

Implementation of Health Literacy, Medication Knowledge, and Pillbox Fill Tests to Facilitate Patient Education in Patients Who Received a Transplant

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Health literacy, defined by the Institute of Medicine as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions”, is an important aspect to evaluate in the healthcare setting.¹ In 2006 the National Assessment of Adult Literacy reported that only 12% of adults have proficient health literacy levels, while 22% have basic and 14% have literacy levels that are less than basic.² Low health literacy is linked to poor outcomes including higher healthcare costs, higher hospitalizations and emergency care use, poorer physical and mental health, and a higher mortality rate among the elderly.³ Low health literacy is prevalent among transplant patients. A study conducted among 36 adult patients with kidney transplants demonstrated that 72% were categorized as having marginal or low health literacy.⁴ Most patients were male with an average age of 53 years and who were 8 years post-transplantation. Low health literacy is also associated with lower adherence to immunosuppressant drugs.⁵⁻⁷ Poor medication adherence in transplant is associated with a higher incidence of acute and chronic rejection, graft loss before death, and mortality.^{8,9}

In order for a patient to be adherent to their medication regimen, they must have adequate knowledge on how to take their medications. This is especially important for transplant patients with complicated medication regimens. Zartman and colleagues developed a pillbox test to evaluate executive functioning and medication administration knowledge

Abstract

Objectives: To evaluate the implementation of health literacy, medication knowledge and adherence, and pillbox fill tests post-transplantation to facilitate patient education.

Methods: The intervention was the the addition of health literacy, medication knowledge and adherence, and pillbox fill tests for pharmacist use in patient education. All patients who received a heart, liver, or lung transplant were administered the Rapid Estimate of Adult Literacy in Medicine-Transplant (REALM-T), the Short Test of Functional Health Literacy in Adults (S-TOFHLA), a pillbox fill test, medication knowledge questionnaire, and the Morisky, Green, and Levine Adherence Scale prior to discharge. Self-reported number of monthly missed medication doses were documented. Subsequent tests, excluding health literacy assessments, were administered monthly for the following three months. The baseline pillbox fill test evaluated the patient’s ability to fill one week of medications in a pillbox for six transplant-related medications. Subsequent pillbox checks were administered based on the patients’ actual medication regimen. Implementation outcomes included patient retention based on assessment completion rates, time in minutes to administer tests, and surveys from transplant pharmacists regarding usefulness and likelihood of future use.

Results: Out of the 11 patients included, most patients were identified to have adequate health literacy (64%) by S-TOFHLA with average REALM-T score of 61 of 69 words. Most performed well in the pillbox test (99-100% accurate by month 3), the medication knowledge quiz (80-90% by month 3), and the adherence scale (average score of 0 by month 3 with 0 missed monthly doses reported). Pharmacists found the completion of the health literacy tools, adherence assessments, and pillbox tests feasible with the pillbox test the most time intensive at an average of 16 minutes.

Conclusions: Evaluating health literacy and patient knowledge and adherence post-transplant was feasible with pillbox tests being the most useful.

TABLE 1. Medication Knowledge Multiple Choice Quiz Questions

<p>1. The best time to have my lab work drawn if I take my tacrolimus at 8:00am and 8:00pm is:</p>	<p>a. Any time in the morning b. Between 8:00 and 8:30 in the morning, after taking my tacrolimus c. Between 7:30 and 8:00 in the morning, before taking my tacrolimus</p>
<p>2. What do you do if you forget to take a medication at your usual time, and who do you inform if you miss a dose?</p>	<p>a. If you are less than “half-way” to taking the next dose, do not take the medication and continue with your next scheduled dose like normal; tell the Transplant Coordinator b. If you are more than “half-way” to taking the next dose, do not take the medication and continue with your next scheduled dose like normal; tell the Transplant Coordinator c. Take double the dose the next time you take the medication and tell the Transplant Coordinator</p>
<p>3. Tacrolimus (Prograf/Hecoria), mycophenolate sodium (Myfortic) or mycophenolate mofetil (Cellcept), and prednisone are what type of medication?</p>	<p>a. Anti-rejection b. Antibiotic c. Antiviral d. Antifungal</p>
<p>4. I take sulfamethoxazole/trimethoprim (Bactrim, TMP/sulfa, co-trimoxazole) to:</p>	<p>a. Prevent rejection b. Prevent urinary tract infections c. Prevent lung and kidney infections</p>
<p>5. What type of vaccine is okay for me to get after getting a transplant?</p>	<p>a. Nasal spray vaccine b. Live vaccine c. Shot</p>
<p>6. I can take this over-the-counter pain medication safely if I have a headache:</p>	<p>a. Nasal spray vaccine b. Live vaccine c. Shot</p>
<p>7. I might have to start a new medication for high blood pressure or blood sugars because of:</p>	<p>a. Acyclovir b. Mycophenolate sodium (Myfortic) or mycophenolate mofetil (Cellcept) c. Nystatin d. Prednisone</p>
<p>8. Which side effect is a side effect of tacrolimus (Prograf/Hecoria)?</p>	<p>a. Low blood sugars b. Kidneys might not work as well c. Low blood pressure d. Increased facial hair</p>
<p>9. I take this liquid medication to help prevent fungal infections:</p>	<p>a. Prednisone b. Itraconazole (Sporanox) or Nystatin c. Tacrolimus (Prograf/Hecoria) d. Multivitamin</p>
<p>10. What should I do if I am going to run out of a medication in three days?</p>	<p>a. Call the Transplant Coordinator and have them send the medication overnight in the mail b. Wait until my next clinic visit in a month to refill the medication c. Wait until I run out and then call the Transplant Coordinator</p>

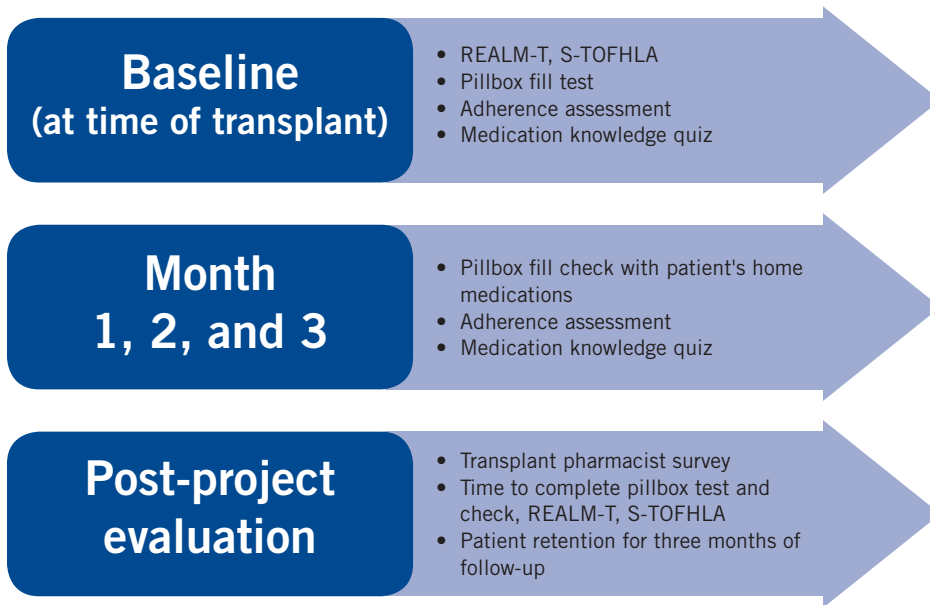
where participants had five minutes to fill a four-slotted weekly pillbox for five medications based on the medication label.¹⁰ Errors were categorized as omission, misplaced movement, or commission (i.e. excess pills). The three categorized groups were the community control (recruited following presentations on aging at senior centers), the medical control (recruited with flyers posted in a cardiovascular rehabilitation clinic), and the neurological group (referred by physicians from an outpatient memory clinic or neurorehabilitation day program). Among the groups, the health community control group had 3 total pill errors, the medical control group had 9 total pill errors, and the neurological cognitive dysfunction group had 30 errors ($p < 0.001$). Failing to

complete the pillbox was determined to be 3 or more total errors on the test. Failure rates for the groups were 15%, 43%, and 75%, for the community control, medical control, and neurological groups, respectively ($p < 0.05$). Another study utilizing a similar pillbox test among heart failure patients demonstrated that errors of omission or commission were found in 67% of the pillboxes with more omission errors noted among patients with cognitive impairment.¹¹ Although these studies were not completed in the transplant population, they illustrate the potential use for a pillbox test to evaluate medication administration knowledge. Pillboxes are self-identified as one mechanism to ensure medication adherence among kidney transplant patients, along with other

reminder methods and developing routines and problem-solving strategies.¹²

Health literacy and cognitive status have an impact on a patient's ability to understand medications. Evaluating health literacy and patient medication knowledge via a pillbox test as part of the process to receive a transplant could allow the pharmacist to better identify patients who need additional counseling and education and improve their communication with lower health literate patients. Therefore, this project aimed to evaluate the implementation of health literacy, medication knowledge and adherence, and pillbox fill tests post-transplantation to facilitate patient education.

FIGURE 1. Timeline of Assessment Completion



ability to accurately fill one week of medications in a pillbox for six commonly used transplant medications. These common medications were chosen as patients' individual transplant medication regimens may change while hospitalized immediately post-transplant. Patients were given a detailed medication chart to use, including medication name, indication, and instructions for use as is the standard for all transplant patients at the site. Once stable, for subsequent outpatient visits, patients brought their home pillbox for a verification check by the transplant pharmacist. Therefore, the follow up pillbox fill checks were based on the patients' actual medication regimens. Patients receive a detailed medication chart specific to their medication regimen at every clinic visit.

The medication knowledge quiz was comprised of ten multiple choice questions relating to commonly used transplant medications and adherence, indications, and side effects (Table 1). All information was obtained from a standardized medication education packet all new transplant patients received. To assess adherence, patients self-reported the number of missed medication doses per month. The Morisky, Green, and Levine Medication Adherence Scale was used and consisted of four closed-ended questions

Methods

This was a single-center, quality improvement project to implement health literacy assessment tools and medication knowledge screenings for pharmacist use in enhancing patient education. The intervention consisted of two health literacy tools, a pillbox fill test, a medication knowledge questionnaire, and an adherence assessment into the transplant pharmacist workflow. All patients who newly received a heart, liver, or lung transplant from September 2017 through January 2018 at the William S. Middleton Memorial Hospital were included. As this was a quality improvement initiative, there were no exclusion criteria.

To assess health literacy, the Rapid Estimate of Adult Literacy in Medicine-Transplant (REALM-T) and Short Test of Functional Health Literacy in Adults (S-TOFHLA) were used. Two distinct assessments tools were utilized as they each evaluate a different aspect of health literacy. The REALM-T is a transplant-specific version of the REALM test, one of the most widely used tools to assess adult health literacy.¹³ This test was originally validated among kidney transplant patients. The REALM-T is a word recognition test with patients pronouncing a total of 69 transplant-related words in order of increasing difficulty. The REALM has scoring ranges to identify the level of health

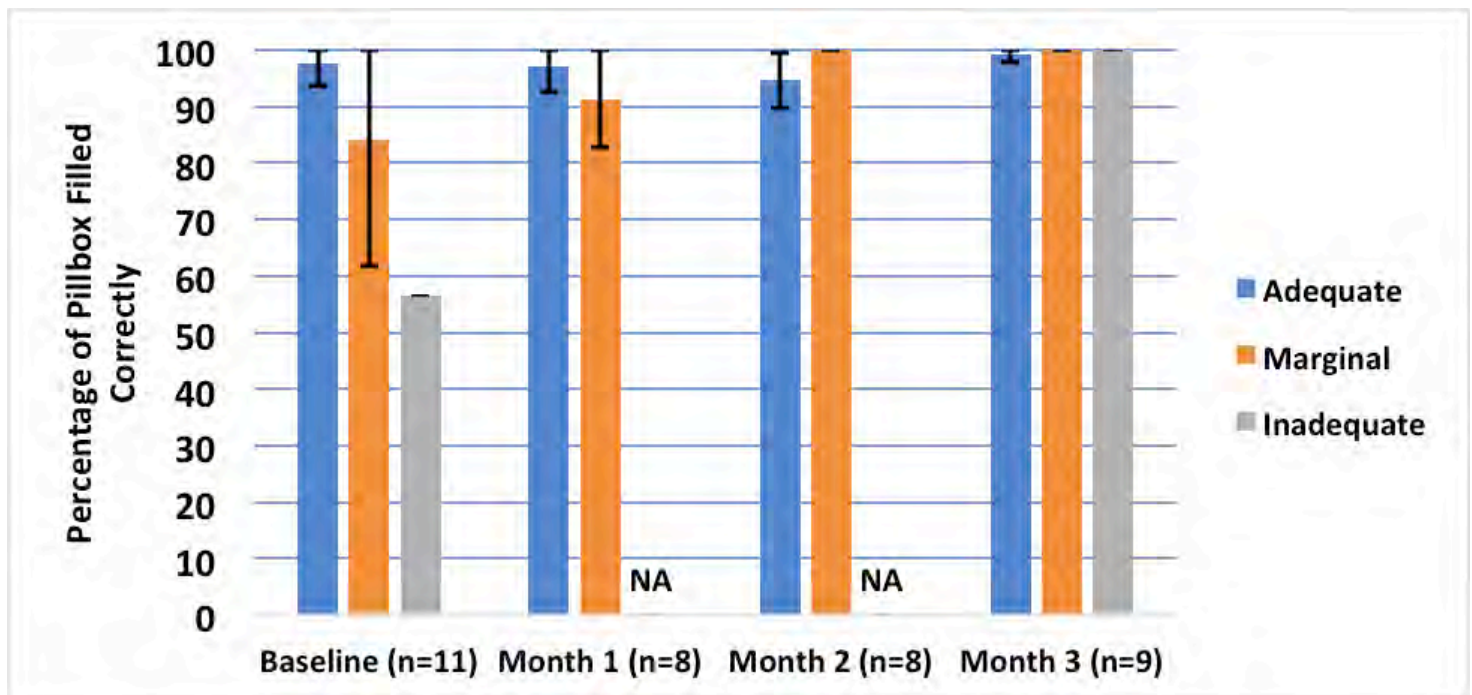
literacy; however, the REALM-T does not have these ranges. The S-TOFHLA is a self-administered, 36-item, timed, reading comprehension test where patients must select the correct missing word from the sentence.¹⁴ Patients are identified as having adequate (23-36), marginal (17-22), or inadequate (0-16) health literacy based on their score.

The pillbox fill test was completed at baseline and evaluated the patient's

TABLE 2. Baseline Demographics

<i>Demographic</i>	<i>Results (n=11)</i>
Age in years (SD)	59 (8)
Annual income in dollars (SD)	47,354 (31,351)
Sex, No. (%)	
Male	11 (100)
Transplant type, No. (%)	
Liver	9 (82)
Heart	2 (18)
Race, No. (%)	
White	6 (55)
African American	3 (27)
Hispanic/Latino	2 (18)
Level of Highest Education, No. (%)	
Some High School	1 (9)
Completed High School	3 (27)
Some College	5 (45)
Completed College	2 (18)

FIGURE 2. Accuracy of Patients Completing Pillbox Fill Test and Check Based on Health Literacy as Determined by S-TOFHLA Score*



*No data is available for month 1 and 2 for the patient categorized as having inadequate health literacy due to hospitalization during that time.

regarding if the patient 1) forgets to take medication, 2) is careless with taking medication, and discontinues medication if the patient 3) feels better or 4) worse.¹⁵ Patients received a score of 0 (high adherence), 1 to 2 (moderate adherence), or 3 to 4 (low adherence).

Prior to discharge during the initial hospitalization for transplantation, an ambulatory care pharmacy resident administered the REALM-T, S-TOFHLA, pillbox fill test, and medication knowledge quiz, and assessed adherence subjectively and via the Morisky, Green, and Levine Medication Adherence Scale. Two transplant pharmacists conducted outpatient clinic visits and administered the follow up pillbox fill check, medication knowledge quiz, and adherence assessment monthly for the subsequent three months (Figure 1).

Feasibility and appropriateness were assessed to evaluate service implementation.¹⁶ Feasibility was measured by the time in minutes for each test administration, the proportion of patients who completed the new assessments, and the proportion of patients who completed the full three months of follow up. Appropriateness was measured by surveys completed by the transplant

pharmacists who were asked to rate the usefulness and likelihood of future use of the health literacy and pillbox fill tests. Free response questions included discussion of the benefits of the health literacy and adherence information gathered, challenges to implementing these assessments into current workflow, and recommended changes to the assessments for future use. As this quality improvement project was undertaken for programmatic evaluation, the University of Wisconsin-Madison Health Sciences Institutional Review Board (IRB) determined this project did not meet the federal definition of research therefore IRB review was not required.¹⁷ Data were analyzed using descriptive statistics.

Results

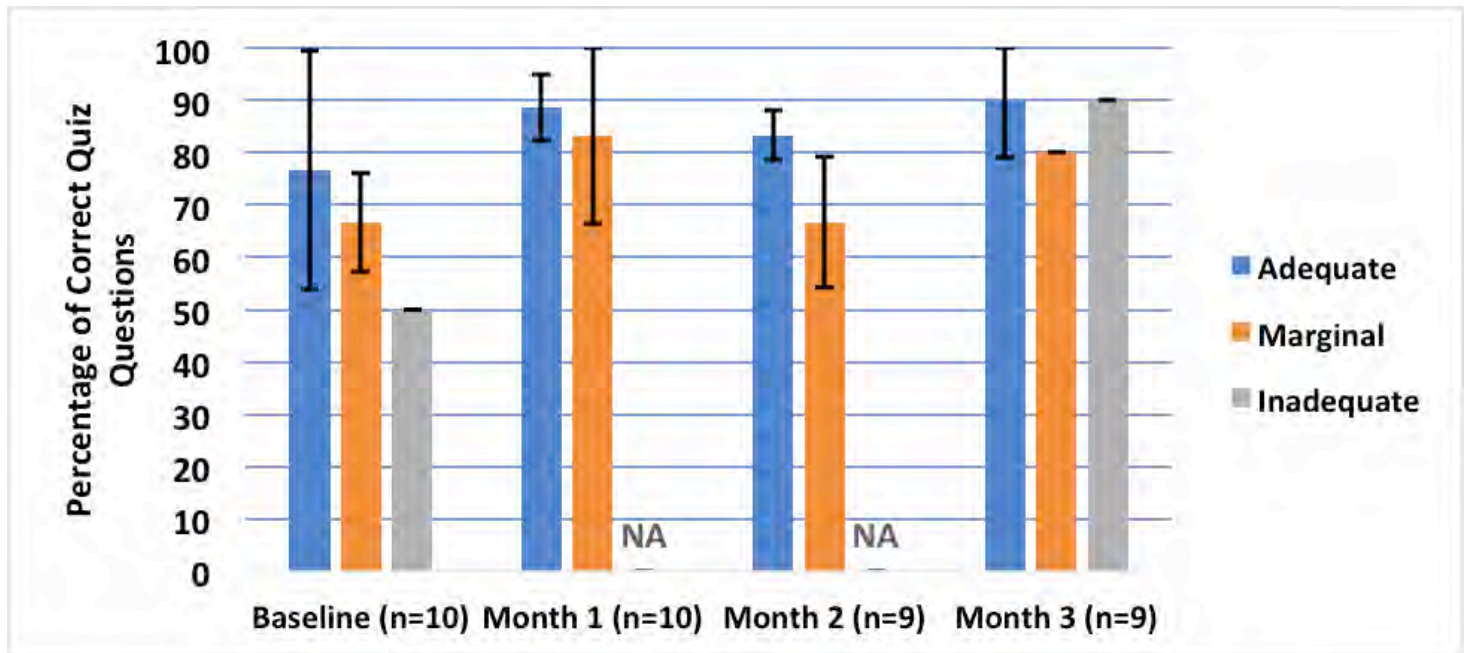
A total of 13 patients received a transplant during the specified timeframe with 11 completing the assessments. One patient declined the services and another was discharged from the hospital prior to completing baseline assessments. Baseline demographics are provided in Table 2. All patients included were male with the majority having received a liver transplant. No lung transplants were completed during the timeframe. Based on the S-TOFHLA, 7 patients (64%) were identified to have

adequate health literacy, with 3 (27%) and 1 (9%) having marginal and inadequate health literacy, respectively. Average REALM-T score was 61 out of 69 words with adequate and marginal health literate patients at similar scores of 64 and 60, respectively, and the inadequate health literate patient with a score of 42.

Patient accuracy in filling the pillbox improved from baseline to filling the pillbox 99-100% accurately at month 3 (Figure 2). Medication knowledge quiz scores improved from baseline to month 3 with lower scores for month 2 (Figure 3). At baseline, patients with adequate, marginal, and inadequate health literacy self-reported number of monthly missed doses at 0, 1, and 30 doses, respectively with corresponding average Morisky, Green, and Levine Adherence Scale scores of 0, 1, and 4. For the subsequent three months, average number of monthly missed doses and Adherence Scale scores were 0 among all health literacy groups.

In terms of feasibility, the pillbox test at baseline was the most time-intensive, taking on average 16 minutes to complete (range 12-29 minutes). The pillbox check at the outpatient clinic visits took 7 minutes on average (range 3-15 minutes). The REALM-T took 1-2 minutes and the

FIGURE 3. Percent Correct Answers on Medication Knowledge Quiz Based on Health Literacy as Determined by S-TOFHLA Score*



*No data is available for month 1 and 2 for the patient categorized as having inadequate health literacy due to hospitalization during that time.

S-TOFHLA took 5-7 minutes to complete. At baseline, 91% of patients completed all required assessments; one patient did not complete the medication knowledge quiz. Completion rates for month 1 (73%), month 2 (73%), and month 3 (80%) were lower than baseline. Reasons for not completing the assessments included hospitalization, transplant pharmacist staffing changes, and the patient not bringing in their home pillbox for the check.

For appropriateness, transplant pharmacists were surveyed (n=2) and felt that the pillbox test and check was the most useful and had a high likelihood of continued use in the future compared to the REALM-T and S-TOFHLA (Figure 4). Identified benefits of health literacy and pillbox assessments included tailoring education to patient needs and identifying patients who need additional instruction despite an initial impression of medication understanding. During the outpatient clinic visits, the pillbox check allowed the pharmacists to identify and correct filling errors made by the patient or caregiver. One pharmacist plans to complete a pillbox fill check as a standard assessment at each patient's first clinic visit post-transplant as the pharmacist felt that most filling

errors were made at the first month pillbox check. The main barrier noted was time to complete all assessments. One of the pharmacists remarked that the use of a pharmacy resident was essential in order to complete the baseline assessments in a timely manner. Future changes recommended were to complete health literacy and pillbox tests pre-transplant to alleviate the time constraint.

Discussion

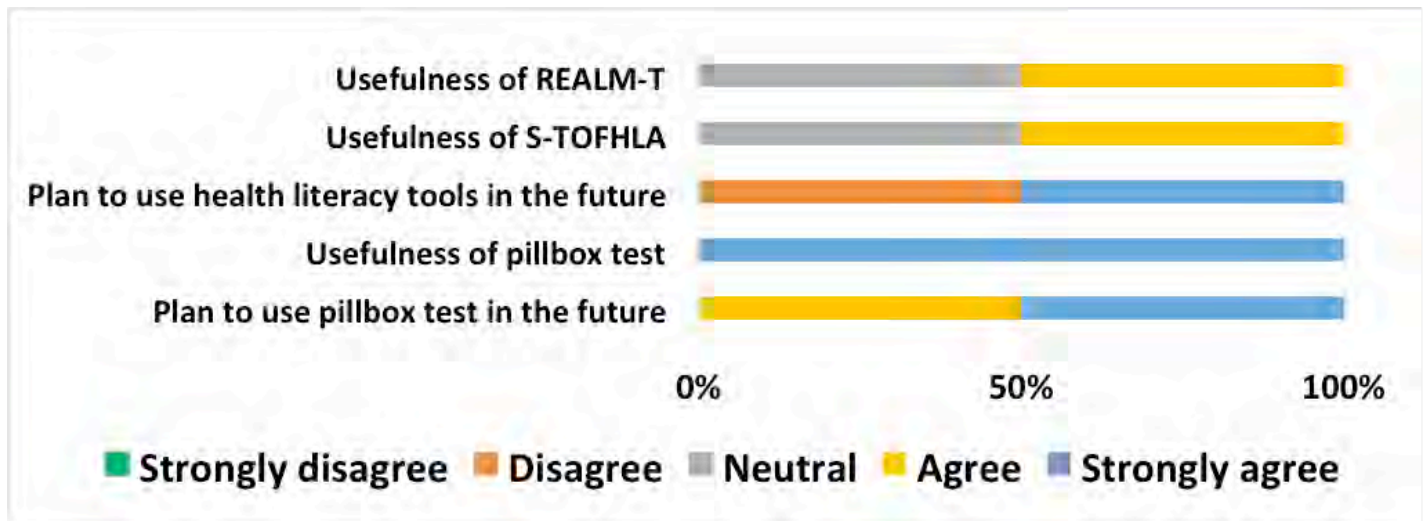
The majority of patients were identified to have adequate health literacy and performed well in the pillbox test and the medication knowledge quiz. Completion of the health literacy tools, adherence assessments, and pillbox tests were feasible with the addition of a pharmacy resident into the transplant pharmacist workflow. Pharmacists found the pillbox test to be the most beneficial to identify and correct patient errors.

Completing the assessments at baseline prior to discharge was time-intensive and would not have been feasible without the addition of a resident into the transplant pharmacist workflow. Another consideration is to utilize pharmacy technicians or pharmacy students to aid in the assessment completion. The pillbox fill test, although identified as the most

useful, required the most time to complete. Additional staff was necessary to ensure assessment completion in addition to medication education prior to discharge. The REALM-T was validated among kidney transplant recipients which were not completed at this institution.¹³ However, using the REALM-T rather than its original counterpart was thought to be a more targeted approach to evaluate health literacy in the transplant population.

The baseline pillbox test evaluated the patient's individual ability and the subsequent pillbox checks assessed the ability of the patient and the caregivers or family members who also participated to fill the patient's pillbox at home. Although the pillbox checks evaluated both the patient and caregiver's abilities, it was determined to be a more accurate representation of how the patient would ultimately be taking their medications at home. A study completed in heart failure patients utilized a similar pillbox test for five heart failure medications.¹¹ Filling errors were categorized as either omission or commission which were found in 67% of the pillboxes. The pillbox test was comparable and their pillbox assessment mirrored the baseline pillbox fill test completed in this project. The higher accuracy rates in completing the pillbox

FIGURE 4. Transplant Pharmacist Perceptions (n=2) on Use of Health Literacy Tools and Pillbox Test



check the subsequent months post-transplant are not necessarily comparable to the rates found in the study for heart failure hospitalizations. Another future consideration may be to further categorize the type of filling error made rather than a quantitative assessment of how many errors which could enable the pharmacist to further tailor re-education on appropriate ways to fill a pillbox.

The medication knowledge quiz included a question regarding a medication that most patients discontinue 1 to 2 months post-transplant. This could account for the decrease in quiz scores at month 2. Medication knowledge assessments have been used in other studies to evaluate patient knowledge. In a similar fashion, a pre-post knowledge test was used to evaluate a solid organ transplant patient education program after medication education conducted by the pharmacist, provision of medication informational sheets, and participation in a self-medication transplant program.¹⁸ The free response test questions consisted of general medication information and a transplant drug-specific section for indication, dosing, side effects, and monitoring. Test scores improved from 25% on the pre-test to 66% on the post-test. Patients understood medication information on drug identification, dosage, and indications while they scored poorly on questions relating to medication side effects. The medication knowledge quiz completed also demonstrated an improvement over

time, but with higher accuracy rates which could be due the difference in question format (free response compared to multiple choice).

Several limitations were identified with the implementation of the project. The project captured a small number of patients, which makes it challenging to extrapolate a relationship between health literacy adherence, knowledge, and accuracy in completing a pillbox test. However, the data provided were able to provide a general sense of the abilities and knowledge of newly transplanted patients. The REALM-T does not provide health literacy categories based on scores unlike its original counterpart, the REALM, which made it challenging to interpret the scores when compared to the S-TOFHLA scoring.

Future directions include completing the health literacy assessment and baseline pillbox test pre-transplant during the initial pharmacist evaluation phase which may alleviate the time burden on pharmacists to complete these assessments in addition to the usual medication education prior to discharge. As the transplant pharmacist found the pillbox test to be the most useful in identifying otherwise unknown medication fill errors, the plan moving forward is to complete a pillbox check for all newly transplanted patients for the first month with additional follow-up as needed. To further elucidate the relationship between health literacy and medication knowledge, a larger sample size

and data collection time period is needed.

Conclusion

Evaluating health literacy and medication knowledge was feasible and demonstrated that many transplant patients had adequate health literacy and were able to complete the medication and adherence assessments well. Pillbox tests and checks were identified as the most beneficial to enable the pharmacist to identify and correct medication errors. Further steps are needed to include a larger sample size to assess which specific tools are the most beneficial.

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