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Report from the American Society of Transplantation Psychosocial Community of Practice Adherence Task Force: Real-world options for promoting adherence in adult recipients

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Abstract

Starting in 2015, the American Society of Transplantation Psychosocial Community of Practice, with representatives of the Transplant Pharmacy Community of Practice, convened a taskforce to develop a white paper that focused on clinically practical, evidenced-based interventions that transplant centers could implement to increase adherence to medication and behavioral recommendations in adult solid organ transplant recipients. The group focused on what centers could do in their daily routines to implement best practices to increase adherence in adult transplant recipients. We developed a list of strategies using available resources, clinically feasible methods of screening and tracking adherence, and activities that ultimately empower patients to improve their own self-management. We limited the target population to adults because they

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CONFLICT OF INTEREST

None.

predominate the research, and because adherence issues differ in pediatric patients, given the necessary involvement of parents/guardians. We also examined broader multilevel areas for intervention including provider and transplant program practices. Ultimately, the task force aims to foster greater recognition, discussion, and solutions required for implementing practical interventions targeted at improving adherence.

Keywords

adherence; adult recipients; organ transplantation

1 | INTRODUCTION

Adherence, dynamic and multifaceted, is “the extent to which a person’s behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider.”¹ The World Health Organization outlines five overarching dimensions or factors that impact adherence, including the following: health system/healthcare team, social/economic, condition-related, therapy-related, and patient-related.¹ Despite challenges patients may face in these dimensions, it is recommended that individuals living with a solid organ transplant maintain adherence for successful clinical outcomes.

Meta-analytic findings show that, on average, 23 per 100 organ transplant patients per year are nonadherent with immunosuppressant medications,² and that nonadherence to the medical regimen increases with time post-transplant.² Patients may have occasional or intermittent lapses in adherence, variability in immunosuppression exposure, or differences in immunologic risk; thus, the clinical outcomes of nonadherence vary.³ Nonadherence has been associated with acute rejection, post-transplant infections, decreased graft survival, increased medical costs, and overall mortality.⁴ Given the potential for serious adverse outcomes, a multimodal approach to post-transplant adherence, including assessment for identifying nonadherence, education for patients and caregivers, and multilevel systematic evaluation and improvement strategies to assist with adherence should be incorporated into the care of all transplant patients. Based on survey data, however, only about half of US transplant centers have protocols to evaluate adherence.⁵ When attempts are made to increase adherence, the most commonly used intervention is providing reading materials, which has not been found to be effective when used in isolation.⁶

Currently, there are no guidelines outlining best practice interventions that can be used by transplant centers to increase adherence after transplant. In 2015, members of American Society of Transplantation’s Psychosocial Community of Practice, with representatives from the Transplant Pharmacy Community of Practice, convened a task force to develop recommendations for clinically practical, evidence-based interventions that transplant centers could implement to improve patient adherence to medications, healthcare provider visits, and lifestyle recommendations in adult organ transplant recipients. Focusing on items that clinicians could implement in their daily routines to increase and maintain patient adherence, we developed a list of strategies that includes existing resources and clinically

feasible methods of screening and tracking adherence. We focused on adult organ recipients as this is the primary population studied, and because adherence issues and interventions in pediatric patients differ. We examined interventions based on patient, provider and transplant program practices because adherence is influenced by multiple factors. We did not include policy-level systemic solutions (ie, better coverage of medication costs through long-term Medicare immunosuppression coverage), as these interventions would not be within the direct control of the transplant center. Given the existence of other comprehensive reviews on adherence in transplant patients,⁴ we focused on issues related to feasibility for clinical application, scalability, and dissemination. We identified the key findings from the literature and then came to consensus about best practices for adherence assessment and intervention.

2 | RISK FACTORS FOR NONADHERENCE

Research has identified numerous modifiable and nonmodifiable factors that play a role in the risk of nonadherence among solid organ transplant recipients, pre-and post-transplant (Table 1). Risk factors are often inconsistently associated with nonadherence;^{2,4,7} and the ability of specific risk factors to predict nonadherence varies by the adherence behavior that is being studied (eg, medication adherence vs other adherence behaviors). Therefore, we propose early identification (pretransplant) of potential risk factors and barriers to allow for targeted intervention and heightened monitoring. When warranted, pretransplant psychosocial and adherence evaluation may allow pretransplant interventions to be performed to mitigate post-transplant nonadherence. Once risk factors and barriers to adherence are identified, interventions to promote adherence should be implemented throughout the transplant process.

3 | TOOLS TO ASSESS NONADHERENCE

Previous reviews have identified numerous ways to measure adherence.⁸ Although multimodal adherence assessment is recommended,⁸ and it may be synergistic to use 2–3 methods simultaneously, this approach may not be practical or even possible in routine clinical practice often due to cost, time, or staffing constraints. The top priorities of adherence screening in a clinical setting are to detect nonadherence, implement interventions, then track progress over time. The objective for selecting an adherence measure should be to balance reliability and validity with practicability for administration. Table 2 details the strengths and weaknesses of common approaches, along with recommendations for their use.

Perhaps the most expedient and efficient means of screening for adherence at a low cost in a clinical setting is patient self-report through standardized survey instruments.⁹ Several transplant-specific⁸ instruments are available for use with transplant patients which have demonstrated reliability and validity, (reviewed in detail by Dobbels et al.⁹). These measures are brief and can be administered informally during the course of clinical interviews or counseling. Some instruments cover only medication adherence,⁹ but others cover the entire range of medical recommendations following transplant, including attending clinic visits, completing required labs and medical tests, and dietary and exercise requirements.⁸ Another advantage of self-reported adherence measures is their ability to elicit potential reasons for

nonadherence, which can identify the cause for nonadherence. Identifying the reasons for nonadherence allows appropriate and effective intervention.⁴

Disadvantages to patient self-report include lower specificity, sensitivity, and precision about the extent of nonadherence, and the potential for reporting bias due to either poor recall or an interest in giving the healthcare provider the desired response.¹⁰ However, a meta-analysis² showed that self-report assessments captured higher rates of nonadherence to immunosuppressants than other assessment methods. In addition, they may be superior to other measures of assessing nonadherence because they are less expensive and labor intensive, and more practical in clinical settings compared to other methods. Disadvantages of self-reports may be minimized if they are administered in a nonjudgmental way and conservative cut-offs are chosen to define nonadherence to reduce bias from under-reporting nonadherence.⁹

The strengths and weaknesses of other methods, including provider reports, medication refill reports, medication blood level metrics, electronic medication event monitoring devices, remote spirometry for lung transplantation, and other biological assays are detailed in Table 2. Due to underestimation, we do not recommend the sole use of provider reports of nonadherence.¹¹ Although providers are encouraged to conduct standardized reviews of medical records to examine patients' adherence to laboratories and clinic visits, multimodal methods of nonadherence assessment are more sensitive.¹¹ Similarly, although there are some attractive properties of medication refill reports, electronic medication event monitoring devices, and assays of medication levels in patients' blood, there are also potentially prohibitive disadvantages including availability of resources to obtain medication refill reports and access to electronic medications event monitoring devices.¹¹ Despite these concerns, electronic monitoring devices can provide detailed data on medication-taking initiation, execution, and persistence, which are key components for identifying opportunities for interventions.

4 | BEST PR ACTICES FOR INTERVENTIONS

In Table 3, we summarize interventions that have been tested and found efficacious, their key components, implementation benefits, challenges, and other considerations. Transplant centers with diverse needs, patient populations, and resources for adherence monitoring and interventions may need to tailor the implementation of these efforts in different ways, and it is likely that no "one-size-fits-all" approach is warranted to recommend to all transplant centers.

4.1 | Educational intervention

Education is the most frequently used method by transplant staff to encourage patient adherence.⁶ Education is often necessary to ensure patients' understanding of their condition and treatment. Transplant patients and their supports report the need for comprehensive education related to transplantation.⁶ The duration and content of educational interventions range from brief and general (eg, providing an educational brochure) to repeated and individualized. Although they have been shown to improve patient understanding and knowledge, meta-analytic data show that education alone does not significantly impact

adherence.¹² Therefore, we recommend that education should be paired with other empirically supported adherence interventions. Also, it should be provided throughout all transplant phases as patient needs change over time from pretransplant, inpatient, early and late post-transplant. Education should be provided via a multidisciplinary approach that could include a coordinator, social worker, psychologist, and/or pharmacist based on available resources.

4.2 | Cognitive/behavioral interventions

Interventions aimed at improving adherence through repeated visits with transplant team members and/or through implementing memory or monitoring strategies may be characterized as cognitive/behavioral interventions.⁴ Many of these interventions involve discussions regarding patients' motivation for adherence, involvement of social support, addressing barriers to adherence, and implementing strategies to enhance adherence, such as assistive tools (eg, alarm, a pill box) or receiving reminders from others.^{4,13}

Behavioral contracts have been used before and after transplant to increase adherence with medication and other behaviors.¹⁴ In behavioral contracting, the patient and a provider identify a specific health behavior to address, then write an agreement (the contract) describing how the behavior will be modified to achieve the desired effect.¹⁴ Contracting is designed to increase patients' sense of self-efficacy, or belief in their ability to accomplish a goal, which is correlated with medication-taking in transplant patients. Behavioral contracts can be an effective method of delineating expectations about post-transplant adherence while holding patients accountable for their actions. However, contracting may require extra effort and time by a member of the transplant team.¹⁴

Pharmacist counseling is the addition of multiple visits with pharmacists to individualize pharmaceutical care after transplant and has been found to be successful in improving medication adherence.¹⁵ Because the pharmacist can identify patients who may require intervention early,¹⁶ the intervention may start at the pretransplant evaluation phase or the initial hospitalization after transplant surgery and continue post-transplant.¹⁷ The pharmacist's role entails education about medications, and uses a collaborative approach to identify signs of nonadherence and barriers that may increase the risk of nonadherence in the future, such as side effects, cost, and regimen complexity, and includes review of medication regimens, laboratory values, and side effects. The pharmacist can modify medication regimens to reduce adverse effects or select lower cost alternatives.¹⁵

Motivational interviewing (MI) is a nonjudgmental style of communication that helps patients to elicit their own intrinsic desire and intent to change behavior.¹⁸ Because multiple motivations can be at play when it comes to following a medical regimen, this can be a particularly effective strategy. MI interventions improve adherence to medication and lifestyle recommendations in patients with chronic disease,¹⁹ but only one study used MI in transplant to date.²⁰ MI requires clinician training to ensure proper implementation. This may be a barrier in some transplant settings, as the cost and time for training team members in MI may be prohibitive. However, some centers may already have social workers, psychologists, psychiatrists, or pharmacists trained in this technique.¹⁹ Thus, we recommend

that transplant teams explore the trade-offs between the intensity of training required and resources available to support the training, versus the benefits to patient outcomes.

In summary, advantages of cognitive/behavioral interventions include the personalized nature of these interventions, with time spent understanding the patients' perspectives and their individual barriers to adherence. These interventions can be tailored over time to meet patients' needs. Through these interventions, patients become more active, empowered participants in their medical care, and communication between patients and their transplant team is increased.¹⁴ Disadvantages of these interventions include their potentially time-consuming and personnel-intensive nature. Transplant centers may not have the number of staff needed to maintain frequent patient visits and monitoring. Many of the studies examining these strategies for improving adherence have only tested them over short time periods; thus, the long-term feasibility of implementing them is still unknown.

4.3 | Health information technology intervention strategies

Health information technology (HIT) applications are used increasingly often by both healthcare professionals and patients. HIT applications include traditional software run on desktop and laptop computers, Internet-based strategies, personal electronic monitoring devices that track routine daily behaviors (eg, fitness devices), and smartphone apps. The ubiquity and widespread acceptance of apps by all types of users suggest that they may be prime strategies for transplant programs to harness and facilitate patient adherence.²¹ Within organ transplantation, studies have begun to examine the efficacy of some HIT approaches.²¹ This work is summarized below and leads to our suggestions in Table 3 regarding potential benefits and challenges for transplant programs to consider if they seek to use any of four HIT approaches to improve or maximize patients' medical adherence.

A notable example of a *smartphone app* that has undergone user-centered development and testing in transplant recipients is the Pocket Personal Assistant for Tracking Health (Pocket PATH). Tailored to the specific elements of the post-transplant medical regimen,²² it includes customized data recording and graphing programs for tracking health indicators, activities, and symptoms; reminders about medication-taking and other behaviors; and decision support to guide patients about when to seek assistance from the transplant team. In a randomized controlled trial, Pocket PATH users showed better self-monitoring and adherence.²² A critical element of effective apps is that they include multiple components; single-component apps, (eg, those providing only educational information) do not appear useful.²¹ Useful websites that discuss and compare available apps are <https://publichealthonline.gwu.edu/quantified-self-health-tracking-technology/> and www.medappfinder.com, and several reviews of commercially available apps for general health behavior and adherence to medication specifically have been published in recent years.²¹ Reviews conclude that an increasing number of patients have access, are willing to use, and are highly satisfied with smartphone apps, but that interest in using an app decreases over time.²¹

Websites for patient health promotion and medical regimen adherence have been found effective in various chronic disease populations.²³ Many transplant programs now host their own webpages, either within the websites of their home institutions or through other sources

(eg, Facebook). Although often focused on educational information, programs could consider including other features found useful in chronic disease and transplant populations, including bulletin boards for (nonurgent) patient questions and comments, opportunities for patients to upload personal data to monitor trends over time, and interactive workshops. These features may benefit patients and be time-saving for programs, such as face-to-face education, obtaining more detailed information, skills-building activities, or tools to monitor self-care activities. However, resources would be needed to ensure that materials were updated regularly and that patients' posted comments or questions were appropriate and not about urgent issues.

Providing patients with *prompts, alerts, or reminders* to take medications or perform other activities also improves medical regimen adherence.¹³ Studies of medication taking suggest that monitoring systems that include multiple components (eg, reminders emitted by medication dispensers combined with smartphone app reminders, tracking capabilities, and text messaging) are more likely to promote adherence²⁴ than are simple medication dispensers with alerts or alarms used in isolation.²⁵ However, the studies in transplant recipients have followed patients for relatively short periods of time (a year or less),^{24,25} and the long-term durability of any effects is unknown.

Remote monitoring of other health activities (eg, blood pressure monitoring, glucose monitoring, home spirometry) can also facilitate patient adherence in transplant patients.²⁶ Finkelstein and colleagues demonstrated that home monitoring and transmission of pulmonary function results to the transplant team by lung recipients is feasible, allows for timely interpretation by the transplant team, and can be facilitated by computer-based algorithms that assist transplant team members in determining when patients require clinical intervention.²⁶ Many medical centers are expanding their use of telemedicine and may have their own remote monitoring and alerting systems that could be adopted by their transplant programs to address specific patient self-management issues.

Text messaging has generally superseded the use of other rapid electronic communications (eg, pagers, beepers) for immediate communication with patients. A recent meta-analysis found that mobile phone text messaging more than doubled the likelihood of patient medication adherence, across studies of chronic disease populations.²⁷ Although this report did not identify any studies focused on transplant patients, the findings strongly suggest that text messaging may be similarly useful with transplant recipients, and text messages have been incorporated into a recent multicomponent intervention tested with kidney recipients.²⁴ Text messaging is the least complex and costly of the HIT interventions discussed and may be highly feasible for most transplant programs to implement and routinely use.

5 | CONCLUSIONS AND RECOMMENDATIONS

Although we have emphasized the costs and limitations of measuring, monitoring, and intervening upon nonadherence, it is also important to emphasize the profound cost to health, quality of life, payers, and society of not doing so. Thus, our group hopes that this article will be a call to action for centers and health systems to re-evaluate their cost equations, to incorporate the approaches discussed. As acknowledged in our introduction,

our group hopes that a similar initiative develops for pediatric/adolescent transplant recipients. Tables 1–3 are designed to allow readers to easily select methods to systematize screening for risk factors, assess and monitor adherence, and intervene on patients at risk for nonadherence that best meet the needs of their patients within the existing assets of their unique transplant center. Our overall recommendations are summarized in Table 4. Other specific recommendations may be found in the work of Oberlin and colleagues, who developed a model that includes five strategies for transplant centers to incorporate evidence-based interventions into their clinical care activities;²⁸ or by the COMMIT Group, who developed a guidance report and clinical checklist on managing modifiable risk in transplantation.³

Coupled with patient report of nonadherence, technology-based nonadherence monitoring may complement technology-based nonadherence interventions with transplant recipients and offer accurate, but clinically feasible, screening for nonadherence in a way that not only detects nonadherence, but also reveals the reasons for nonadherence. To achieve these multiple objectives, we recommend patient reports using validated, standardized instruments for nonadherence screening. The coupling of screening with more intensive intervention approaches is likely the most effective way to increase adherence among transplant patients. Educational interventions are important to adherence; however, they should be coupled with other interventional components, such as behavioral contracting, clinical, counseling, and motivational interviewing. Given that adherence is known to decline over time post-transplant, it is important for transplant teams and patients to stay engaged in these strategies over the long-term. Additionally, incorporating technology-based methods, such as text messaging and smartphone, computer, or tablet applications can improve adherence. Although it may be time- and resource-intensive to expand interventions beyond patient education, we strongly recommend providers consider these additional investments.

Transplant teams can use models such as the Model for Improvement²⁹ or the Consolidated Framework for Implementation Research (CFIR) Model³⁰ to implement and reliably test these strategies. Finally, for any adherence measurement, tracking and intervention effort to be effective, the entire team would need to support its' use. If such activities are seen as the sole responsibility of only one team member, it is likely that both patients and the team as a whole will continue to see the activities as peripheral rather than central to patient care.

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TABLE 1

Examples of factors often associated with nonadherence post-transplant

	Modifiable	Nonmodifiable
Sociodemographics ^{4,7,16,31}		<ul style="list-style-type: none"> • Younger age • Male gender • Race/ethnicity • Lower SES • Rural (versus urban) residence • Living alone
Pretransplant factors ^{4,7,16,31}	<ul style="list-style-type: none"> • Adherence (pre-tx) • Reduced medication self-efficacy^a • Mood disorder/depression • Anxiety • Hostility • Limited social support/lower perceived social support • Lower conscientiousness • Health literacy 	<ul style="list-style-type: none"> • More comorbid medical conditions
Post-transplant factors ^{4,7,16,31}	<ul style="list-style-type: none"> • Distress • Depression • Low self-care agency^b • Disruption to daily routine/travel • Forgetfulness • Poorer perceived health • Running out of medication • Inadequate monetary funds to cover medication costs • Low knowledge/negative beliefs about medications • Medication complexity (type and schedule) • Medication side effects 	<ul style="list-style-type: none"> • Longer time since transplant

^aSelf-efficacy—an individual's belief that he or she has the ability to implement a behavior that will produce a desired outcome.

Self-care agency—an individual's cognitive and physical/behavioral ability to engage in self-care, this includes the ability to perform behaviors aimed at maintaining health and well-being.

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TABLE 2

Comparison of approaches to measuring adherence for clinicians

Measurement method	Strengths	Weaknesses	Recommendation
Self-report w/standardized instruments	Inexpensive, easy to administer, can determine reasons for nonadherence and lead to intervention planning, represents patients' experience/views; can assess multiple elements of the posttransplant medication regimen, including medication-taking, clinic appointment attendance, completion of blood work, following diet and exercise requirements, use of substances (eg, alcohol, tobacco), and any other monitoring requirements (eg, blood pressure, temperature, lung function)	May be less sensitive, specific, or precise than desired, subject to desirability response bias and recall bias; in the case of medication adherence, does not assess key components of medication-taking execution, for example taking, timing, or drug holidays	We recommend use of a self (patient)-reported standardized instrument that indicates reasons for nonadherence (eg, intentional or unintentional). Efforts should be made to reduce bias in reporting, such as explaining to the patient that it may be difficult to stay totally adherent to all prescribed regimen components
Provider report	Inexpensive, easy to administer, can determine reasons for nonadherence and lead to intervention planning	May be less sensitive, specific, or precise than desired, subject to bias due to provider misperceptions; often underestimates nonadherence; in the case of medication adherence, does not assess key components of medication-taking execution, for example taking, timing, or drug holidays	We do not recommend the sole use of provider reports
Medication refill reports ^a	Not subject to reporting bias, potentially accurate, potentially inexpensive	Indirect measure—pills obtained by patients may not have been taken, not taken on time, and/or not taken for multiple days (ie, drug holiday), clinics may not have access to all pharmacies used by their patients to obtain refill records, may not reflect dose changes	We recommend use of refill reports if a clinic has resources in place to access these metrics
Medication blood levels ^a	Direct measure of whether medication has been taken	Potentially difficult or expensive to implement, relatively intrusive to patient; only reflects adherence within a few days prior to level (ie, skipped for multiple days drug holiday); potentially less accurate because many factors other than adherence impact blood level results	We recommend use of blood levels if a clinic has resources in place to collect blood samples and data
Electronic medication event monitoring devices ^a	Can provide precise determination of concordance between pills used and prescribed regimen (eg, taking, timing, drug holidays), continuously records pill usage over desired time period and can quantify length of gaps between pills used, not subject to reporting bias	Expensive to obtain, potentially difficult and costly to implement by providers and use by patients, indirect measure—pills removed from device by patient may not have been taken; patients often only willing to use for short periods of time and do not see these devices as suitable replacements for weekly pill boxes for all medications	Recommended if a clinic has resources in place to purchase and implement these devices
Electronic medical record review of adherence behavior (eg, clinic appointments, laboratories completed)	Can provide data on appointment and laboratory testing adherence; easily accessible by transplant staff; adherence assessment can be performed quickly	Requires access to electronic medical record	We recommend that this method should be implemented for laboratory tests and clinic visits
Remote spirometry monitoring (in lung transplantation)	Can provide precise determination of spirometry use; not subject to reporting bias	Potentially difficult to implement by providers and for use by patients, indirect measure	We recommend this method as a complement to patient report if a clinic has resources to commit to its use

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Measurement method	Strengths	Weaknesses	Recommendation
Other biological assays (eg, smoking, alcohol use indicators)	Direct measure of whether prohibited substances have been used	Potentially difficult or expensive to implement, relatively intrusive to patient	We recommend this method as a complement to patient report if a clinic has resources to commit to its use

^a Only applicable to medication adherence.

TABLE 3

Interventions, key components, and implementation benefits, challenges and other considerations

Intervention strategies	Key components	Benefits	Challenges	Other considerations
Education	<ul style="list-style-type: none"> Oral, written, auditory, or audio-visual formats Provision to individuals or groups 	<ul style="list-style-type: none"> Majority of patients and support persons want comprehensive education Can be offered in various patient languages, literacy level, and specific to individual situations 	<ul style="list-style-type: none"> Patient recall of information may reduce over time, especially when receiving other information about transplant Requires some level of literacy and fluency in language the information is provided Requires dedicated staff time and training 	<ul style="list-style-type: none"> Should supplement other strategies; not effective in isolation. Benefits may be sustained longer if social supports are engaged
Cognitive behavioral interventions				
Behavioral contracting	<ul style="list-style-type: none"> Regular meetings with provider to renew/renegotiate contract Contract components include: goals, motivations, consequences of nonadherence, social support, adherence reminders, barriers to adherence, and tools to overcome barriers Both provider and patient sign contract to reinforce commitment to achieving adherence goals 	<ul style="list-style-type: none"> Specific to the individual patient Promotes communication between patient and provider Facilitates opportunities for providers to educate patients and reinforce importance of adherence 	<ul style="list-style-type: none"> Could be time-consuming for provider Patient may have difficulty implementing tools/strategies to improve adherence. In this case, the provider should be available to assist or guide the patient as needed 	<ul style="list-style-type: none"> Contract meetings may be conducted in-person or over the telephone Both the provider and patient should keep a copy of the signed contract
Pharmacy counseling	<ul style="list-style-type: none"> Scheduled meetings with a pharmacist to review medication history, current medication regimen (including dosage schedule and special instructions for taking medication), side 	<ul style="list-style-type: none"> Facilitates an individual approach to removing barriers to medication-taking and reinforces importance of adherence 	<ul style="list-style-type: none"> Could be time-consuming for provider 	<ul style="list-style-type: none"> Provides opportunity for providers to simplify the medication regimen; address side effects; or, address drug availability or financial barriers

Intervention strategies	Key components effects, and laboratory values	Benefits	Challenges	Other considerations
Motivational interviewing	<ul style="list-style-type: none"> • Collaborative approach used to identify barriers to adherence and to implement intervention goals through exploring the patient's motivations development of a plan of action to support adherence 	<ul style="list-style-type: none"> • Patient-centered: patients partner/ collaborate with providers throughout the intervention process • Promotes communication between patient and provider • May assist patient in addressing ambivalence regarding adherence to long-term medication regimen 	<ul style="list-style-type: none"> • Must be conducted by a provider who has received training in performing motivational interviewing • Need to assess fidelity to motivational interviewing protocol • Duration of intervention and impact on nonadherence have not been assessed in transplant patients 	<ul style="list-style-type: none"> • Motivational interviewing may be conducted one-on-one, in group sessions, or over the telephone
Health information technology				
Smartphone or tablet apps	<ul style="list-style-type: none"> • Software downloaded onto device • May include components to graph trends in symptoms or behaviors over time • May include alerting/reminder functions • May include educational information 	<ul style="list-style-type: none"> • Good patient acceptability • Apps may be inexpensive or free • Components help patients visualize trends and be alerted to potential problems in real time • Mobile health apps have been judged by governmental agencies such as the FDA to pose low risks to patients 	<ul style="list-style-type: none"> • Patient use may decline over time • Use may be limited by patient vision, dexterity, literacy, or health literacy • Patients may not have resources to purchase electronics or apps • Transplant programs may not have resources to develop apps; available apps may not have desired features • Apps tested in research may not be publicly available; commercial apps may not have been tested for efficacy • Any data to be transmitted from device to the transplant program would need security and confidentiality protections 	<ul style="list-style-type: none"> • Apps would need to be identified and reviewed before recommending patient use • Transplant program staff would need familiarity with the app to advise patients on use • Strategies may be needed to keep patients motivated to use apps (eg, providing feedback on app results) • Patients must understand that the apps should not be used to address urgent or time-sensitive health issues

Intervention strategies	Key components	Benefits	Challenges	Other considerations
Websites	<ul style="list-style-type: none"> Available via the Internet using multiple devices (personal computers, tablets, smartphones) May include multiple components (eg, education, communication with other users or experts, options for uploading personal data to monitor health trends or activities) 	<ul style="list-style-type: none"> Good patient acceptability Use may be inexpensive or free If hosted by a transplant program, program can ensure accurate content; patients may feel more connected to the program Patients may feel more connected to other patients with similar health conditions May be time-saving for transplant programs; patients can be referred to website for information/resources Users need not own any device; Internet can be accessed at public locations, e.g., libraries If desktop/laptop computer is used, vision and manual dexterity problems may be minimized due to keyboard/screen size 	<ul style="list-style-type: none"> Similar constraints as noted above with apps: declining use, literacy, program development, and security/confidentiality challenges as for apps Websites may lack features that programs feel would be useful Websites tested in research may not be available; those publicly available may not have been tested for efficacy It may be inconvenient to access the Internet in public locations and patients may be unable to afford either a computer or Internet access 	<ul style="list-style-type: none"> See other considerations for apps; these apply for websites as well If developed by transplant program, resources would be needed to update and monitor website If website included options for communication between users or health professionals, transplant programs would need plans to monitor and respond in a timely way to posted comments
Alerting and remote monitoring systems	<ul style="list-style-type: none"> Usually requires that patients receive a device and maintain it in their homes (eg, a special medication dispenser or equipment for monitoring health parameters) May include or require Internet access or other technology for transmitting data May include alerting features to remind patients or notify them of problematic values 	<ul style="list-style-type: none"> Alerting/reminder systems can lessen patients' need to remember to perform activities Remote monitoring can provide information to the transplant team in real time Remote monitoring can reduce the need for patient to return to medical center for frequent monitoring Commercially available remote monitoring 	<ul style="list-style-type: none"> May require purchase of monitoring equipment; may have maintenance and data transmission costs Patients may be unable to afford or unwilling to purchase these systems Similar declining use, vision, manual dexterity, literacy, security issues as for apps Systems tested in research may not be available; those commercially available may not have been tested for "user 	<ul style="list-style-type: none"> Same issues are for apps

Intervention strategies	Key components	Benefits	Challenges	Other considerations
Text messaging	<ul style="list-style-type: none"> Transplant team or automated system contacts patients on cell phone to remind them about clinic visits, medical appointments, labs that are due, etc. Contact can require a response by the patient indicating task has been accomplished 	<ul style="list-style-type: none"> Good patient acceptability Does not require a smartphone; other mobile phone devices can receive these messages If automated, can be time-saving for transplant program Potentially less intrusive than phone calls and answering machine messages Potentially more confidential than communication by pagers or beepers 	<ul style="list-style-type: none"> Similar declining use, literacy, vision, confidentiality issues as for other technologies Requires that patients have cell phone; some patients may be unable to afford cell phones 	<ul style="list-style-type: none"> Policies would need to be in place for whether the text messaging is one way only (from program to patient) or whether program would encourage/allow patients to send text messages as well Strategies may be needed to keep patients motivated to act when they receive text messages

Nurses refers to either nurse coordinators or floor nurses.

TABLE 4**Summary of recommendations for adherence intervention and monitoring**

Recommendation 1:	Use validated adherence screening tools. If possible, use a multimodal approach to assessing adherence (eg, patient report + pharmacy records or electronic monitoring + screening for missed appointment and labs)
Recommendation 2:	Use technology-based interventions and adherence monitoring approaches
Recommendation 3:	Couple educational interventions with other intervention approaches (eg, behavioral, cognitive)
Recommendation 4:	Include the entire transplant team (including the surgeons, psychologist, psychiatrist, pharmacist, and social worker) in adherence monitoring and intervention implementation