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ORIGINAL ARTICLE

Assessment of the Impact of Clinical Pharmaceutical Care in Heart or Lung Transplant Patients: Correlation Between Health Literacy and Medication Adherence

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ABSTRACT

Introduction: In Brazil, organ transplant activity began in 1964. In 1968, the first heart transplant was performed; years later, in 1989, the first lung transplant was conducted. This therapeutic alternative for terminal diseases has grown in recent years and, due to its complexity, requires a multidisciplinary team. Focusing on pharmacotherapy, the study addresses the importance of clinical pharmaceutical care in heart or lung transplant patients, highlighting the challenges of medication adherence and low health literacy, crucial factors for clinical outcomes. Objectives: To measure health literacy and medication adherence in heart or lung transplant patients during pharmacotherapeutic follow-up to identify the correlation between these indicators and compare them before and after the educational pharmaceutical intervention proposed in the study. Methods: A prospective and single-center study conducted at the Heart Institute of the Hospital das Clínicas of the University of São Paulo Medical School with 14 transplant patients (7 heart and 7 lung) from July to December 2024, using the Test of Health Literacy (TLS) and the Brief Medication Questionnaire (BMQ). Results: There was a significant improvement with $p < 0.001$ in post-intervention health literacy (mean from 77 to 87 points). Among the individuals, 64.3% were male, 78.6% had completed high school, and the average age was 43.6 ± 13.8 years. The correlation between TLS and BMQ revealed that 43.2% of medication adherence can be explained by health literacy. Conclusion: It can be inferred that clinical pharmacist interventions are capable of modifying health literacy, which consequently alters medication adherence.

Descriptors: Health Education; Pharmaceutical Services; Functional Literacy; Transplantation.

Avaliação do Impacto da Assistência Farmacêutica Clínica em Pacientes Transplantados Cardíacos ou Pulmonares: Correlação entre Letramento em Saúde e Adesão Medicamentosa

RESUMO

Introdução: No Brasil, a atividade de transplante de órgãos teve início nos anos 1964. Em 1968, foi realizado o primeiro transplante de coração; anos depois, em 1989, foi realizado o primeiro transplante de pulmão. Essa alternativa terapêutica para doenças terminais tem crescido nos últimos anos e, devido a sua complexidade, requer uma equipe multiprofissional. Com foco na farmacoterapia, o estudo aborda a importância da assistência farmacêutica clínica em pacientes transplantados cardíacos ou pulmonares, destacando os desafios da adesão medicamentosa e do baixo letramento em saúde — fatores cruciais para os resultados clínicos. **Objetivos:** Medir o letramento em saúde e a adesão medicamentosa de pacientes transplantados cardíacos ou pulmonares durante o acompanhamento farmacoterapêutico de forma a identificar a correlação entre esses indicadores e compará-los, antes e depois da intervenção farmacêutica educacional proposta no estudo. **Métodos:** Estudo prospectivo e unicêntrico realizado no Instituto do Coração do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo com 14 pacientes transplantados (7 cardíacos e 7 pulmonares) no período do julho a dezembro de 2024, utilizando o Teste de Letramento em Saúde (TLS) e o *Brief Medication Questionnaire* (BMQ). **Resultados:** Houve melhora significativa com $p < 0,001$ no letramento em saúde pós-intervenção (média de 77 para 87 pontos). Dos indivíduos, 64,3% eram do sexo masculino, 78,6% possuíam o ensino médio completo e a média de idade foi de 43,6 ± 13,8 anos. A correlação entre o TLS e o BMQ revelou que 43,2% da adesão medicamentosa pode ser explicada pelo letramento em saúde. **Conclusão:** é possível inferir que as intervenções do farmacêutico clínico são capazes de modificar o letramento em saúde que consequentemente modifica a adesão medicamentosa.

Descritores: Educação em Saúde; Cuidados Farmacêuticos; Alfabetização Funcional; Transplante.

INTRODUCTION

In Brazil, organ and tissue transplantation began in 1964. The first heart transplant was performed in 1968, but the disappointing results led to the suspension of transplant programs at that time, except for kidney transplants. The discovery of cyclosporine in the early 1980s brought better results. Consequently, a heart transplant program (1984) emerged in Brazil, as well as an early lung transplant program (1989).[1,2]

According to the Brazilian Ministry of Health and the Brazilian Association of Organ Transplants, 208 heart transplants and 32 lung transplants were performed in the first half of 2023. There was an 18% increase in heart transplants compared to the same period in 2022, while the number of lung transplants remained the same. In this way, it is possible to see that the country is increasingly taking its place in the field of transplants.[3,4]

In general, the care of pre- and post-transplant patients reaches a high level of complexity. It is therefore of the utmost importance to work with multi-professional teams that provide a holistic approach and specialized care for the patient.[5,6]

Post-transplant therapy consists of immunosuppressants, responsible for reducing the incidence of rejection; prophylactic drugs, to avoid opportunistic infections; and drugs considered symptomatic, which help with immediate and late post-operative discomfort. Therefore, this therapy characterizes the complexity of pharmacotherapy, due to polypharmacy, and highlights the need for the patient to be monitored by the clinical pharmacist.[2]

The pharmacist is the professional trained to act in the entire drug chain, which directly or indirectly impacts the patient. This professional is responsible for drug treatment, which involves clinical assessment of the prescription, indication of pharmacotherapy, drug reconciliation, screening for drug-related problems, checking for drug interactions, adjusting the dose and route of administration, checking the technical preparation of the drugs, providing guidance to the patient, and identifying and helping with the level of drug adherence.[7,8]

Among the pharmacist's clinical attributions, what has been highlighted in recent years are health education actions, often justified by the socioeconomic profile and vulnerability of the Brazilian population using the Unified Health System, where half of the users were classified as class C and 24.8% received a family allowance, corroborating research by the Ministry of Health, in partnership with the Brazilian Institute of Geography and Statistics, which reports that 41.4% of individuals who have had access to medicines in public services have no education or have incomplete primary education.[9,10]

With a low level of schooling, the level of health literacy is also inadequate. By definition, health literacy implies the ability to obtain, process, and understand information needed to make decisions regarding one's own health, enabling the individual to move around in the health environment. Assessing health literacy has been a concern for researchers and health professionals due to the relationship between low levels of health literacy and health care, with poorer quality and higher costs, low adherence to treatment, and less favorable clinical outcomes.[11,12]

The *Teste de Letramento em Saúde* (TLS) (in English: Test of Health Literacy) is culturally adapted and transcribed into Brazilian Portuguese based on the Test of Functional Health Literacy in Adults (TOFHLA)[10]. It measures an individual's level of ability in health-related reading and numeracy, making it possible to quantify health literacy.[13]

The concept of adherence is understood as the use of prescribed medication in at least 80% of its total, including schedules, doses, and treatment time. In addition, the way in which patients are included in their treatment also has an influence on poor adherence, which may be a reflection of inadequate health literacy.[14]

In light of the above, it can be said that the complexity of pharmacotherapy and the population's low health literacy are factors that contribute to lower adherence to treatment and are directly linked to more complex clinical outcomes. In this context, the pharmacist is a professional trained to monitor pharmacotherapy, promoting, through health education, greater medication adherence and influencing the health literacy of transplant patients.[15,16]

The aim of this study is to measure health literacy and medication adherence and correlate them in heart or lung transplant patients during pharmacotherapeutic follow-up, which is the intervention carried out during the study.

METHODS

Type of study

This was a prospective, single-center clinical study carried out at the Heart Institute of the Hospital das Clínicas of the Faculty of Medicine of the University of São Paulo, a teaching hospital specializing in Cardiology and Pulmonology, in the city of São Paulo, Brazil, from July to December 2024.

Sample and eligibility

Patients were recruited from the heart or lung transplant clinical units in ward beds who met the inclusion criteria:

- Patients who underwent heart or lung transplantation during their current hospitalization in the study period and who were subsequently followed up with the pharmaceutical team on an outpatient basis;
- Patients with the Unified Health System as their provider;
- Patients aged 18 or over.

Patients were excluded if:

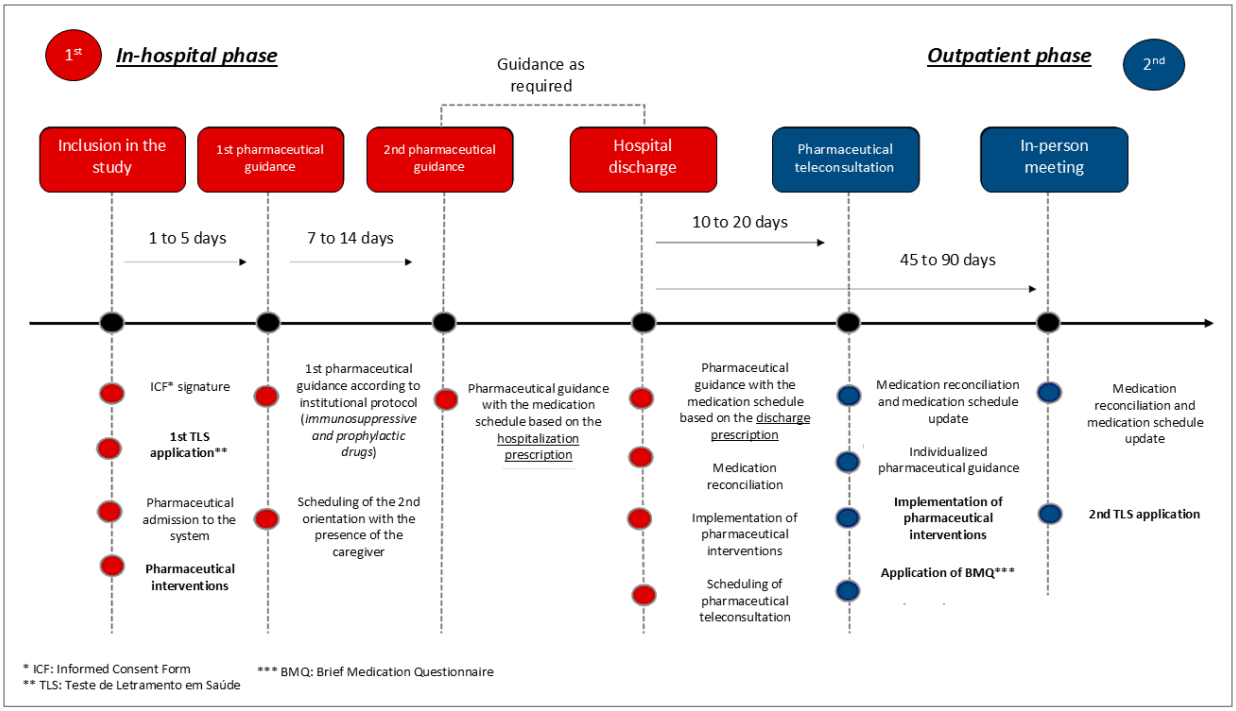
- They have not undergone a transplant or had a heart or lung transplant prior to the date of the current hospitalization;
- They remained hospitalized at the end of the study, or were hospitalized during one of the stages;
- Patients who refused to take part in the study or who withdrew their consent during the study;
- Patients who died during the study.

Ethical procedures

After approval by the ethics committee (CAAE: 81183324.0.0000.0068), the eligible participants signed the Informed Consent Form, and only then did the study protocol begin.

Intervention protocol

The stages of the study are described in the flowchart in Fig. 1. It is important to note that there is only one group, in which the same individuals were assessed before and after the interventions.



Source: Authors.

Figure 1. Flowchart describing the interventions conducted during the study.

Teste de Letramento em Saúde (TLS)

The TLS was applied on the first day of follow-up, on the day of inclusion in the study, and 45 to 90 days after hospital discharge. The test is divided into two segments: the first is numbering, where the patient answers a questionnaire based on information given to them in a sentence, for example, a prescription for painkillers. The initial score ranges from 0 to 17, which is transcribed into a weighted score from 0 to 50 using the original TOFHLA table. In the second reading segment, the participant scores from 0 to 16 in section A; from 0 to 20 in section B; and from 0 to 14 in section C. The participant's final score is between 0 and 50 points.[13]

In both segments, 1 point is awarded for each correct answer and 0 for each incorrect answer. In the end, a score from 0 to 100 is obtained, which allows the classification of: inadequate literacy (0–59), limited literacy (60–74), and adequate literacy (75–100).[13]

Brief Medication Questionnaire (BMQ)

The BMQ was taken at the pharmaceutical teleconsultation held 10 to 20 days after hospital discharge. The test consists of three domains: the patient is asked about their medication regimen, preexisting beliefs, and their recollection of the drug treatment. The test therefore provides a score for the three domains: adherence (0 to 7 points), belief (0 to 2 points), and recall (0 to 2 points). The reference value used is: ≥ 1 the individual may have poor adherence, barriers related to belief, and/or recall.[17]

It was not possible to administer the pre-intervention test due to the profile of the population. The majority of patients in the transplant queue are subjected to prolonged hospitalizations until the organ arrives; therefore, the adherence test would be compromised, as the medication is administered by the nursing team, and the patient does not have the full autonomy necessary to assess the three domains.

Pharmaceutical interventions

The subclassification of the institutional protocol was used to classify the pharmaceutical interventions, which includes the items described in the list below:

- Adequate treatment time;
- Dose adjustment;
- Change in frequency;
- Change of administration route;
- Adjustment of infusion time;
- Adjustment in the schedule;
- Adjustment of diluent volume;
- Medication reconciliation;
- Correction of prescription;
- Inclusion of medication;
- Team/patient orientation or referral;
- Request for laboratory test;
- Diluent replacement;
- Drug replacement;
- Suspension of medication;
- Not applicable.

Acceptability was subdivided into: accepted, not accepted with justification (when the health team provides some information that justifies not carrying out the intervention), and not accepted (when the intervention is not carried out).

To identify the drugs involved in the pharmaceutical interventions, the Anatomical Therapeutic Chemical Classification was used, which subdivides drugs according to the related organ or system. Some of the interventions were not related to medication, in which case we used the term: not related to medication.[18]

Statistical analysis

The data collected was organized in a Microsoft Excel spreadsheet (.xlsx) and analyzed in the software Jamovi (version 2.3.28.0).

For the applicable variables, the descriptive statistical method was used, calculating the measures of central tendency of mean and dispersion by standard deviation, median, and interquartile range [p25, p75] when not normal. Categorical variables were represented using absolute (n) and relative (%) frequencies.

To evaluate the results of the TLS, the *t*-test for paired samples (pre- and post-intervention) was used. The normality test was applied, and the Wilcoxon test was used when the normality assumption was violated.

To investigate the correlation between the TLS and BMQ instruments, Pearson's correlation (r) was used as a reference value.[19]

A univariable linear regression was then carried out, with the TLS instrument as the predictor and the BMQ as the response variable.

The assumption of normality was assessed using the Shapiro–Wilk test in all analyses. The confidence interval adopted was 95%, and the *p*-value to determine statistical significance was 5% ($p < 0.05$) for all analyses.

RESULTS

Sample characterization

A total of 25 patients were assessed, of whom 6 did not meet the inclusion criteria and 2 did not agree to take part in the study; 17 patients were included in the study. Of these, 3 did not complete the study, the reasons being: 1 death, 1 hospital discharge before completing all the stages of the study, and 1 due to rehospitalization during the study period, making the outpatient stages impossible. As a result, 14 patients completed the study.

In total, the hospital performed 75 adult transplants through the Unified Health System in 2024, 42 of which were heart transplants and 33 lung transplants. The study sample corresponds to 18.6% (n = 14) of the total, with 16.6% (n = 7) of patients undergoing heart transplantation and 21.2% (n = 7) lung transplantation.

Of the sample, 64.3% (n = 9) were male, 78.6% (n = 11) had completed high school, 71.4% (n = 10) were married, and 64.3% (n = 9) had their spouse as their main caregiver. The average age was 43.6 ± 13.8 years.

The sample was stratified into heart or lung transplants. In heart transplants (n = 7, 50%), the majority were male, with 71.4% (n = 5), and 100% (n = 7) had completed medical school. The average age was 42 ± 15.3 years. In lung transplants (n = 7, 50%), the majority were male, with 57.1% (n = 4); 14.3% (n = 1) had completed elementary school, 57.1% (n = 4) had completed secondary school, and 28.6% (n = 2) had completed higher education. The average age was 43 ± 13.2 years.

The average length of stay in the study was 67.8 ± 21.2 days, with a minimum of 38 and a maximum of 98 days.

Teste de Letramento em Saúde (TLS)

The average time taken to complete the test in the first application was 23.0 ± 5.1 minutes, while in the second application the average was 18.4 ± 4.4 min. As shown in Table 1, the *t*-test was applied with $p < 0.001$.

Table 1. *t*-test for paired samples with the filling time variable.

Variable	Pre-intervention	Post-intervention	Statistical test
	Mean ± SD	Mean ± SD	t(df) = e, p =
Completion time (minutes)	23.0 ± 5.1	18.4 ± 4.4	t (13) = 5.00, $p \leq 0.001$

SD: standard deviation; t: Student's *t*-test; df: degree of freedom; e: test result.

With regard to the scores, the average in the first application was 77.0 ± 16.4 points, while in the second application the average was 87.1 ± 11.1 points. The difference between the 1st and 2nd TLS was 10.1 ± 8.3, with 92.8% (n = 13) scoring higher on the 2nd TLS, while only 7.15% (n = 1) scored lower on the 2nd TLS. Table 2 shows that the higher the individual's level of education, the higher the score, both before and after the intervention.

Table 2. Descriptive statistics, TLS scores subdivided by level of education.

	Complete elementary school (n = 1)		Complete high school (n = 11)		Complete higher education (n = 2)	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
1st TLS	75.0	-*	76.0	18.1	83.5	10.6
2nd TLS	80.0	-*	87.6	12.0	88.0	11.3

TLS: *Teste de Letramento em Saúde*; *Given N without standard deviation.

When stratifying the score by age range (Table 3), it can be seen that patients under the age of 40 have higher health literacy. However, when looking at the difference between the scores, those aged between 40 and 65 increased by 11.8 points (15.9%) compared to those aged under 40, who increased by 8.0 points (9.9%).

Table 3. Descriptive statistics: TLS scores subdivided by age range.

	< 40 years (n = 6)		40–65 years (n = 8)	
	Average	Standard deviation	Average	Standard deviation
1st TLS	81.0	9.4	74.0	20.2
2nd TLS	89.0	8.6	85.8	13.1

TLS: *Teste de letramento em saúde*.

In terms of classification, in the 1st TLS, 71.4% (n = 10) rated their literacy as adequate, 14.3% (n = 2) as limited, and 14.3% (n = 2) as inadequate. In the 2nd TLS, 85.8% (n = 12) were classified as having adequate literacy, 14.2% (n = 2) as limited, and none as inadequate.

The four individuals who showed limited/inadequate literacy scored enough to be reclassified one category higher at the end of the study, as can be seen in Fig. 2. It should be noted that individual 10, who had the lowest score on the 1st TLS, was also the one who obtained the greatest difference in score between the 1st and 2nd TLS (25 points), which is equivalent to a 67.6% improvement in their literacy.

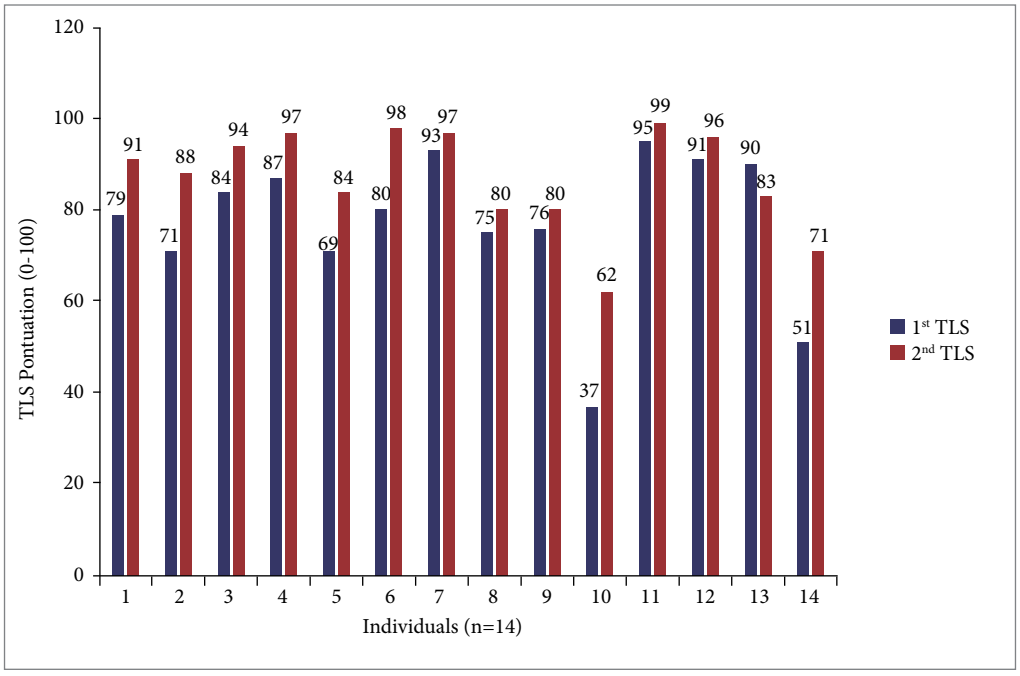


Figure 2. Comparative presentation of the patients' scores on the 1st (pre-intervention, 1st day of follow-up) and 2nd TLS (post-intervention, between 45 and 90 days after hospital discharge).

Using the *t*-test for paired samples (Table 4), it can be seen that there was statistical significance in all sections of the test, with the total value of the test standing out at $p < 0.001$.

Table 4. *t*-test for paired samples of TLS score variables subdivided by segments and sections of the test.

Variable	Pre-intervention	Post-intervention	Statistical test
	Mean ± D*	Mean ± SD	*t*(df) = e, *p* =
1st TLS segment	38.6 ± 10.1	44.3 ± 7.0	t (13) = –3.31, p = 0.003
2nd TLS Segment – Section A	13.7 ± 2.8	15.0 ± 1.6	t (13) = –2.78, p = 0.008
2nd TLS Segment – Section B	12.6 ± 4.1	14.9 ± 2.8	t (13) = –2.07, p = 0.029
2nd TLS Segment – Section C	12.1 ± 1.9	12.9 ± 1.1	W = 8.00, p = 0.040
Total*	77.0 ± 16.4	87.1 ± 11.1	t (13) = –4.53, $p \leq 0.001$

TLS: *Teste de Letramento em Saúde*; SD: standard deviation; *t*: Student's t-test; W: Wilcoxon test; df: degree of freedom; e: test result. *Total = 1st + 2nd TLS segments.

The sample was stratified into heart or lung transplants. In heart transplantation, the average score was 80.4 ± 8.5 in the 1st TLS and 92.7 ± 5.2 in the 2nd TLS, with an increase of 12.3 points (15.29%). In lung transplantation, the average score was 73.6 ± 21.9 in the 1st TLS and 81.6 ± 13.0 in the 2nd TLS, with an increase of 8 points (10.87%).

Brief Medication Questionnaire (BMQ)

The average number of days before the test application was 18.2 ± 8.6 days after hospital discharge. The average score for the three domains was 4.0 ± 1.6 points. The individuals showed barriers in all aspects, with greater fragility in adherence and recall.

Concerning the barriers to adherence, the average score was 1.9 ± 1.2. With regard to the questionnaire, 78.6% (n = 11) failed to list the prescribed medication in the initial report; 50.0% (n = 7) reported missing days or doses taken; 28.6% (n = 4)

reduced or omitted doses of some medication, 14.3% (n = 2) interrupted therapy due to a delay in receiving the medication or for another reason, 14.3% (n = 2) took an extra dose or more medication than prescribed, and 14.3% (n = 2) answered that they "did not know" any of the questions. About the immunosuppressants, 92.8% (n = 13) of the patients mentioned them in the list of medicines in use and only 7.2% (n = 1) did not report the name of the immunosuppressants.

Regarding the belief barrier, the median score was 1 (0.25–1). On the questionnaire, 64.3% (n = 9) named the medications that bothered them, but none of them answered that any of the medications "don't work well."

About recall barrier, the median score was 1 (1–1). Regarding the questionnaire, 100% (n = 14) of the individuals received a multiple-dose regimen of medication (2 or more times/day) and 7.1% (n = 1) reported difficulty remembering to take them.

The sample was stratified into heart or lung transplants. The average total test score for heart transplantation was 3.5 ± 0.9 points, while for lung transplantation the average was 3.8 ± 2.1 points.

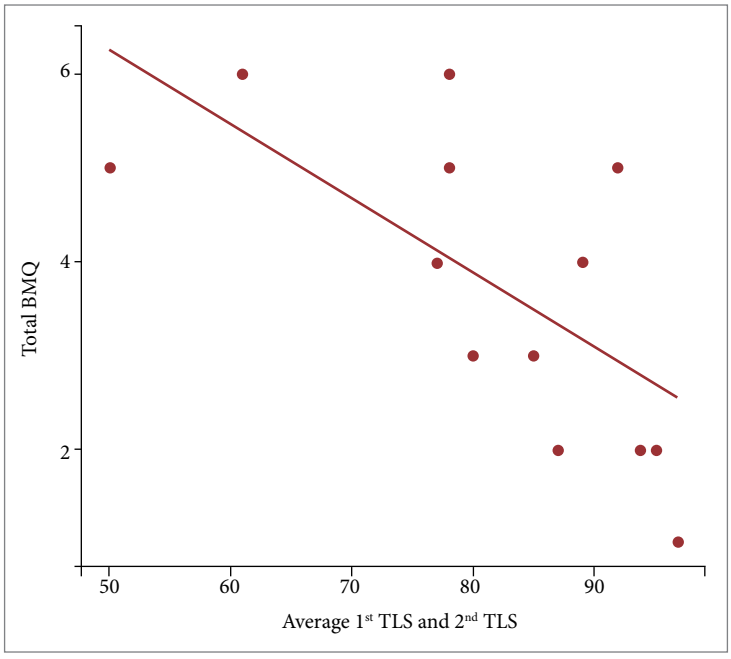
Correlation between TLS and BMQ

There is a strong negative correlation (R = –0.659) between the TLS and the BMQ, with $p = 0.010$, indicating that, for every 1-point increase in the TLS, the BMQ score decreases by 0.0788 (estimate), according to Table 5 and Fig. 3.

Table 5. TLS and BMQ linear regression.

Predictor	Estimate	95% confidence interval (lower limit; higher limit)	*p*
Constant	10.1992	(5.483; –14.9152)	< 0.001
1st and 2nd TLS averages	–0.0788	(–0.135; –0.0222)	0.010

TLS: *Teste de Letramento em Saúde*; BMQ: Brief Medication Questionnaire..



TLS: Teste de Letramento em Saúde; BMQ: Brief Medication Questionnaire.

Figure 3. Scatter plot of the correlation between the TLS and BMQ instruments.

The coefficient of determination (R^2) is equal to 0.432, meaning that 43.2% of the results found can be explained by health literacy.

Inpatient and outpatient interventions

According to Table 6, 58 pharmaceutical interventions were carried out with the medical team during the patients' hospitalization, with 81% acceptability (n = 47) and a median of 3.5 (2–5) interventions per patient. The subtype of intervention with the highest percentage was the inclusion of medication with 22.4% (n = 13) and the medications most involved in an intervention were prophylactic 32.8% (n = 19).

Table 6. Pharmaceutical interventions carried out during hospitalization.

Intervention subtype	Intervention (n)	Percentage (%)
Inclusion of medication	13	22.4%
Team/patient orientation or referral	12	20.7%
Drug replacement	9	15.5%
Request for laboratory test	7	12.1%
Correction of prescription	5	8.6%
Medication reconciliation	3	5.2%
Change in frequency	3	5.2%
Dose adjustment	3	5.2%
Adjustment in the schedule	2	3.4%
Change of administration route	1	1.7%
Total	58	100%

Note: The rankings that did not have scores have not been cited.

During the study's outpatient follow-up period (Table 7), 26 interventions were carried out with 92.3% acceptability (n = 24) and a median of 1.5 (0.25–2) interventions per patient. The subtype of intervention with the highest percentage was "team/patient guidance or referral," with 53.8% (n = 14), and the drugs most involved in an intervention were immunosuppressants (19.2%, n = 5).

Table 7. Pharmaceutical interventions carried out on an outpatient basis.

Intervention subtype	Intervention (n)	Percentage (%)
Team/patient orientation or referral	14	53.8%
Change in frequency	4	15.5%
Dose adjustment	2	7.7%
Adjustment in the schedule	2	7.7%
Correction of prescription	2	7.7%
Suspension of medication	1	3.8%
Medication reconciliation	1	3.8%
Total	26	100%

Note: The rankings that did not have scores have not been cited.

The drugs most involved in the interventions were anti-infectives for systemic use (20.2%, n = 17), those for the alimentary tract and metabolism (16.6%, n = 14), and antineoplastic or immunomodulatory agents (14.2%, n = 12). Table 8 shows the percentages of heart or lung transplants and the phases of intervention.

Table 8. Classification of drugs involved in inpatient and outpatient interventions divided into heart and lung transplantation.

Anatomical Therapeutic Chemical Classification	Hospitalization		Outpatient	
	HTx n(%)	LTx n(%)	HTx n(%)	LTx n(%)
A: alimentary tract and metabolism	6 (15.0%)	5 (27.8%)	1 (11.2%)	2 (11.8%)
C: cardiovascular system	3 (7.5%)	-	-	1 (5.8%)
J: anti-infectives for systemic use	8 (20.0%)	5 (27.8%)	2 (22.2%)	2 (11.8%)
L: antineoplastic and immunomodulatory agents	6 (15.0%)	11 (5.5%)	3 (33.3%)	2 (11.8%)
M: musculoskeletal system	2 (5.0%)	-	-	2 (11.8%)
N: nervous system	4 (10.0%)	1 (5.5%)		3 (17.6%)
A: respiratory system	-	-	-	2 (11.8%)
V: various	8 (20.0%)	3 (16.7%)	-	1 (5.8%)
Unrelated to medication	3 (7.5%)	3 (16.7%)	3 (33.3%)	2 (11.8%)
Total	40 (100.0%)	18 (100.0%)	9 (100.0%)	17 (100.0%)

HTx: cardiac transplantation; LTx: lung transplantation. Note: the rankings that did not have scores have not been cited.

It can be seen that 40 interventions (69.0%) were carried out during hospitalization for heart transplantation, with an average of 5.71 ± 4.68 per patient. In lung transplantation, 18 interventions were carried out (31.0%), with an average of 2.57 ± 2.57 per patient.

In the outpatient clinic, interventions in the lung transplant group accounted for 65.4% (n = 17) of the total, with an average of 2.43 ± 2.23 interventions per patient. In the case of heart transplants, interventions accounted for 34.6% (n = 9) with an average of 1.29 ± 1.50 interventions per patient.

With regard to acceptability, the pharmacist had 82.5% of interventions accepted during hospitalization for heart transplantation and 77.8% for lung transplantation. In the outpatient clinic, the acceptability rate for heart transplants was 100% (n = 9), while for lung transplants it was 88.2% (n = 15).

DISCUSSION

This study evaluated the impact of pharmaceutical care on health literacy and the correlation with medication adherence through the TLS and BMQ instruments in patients undergoing heart or lung transplantation, highlighting the role of the clinical pharmacist through technical and educational pharmaceutical interventions to improve these indicators.

To date, there are no publications that use the heart or lung transplant population as a single sample or relate the sample to health literacy or medication adherence.

The sample of heart transplant patients was mostly male (71.4%, n = 5), married, with an average age of 42 ± 15.3 years. This data is reinforced by the demographic profile studies by Almeida et al. These data are reinforced by the demographic profile studies by Almeida et al and Matos et al. and Matos et al. al. However, Matos et. al. present a sample with incomplete primary education, while in this study 100% (n = 7) had completed secondary education.[20,21]

The patients with lung transplant, the document from the National Commission for the Incorporation of Technologies in the Unified Health System presents sociodemographic data similar to that obtained in this study, in which 57.1% of the individuals were male, with an average age of 43 ± 13.2 years. About the schooling, no research was found for this population.[22]

As for studies aimed at measuring health literacy, there are no studies on lung transplant patients. For the sample of heart transplant patients, the study by Cajita et al. found that 33.1% of heart transplant recipients had inadequate health literacy and that living in Brazil can influence lower health literacy with statistical significance[23]. In the present study, 28.6% of the total sample had limited or inadequate literacy, with only 14.3% of patients undergoing heart transplantation.

Studies such as that by Muscat et al. show that personalized communication significantly increases patient understanding. Health accreditation institutions, such as the Joint Commission International (JCI) and the National Accreditation Organization (ONA), have prioritized these requirements, which are related to safety and quality of care.[24]

The study by Sorensen et al. corroborates the results found in this study, which show that patients with a higher level of health literacy are better able to understand, evaluate, and apply medical information, improving the management of their health conditions.[25]

Zullig et al. indicate that patients who understand the reasons for and benefits of treatment are more likely to follow it correctly, which corroborates the data from the present study, whose correlation between the TLS and BMQ instruments was statistically significant.[26]

In line with the present study, data found in the study by Demian et al. suggest that patients with lower health literacy initially showed greater potential for gain than those with adequate literacy. This difference may be based on the fact that individuals who already have good levels of knowledge have less room for significant improvement.[27]

Patients with lower initial literacy, when exposed to a structured intervention, tend to obtain greater benefits, as they start from a poorer base and absorb more new content.

In addition, the significant improvement of individuals with lower initial literacy, as observed in the case of individual 10, reinforces the importance of personalized educational programs adapted to the individual needs of transplant patients.

This highlights the need for targeted strategies for different patient profiles, ensuring that those with greater initial difficulty receive special attention to reduce inequalities in access to information and medication adherence.

Resolution No. 585, of August 29, 2013, of the Brazilian Federal Pharmacy Council emphasizes that pharmacists are trained and must develop health education actions, aiming at the rational use of medicines, the well-being of the patient, and the promotion, protection, and recovery of health.[28]

Increasingly, the academic training of pharmacists involves clinical skills in their curricula. The "Report of the National Meeting on Pharmaceutical Education," promoted by the Federal Pharmacy Council, emphasizes the need to develop and participate in training, capacity building, and continuing education programs in the area of health.[29]

The guide "Pharmaceutical Care in the Context of the Health System," published by the Brazilian Ministry of Health, emphasizes that the implementation of pharmaceutical care services has the potential to improve adherence to treatment and health literacy,

which corroborates the results of the present study, where there was statistical significance of TLS between individuals before and after interventions and pharmaceutical guidance.[30]

The integration of pharmacists into the multiprofessional heart or lung transplant team shows positive results, promoting safer and more effective care. Cristina et al. emphasize that continuous guidance during post-transplant follow-up helps patients adjust to the new therapeutic regimen, preventing adherence problems that could compromise the outcome of the transplant.[31]

With regard to the pharmacist's technical competence, Falcão et al. reinforce that the pharmacist in the multiprofessional team prevents negative outcomes associated with pharmacotherapy, ensuring medication reconciliation and patient safety[32]. In this study, the technical part is represented by the majority of interventions carried out during hospitalization, 79.3% of which are related to the medication regime.

In view of this data, which contributes to the findings of this study, the need was identified for the creation of an information leaflet, grouping together in a single piece of material information on the ways of withdrawing medication through the Unified Health System.

The benefits of the pharmacist's role in the transplant team are clear and can be extrapolated to their role in the pre-transplant process, during the evaluation, when the professional could lead to changes in these factors, enabling the patient to be better educated and aware of their treatment, which would contribute to a better prognosis.[33]

One of the limitations of the study is the size of the sample, which in turn is justified by the length of the study. With regard to the instruments used, an indirect adherence instrument was chosen, as there is some difficulty in measuring direct adherence in newly transplanted patients by serum immunosuppressant levels, due to factors such as individual variability in drug intake and metabolism at the start of treatment.

CONCLUSION

The educational pharmaceutical interventions carried out through the institutional pharmaceutical care protocol for transplant patients were able to change the health literacy of heart or lung transplant patients and, consequently, increase medication adherence. In addition, they provided greater equity between patients, generating a greater gain in those patients with lower initial health literacy.

CONFLICT OF INTEREST

Nothing to declare.

AUTHOR'S CONTRIBUTION

Substantial scientific and intellectual contributions to the study: Fernandes ATM; Galante MC; Camargo ALRF; **Conception and design:** Fernandes ATM; **Data analysis and interpretation:** Fernandes ATM, Galante MC; **Article writing:** Fernandes ATM; **Critical review:** Galante MC, Camargo ALRF; **Final approval:** Galante MC, Camargo ALRF.

DATA AVAILABILITY STATEMENT

All data was generated or analyzed in this study.

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