data to show the correlation between self-reported and actual adherence. Morisky and his collaborators used physiologic outcomes to assess actual adherence; in turn, the SEAMS used Morisky's four-item scale as its criterion standard. Two measures, the BBQ and the Beliefs about Medicines Questionnaire, used nonvalidated self-report measures of adherence as markers for actual adherence. Bauman and colleagues used morbidity data to reflect actual adherence in the evaluation of the Admitted Nonadherence and Risk for Nonadherence scales.

Electronic adherence monitoring systems may provide a more reliable means of assessing adherence to both oral and topical medications. The Medication Event Monitoring System (MEMS®, AARDEX Corp., Fremont, CA, USA) include microprocessors in the bottle cap of a standard medication bottle that record each time and date the bottle is opened and the interval since the last bottle opening (18). MEMS devices have been used successfully to monitor adherence to cardio-

TABLE 1. Patient-reported adherence assessment tools

Instrument	Purpose	Format	Test population	Criterion standard	Ability to predict adherence
Four-item Morisky (9)	Measure adherence; identify barriers to adherence	Four questions to which patients answer 'yes' or 'no'	290 hypertensive patients	Blood pressure at 2 and 5 years	Being identified as adherent predicted better blood pressure control with 81% sensitivity and 44% specificity
Eight-item Morisky (10)	Measure adherence	Eight-item scale	1367 hypertensive patients	Blood pressure	Being identified as nonadherent predicted poor blood pressure control with 93% sensitivity, 53% specificity
Adherence Self-Report Questionnaire (ASRQ) (11)	Measure adherence	Six descriptions of patients with different adherence levels; patient must indicate which describes him/her the best	216 hypertensive patients	MEMS data	Self-report of adherence predicted actual adherence with 90–93% specificity and 14–42% sensitivity
Admitted nonadherence (12)	Measure adherence	Caregivers indicate 'yes' or 'no' as to whether they followed nine treatment recommendations	Caregivers of 1199 children with asthma	Relationship to asthma morbidity using overall severity of morbidity instrument	Children of caregivers who reported low levels of nonadherence had 3.2 types of serious morbidity vs. 5.0 types of serious morbidity in those whose caregivers reported high levels of nonadherence
Beliefs about Medicines Questionnaire (13)	Measure adherence; assess commonly held beliefs about medicines	19 statements to which patients rate agreement on five-point scale. Subscales include specific-necessity, specific-concerns, general-overuse, and general-harm	206 cardiac and general medicine patients	Reported adherence to medication (RAM), which consists of four items about tendency to forget medication or adjust dose prescribed. Developed by Horne et al.	Higher specific-necessity score correlated with higher adherence ($\rho = 0.19$, $P < 0.01$), whereas higher scores on the specific-concerns ($\rho = -0.28$, $P < 0.001$) and general-concerns ($\rho = -0.19$, $P < 0.01$) scales predicted lower adherence
Beliefs and Behaviour Questionnaire (BBQ) (8)	Measure adherence; assess health beliefs and experience related to nonadherence	30 questions to which patients respond on a five-point Likert-like scale. Subscales include Confidence, Concerns, Satisfaction, Disappointment, Adherence, and Nonadherence	276 chronic lung disease patients	Medication Adherence Report Scale (MARS), which is unpublished	Only the nonadherence subscale was correlated with adherence ($\rho = 0.4$, $P < 0.001$)
Brief Medication Questionnaire (7)	Measure adherence; identify barriers to adherence	Five-item Regimen Screen, Two-item Belief Screen, Two-item Recall Screen; each screen scored separately	48 patients taking angiotensin-converting enzyme inhibitor and at least two additional medications	MEMS data; measured 'repeat' nonadherence (deviation of $\geq$ 20% from prescribed amount) and 'sporadic' nonadherence (deviation of 1–19%)	Sensitivity ranged from 40 to 100% based on type of screen and type of nonadherence, specificity also ranged from 40 to 100%
Medication Adherence Self-Report Inventory (MASRI) (14)	Measure adherence	12 questions with various response options including five- and eight-point scales and a visual analog scale. Subscales include Part A, which assesses the frequency of use, and Part B, which measures timing of use	78 patients with human immunodeficiency virus (HIV)	MEMS data	Relationship varied, with the best correlation between adherence reported via the visual analog scale and the MEMS data ($r = 0.63$, $P < 0.001$)
Risk for Nonadherence (12)	Measure adherence	Caregivers answer 'yes' or 'no' in response to items addressing the complexity of treatment regimens, beliefs about medicines, and practical barriers to adherence	Caregivers of 1199 children with asthma	Relationship to asthma morbidity using the Overall Severity of Morbidity instrument	Children with few risks for nonadherence had 2.8 kinds of serious morbidity compared with 4.5 kinds in children with many risks
Self-Efficacy for Appropriate Medication Use Scale (SEAMS) (15)	Measure adherence; measure confidence about taking medications	13 items for which patients rate their confidence about taking medicines as directed on three-point scale	436 patients with coronary heart disease	Morisky four-item scale	Correlation between self-efficacy and adherence as measured on Morisky four-item scale ($\rho = 0.51$, $P < 0.001$)
Stage of Change Questionnaire (SOC) (16)	Measure adherence	Two questions regarding patient attitudes toward taking medications, each with four response choices	161 patients with HIV	Adapted version of the Morisky four-item scale; MEMS data for 85 patients in the HIV group	Analysis of variance showed association between stage of change and adherence measured by MEMS ($F = 2.95$, $P = 0.03$); association was stronger between stage of change and adherence measured by the adapted Morisky scale ($F = 7.46$, $P < 0.001$)

vascular medications and to highly active antiretroviral therapy for human immunodeficiency virus (19, 20). Adherence to topical medications can also be monitored using MEMS, which may provide clinical utility in dermatologic conditions such as atopic dermatitis and psoriasis. In one study of 0.1% triamcinolone ointment use in 26 children with atopic dermatitis, the mean adherence over the 8-week study was dismal at 32% (21).

Comparison of data among different adherence monitoring methods for topical medications has revealed higher self-reported adherence rates compared with electronic monitoring. Carroll et al. (22) compared the medication logs, medication weights, and electronic adherence measures in 30 patients with psoriasis. Adherence rates measured by medication logs and weights were consistently higher than those of the electronic monitors. Another study comparing pill counts and electronic monitoring in hypertensive patients showed that pill counts overestimate adherence (23). MEMS also provides information on the dynamic phases of adherence, including quality of execution (when patients begin a new medication regimen) and persistence (including drug holidays and early discontinuation); this information is not revealed by simply monitoring the pill counts (24). MEMS devices may be used to provide a more accurate assessment of patient adherence, in addition to potentially revealing barriers to adherence such as complex dosing regimens.

Other 'electronic' methods have been used to measure patient adherence, such as analyzing serum drug levels at office visits. These spot serum drug levels may not correlate with daily steady-state concentrations, however, due to possible influences of other pharmacokinetic and pharmacodynamic variables (25). This issue is further compounded by so-called 'white coat' adherence, with patients being more likely to take their medications around the time of office visits (25). Pharmacy records of prescription refills have also been used to measure adherence; the problems with this method include patient utilization of multiple pharmacies and the assumption that 'a prescription filled is a prescription taken' (26). The validity of self-report measures was also questioned in a study of college students with acne, with a sensitivity of 0.55 and a specificity of 0.72 compared with concurrent observers' examinations (27). Poor adherence is a major contributor to treatment failures, which in turn leads to increased health care costs.

Discussion

Many self-report measures of adherence in chronic disease have been developed, which differ with regard to their format, their ability to reflect actual adherence, and the patient population in which they were studied. However, they all share a relatively poor ability to predict patient adherence. Furthermore, none has looked specifically at the measurement of adherence in patients with skin disease.

The limits of self-report measures of adherence are well known. Patients do not always accurately remember their own behavior and, even if they do, may misrepresent their actual behavior due to concern about how providers will view them (4). Indeed, self-report measures often overestimate actual use (28). In one sample of psoriasis patients, patient logs reported 87% adherence when electronic monitoring revealed adherence rates of only 55% (22).

Many of the measures included in this review use known risk factors for nonadherence to predict patients' adherence behaviors. Among many other variables, quality of life influences adherence; in an Italian group of outpatient dermatology patients, poor quality of life was associated with lower satisfaction with care, and dissatisfaction with care predicted poor treatment adherence (29, 30). The relationship between poor quality of life and nonadherence is counterintuitive, as one might expect those whose lives are most affected by their skin disease to have the greatest motivation for improvement. However, poor quality of life has been repeatedly associated with nonadherence.

The Skindex, a self-report quality of life measure, asks patients to indicate the frequency with which their skin condition causes symptoms, emotional distress, or functional limitations on a five-point scale; higher scores indicate worse quality of life (31). Recent work by Jones-Caballero suggests a relationship between Skindex-29 and adherence to acne medications: young females with high scores and males with low scores on the Skindex-29 are more likely to be nonadherent (32). Results from another self-report measure of quality of life, the Dermatology Life Quality Index (DLQI), have linked poor

quality of life to nonadherence in both acne and psoriasis patients (33, 34).

While the relationship between quality of life and nonadherence is not strong enough to use either the Skindex or the DLQI as measures of adherence, the data from these studies make an important point: patients do not always behave in predictable ways. This unpredictability underscores the value of self-report and electronic tools to measure adherence. Electronic monitoring may provide the most reliable means of measuring adherence, in addition to potentially providing an insight into why patients are nonadherent. The MEMS system, although costly and not practical for widespread clinical use, is considered the current gold standard for medication adherence monitoring. Specific measures validated for use in dermatology are needed to improve clinical outcomes and facilitate meaningful research. Until such instruments are developed, clinicians and researchers should be cognizant that nonadherence is common and often a factor in skin disease resistant to treatment.

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