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A National Survey Assessing the Current Workforce of Transplant Pharmacists in China

| Journal: | BMJ Open |
|----------------------------------|--|
| Manuscript ID | bmjopen-2024-093542 |
| Article Type: | Original research |
| Date Submitted by the Author: | 09-Sep-2024 |
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| Keywords: | Renal transplantation < NEPHROLOGY, Health Surveys, Pharmacists, Health Services |
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| 1 | A National Survey Assessing the Current Workforce of Transplant Pharmacists |
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| 2 | in China |
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| 32 33 34 35 | 35 | |
| 36 37 38 | 36 | Abstract |
| 39 40 | 37 | Objective: To conduct a national survey to understand the current status of transplant |
| 41 42 | 38 | pharmacists' work in China, including the activities of transplant pharmacists in |
| 43 44 | 39 | providing pharmacy services to patients at different transplantation stages of |
| 45 46 47 | 40 | transplantation and to assess the transplant pharmacist workforce. |
| 48 49 | 41 | Design, setting, and participants: This is a national survey, using questionnaire. |
| 50 51 | 42 | Participants covered 91 transplant centres in China, and the number of organ |
| 52 53 | 43 | transplants performed by these hospitals surveyed exceeded 90% of the total number |
| 54 55 | 44 | of transplants in China. The questionnaire was conducted from 25 March 2024 to 1 |
| 56 57 58 59 60 | 45 | April 2024. |

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Main outcomes and measures: Content and duration of pharmacy services provided
to patients by transplant pharmacists at different transplantation stages of
transplantation in each transplant centre. Calculate the current full-time equivalents
(FTEs) of transplant pharmacists in China using the survey data.

Results: The provision of pharmacy services varies from transplant centre to transplant centre, with an average of only 0.81 pharmacists per 100 transplant patients in China at present. If we take into account the current work situation of transplant pharmacists in China, 2.6 FTE positions are required for every 100 transplant pharmacists to provide comprehensive pharmacy services. If pharmacists were only required to perform pharmacy services and teach, the requirement for FTEs would drop to 1.24 per 100 transplants. Meanwhile, a deviation in pharmacy services, a low number of patients covered by transplant pharmacy services, and a lack of standardisation and information technology are also current problems in China's transplant pharmacy services. The primary reasons were the heavy workload of other routine tasks and the lack of performance incentives. Addressing these issues is an effective way to change the current status of pharmacy services for transplant recipients in China.

Conclusions: The national workforce survey demonstrated the activities of transplant pharmacists in providing pharmacy services to patients at different stages of transplantation and highlighted a significant lack of transplant pharmacy services in China. At the same time, current pharmacy services lack standardization and digitalization. To address the current status of transplant recipient pharmacy services in China, reducing other workloads of transplant clinical pharmacist, increasing performance incentives, expanding the number of transplant pharmacists, and developing standardized service protocols are crucial steps.

73 Strengths and limitations of this study: This manuscript provides a valuable
74 perspective on the field of transplant pharmacy and is the largest survey of transplant

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pharmacists conducted in China, comprehensively describes the current workforce of
transplantation pharmacists in China and makes recommendations accordingly.
However, in clinical practice, pharmacy services are complex, there are many factors
that may influence the survey.

Keywords: Transplantation, Survey, Pharmacists, Pharmacy services, Full-time equivalent

83 Introduction

Organ transplantation is the most effective remedy of end-stage organ failure and
serves as a poignant symbol of a nation's advancement in medical sciences and
societal progress [1]. Over recent decades, the field of organ transplantation has
witnessed continuous advancement, marked by significant enhancements in patient
survival rates [2]. This progress owes much to the implementation of a
multidisciplinary approach to post-transplant care, wherein transplant pharmacists
play a pivotal role [3][6].

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In 2020, the American Society of Health-System Pharmacists (ASHP) issued
comprehensive guidelines regarding pharmacy services for solid organ transplants [7].
These guidelines underscored the indispensable role of transplant pharmacists or
pharmacologists within transplant centers, emphasizing their necessity for meeting
accreditation standards. Moreover, the guidelines elucidated the operational model for
transplant pharmacists, providing clarity on their functions and responsibilities within
the transplantation process.

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Despite the progress seen in many countries, transplant pharmacy services in China are still in their infancy, characterized by ongoing exploration and development [8]. As the demand for transplant pharmacists to actively participate in transplant care grows[4], there has been a corresponding increase in the number of professionals in this field, leading to a diversification of pharmaceutical services provided.

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Nevertheless, there remains a crucial gap in understanding the current landscape of transplant pharmacy services in China [8]. To date, there has not been a nationwide survey conducted to comprehensively assess the number of transplant pharmacists and the scope of pharmaceutical services being offered. Furthermore, a unified set of practice standards outlining the roles and responsibilities of transplant pharmacists throughout the continuum of care is lacking. However, due to differing national contexts, guidelines from other countries only serve as a point of reference and may not be directly applicable.

Therefore, it is imperative to gain a thorough understanding of the current status of transplant pharmacists and their working patterns in China. Therefore, the primary objective of this survey was to conduct a comprehensive assessment of the current situation of transplant pharmacists in China. This research aims to provide a reference and foundation for the development of standardized practices in the field. Additionally, it seeks to assist various programs in evaluating their transplant pharmacy services and staffing. 1en

Methods

Survey design

The questionnaire was shaped through discussions within the National Alliance of Transplant Pharmacists (the alliance was established in 2022 and includes over 100 transplant pharmacists from all provinces of China), which developed the following objectives for the survey, with a focus on the first four:

1. Describe the demographic information of transplant pharmacists currently practicing in China.

2. Obtain detailed information about the daily practice activities of transplant

pharmacists in most hospitals in China during all phases of transplantation (i.e.

evaluation phase, transplant phase, and the post-transplantation phase (ambulatory)),

as well as activities outside of transplant patient care (e.g. pharmacy management,

teaching and scientific research).

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3. Obtain the opinions of transplant pharmacists on the current daily practice of transplant pharmacy services.

4. Calculate the current full-time equivalents (FTEs) of transplant pharmacists in China using the survey data.

The questionnaire was structured into four sections: Basic information, including age, education background, job title and name of organizational unit, etc; Daily practice activities of transplant pharmacists, referring to the ASHP Guidelines on Pharmacy Services in Solid Organ Transplantation[7] (there is no relevant guideline in China), we have divided the pharmacy services into three phases, including evaluation phase, transplant phase and post-transplant phase (ambulatory), covering tasks such as assessment of medication adherence, reviewing and adjusting prescriptions, conducting pharmacy visits, providing patient education, and managing transplant pharmacy clinics, etc; Non-transplant patient care responsibilities, such as pharmacy management, teaching, and research work; in addition to Transplant pharmacists' opinions on current pharmacy services. The questionnaire incorporated both qualitative and quantitative questions, including single- and multiple-choice questions, as well as open-ended questions. Following several rounds of revisions, a small number of questionnaires were distributed to members within the National Transplant Alliance for a pilot test. After reviewing the data and feedback from respondents, further revisions were made, resulting in the completion of a final draft. The ultimate survey obtained executive approval from the National Transplant Pharmacists Alliance.

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Survey participants and dissemination

To ensure data representativeness and maximize participation, the survey targeted transplant pharmacists from all hospitals within the National Transplant Alliance, as well as the top 50 hospitals in China based on transplant volume, totaling 91 hospitals. Data indicates that transplants conducted in these top 50 hospitals encompass 90% of all transplant recipients in China [9]. Therefore, the number of organ transplants performed in the hospitals surveyed exceeds 90% of the total transplant volume in

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> China. One transplant centre discussed among themselves to submit only 1 questionnaire that was reflective of their hospital's pharmacy services. Employing the online questionnaire method (https://www.wenjuan.com/s/UZBZJvxSu9B/), the survey questionnaires were disseminated via the Wechat groups of National Transplant Alliance, with respondents independently completing them. The questionnaire was launched on March 25. 2024 and the working group closely monitored participation. After a week-long period (March 25, 2024 - April 1, 2024), non-responsive instances prompted the creation of a follow-up initiative, wherein a member of the working group directly solicited participation from pharmacists in identified hospitals. After an additional three days, the survey concluded.

Data analysis

Data from all respondents were saved using Microsoft Excel, excluding transplant pharmacists who did not provide direct pharmacy services. Descriptive statistics were utilized to summarize demographic and practice activities. Based on the number of kidney and/or pancreas transplants in the hospitals in 2023 (if kidney and/or pancreas transplantation is not performed, sort by liver transplantation, heart transplantation and small bowel transplantation), grouping hospitals by capacity volume, and comparative analyses of quantifiable indicators were performed using SPSS version 22. Continuous data were expressed as means (standard deviation, SD) or medians (interquartile range, IQR), and group comparisons were executed using the t-test. Categorical variables were described as frequencies and percentages, with between-group comparisons performed using Chi-square tests. A p-value of <0.05 was considered statistically significant.

Results

A total of 91 hospitals participated in the survey (response rate of 100.00%), of which 13 hospitals (14.29%) indicated that they haven't perform organ transplants in recent years. Therefore, our survey was conducted in the remaining 78 hospitals.

Additionally, 9 hospitals (9/78, 9.89%) did not have a transplant pharmacist involved

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| 3 | 196 | in the care of transplant patients. It was noteworthy that 8 of these 9 hospitals were |
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| 5 6 | 197 | among the top 50 hospitals in China in terms of the number of transplants performed. |
| 7 8 | 198 | |
| 9 10 | 199 | Participant demographics |
| 11 12 | 200 | The results of the questionnaires showed that there were a total of 97 transplant |
| 13 14 | 201 | pharmacists in these 78 hospitals, with a median age of 36 years (IQR: 33-39 years). |
| 15 16 | 202 | The vast majority of pharmacists (74, 76.29%) had postgraduate qualifications and |
| 17 18 | 203 | held intermediate technical titles (59, 60.82%). On average, they had 5 years of |
| 19 | 204 | clinical practice (IQR: 2-7 years), with 32 out of 97 pharmacists (32.99%) having |
| 21 | 205 | over 5 years of experience. Additionally, 27 pharmacists (27.84%) indicated that they |
| 22 | 206 | held teaching qualifications in clinical pharmacy and had been qualified for an |
| 24 25 | 207 | average of 4 years (IQR: 2-6 years). Most transplant pharmacists provided care for the |
| 26 27 | 208 | kidneys (87, 89.69%), followed by the liver (68, 70.10%), heart (33, 34.02%), lungs |
| 28 29 | 209 | (26, 26.80%), and intestines (3, 3.09%). It was also noted that a majority of |
| 30 31 | 210 | respondents reported earing for more than one organ type (65, 67,01%) showed as |
| ~~ | 210 | respondents reported caring for more than one organ type (03, 07.0176), showed as |
| 32 33 | 211 | Table 1. |
| 32 33 34 35 | 211 212 | Table 1. |
| 32 33 34 35 36 37 | 211 212 213 | Table 1. Pharmacist activities during the phases of transplantation |
| 32 33 34 35 36 37 38 39 | 211211212213214 | Table 1. Pharmacist activities during the phases of transplantation Evaluation phase |
| 32 33 34 35 36 37 38 39 40 41 | 211 212 213 214 215 | Table 1. Pharmacist activities during the phases of transplantation Evaluation phase 60 out of 78 the hospitals (76.92%) perform medication reconciliation on their |
| 32 33 34 35 36 37 38 39 40 41 42 43 | 211 212 213 214 215 216 | Table 1. Pharmacist activities during the phases of transplantation Evaluation phase 60 out of 78 the hospitals (76.92%) perform medication reconciliation on their patients upon first encounter, the specific elements involved in medication |
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patients, while only 2 hospitals (2/60, 3.33%) stated that they provide medication
reconciliation services to all patients. The majority of hospitals (37/60, 61.67%)
indicated that there is no standard template for recording medication reconciliation,
and 78.33% hospitals (47/60) are unable to integrate the appropriate content into the
hospital information system.

More than half of the transplant centers (42/78, 53.84%) reported assessing patients for medication adherence, with the most frequently used scale is the Morisky Adherence Scale (33/42, 78.57%). Additionally, 17 transplant centers (17/42, 40.48%) reported assessing patients only once, mostly during hospitalisation. 7 hospitals (7/42, 16.67%) assess patients' adherence twice, mainly during the patient's hospitalisation and at the time of the patient's discharge; 10 hospitals (10/42, 23.81%) assess patients three times, at the first time of seeing the patient, during the patient's hospitalisation and at the time of the patient's discharge; 8 hospitals (8/42, 19.05%) assess patients throughout the whole process, at the first time of seeing the patient (pre-hospitalization or clinic prior to transplant), during the patient's hospitalisation, at the time of the patient's discharge and the later follow-up visit, at a minimum of four times.

246 Transplant phase

Of all respondents, 60 hospitals (60/78, 76.92%) indicated that they provided pharmacy services during the transplant phase. Figure 2 depicted the pharmacist's activities during the transplantation phase, focused individualized pharmacy services (57/60, 95.00%), pharmaceutical ward round (57/60, 95.00%), medical order review (56/60, 93.33%), and medication education (53/60, 88.33%). Among hospitals providing perioperative pharmacy services, only a few respondents (14/60, 23.33%) offer this care to all recipients. The majority of hospitals (23/60, 38.33%) can provide the above pharmaceutical services to less than half of the patients. Additionally, 28 hospitals (28/60, 46.67%) mentioned that they paid extra attention to patients who were retransplanted.

| 2 3 | 257 | |
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| 4 5 | 257 | Of all respondents 84.62% of the hospitals $(66/78)$ provided therapeutic drug |
| 6 7 | 250 | Of all respondents, 84.02% of the hospitals (00%) provided incrapeutic drug |
| 8 9 | 259 | monitoring (1DM) and 58.97% of the nospitals (46/78) provided pharmacogenetic |
| 10 | 260 | testing services for the relevant drugs. |
| 12 | 261 | |
| 13 14 | 262 | <i>Medical order review</i> : Among all the surveyed hospitals, a total of 56 hospitals(56/78, |
| 15 16 | 263 | 71.79%) conduct regular medical order reviews. Regarding the frequency of these |
| 17 18 | 264 | reviews, most hospitals (33/56, 58.93%) conduct reviews three times a week or more |
| 19 20 | 265 | for indications, dosage, repeat medications, drug interactions, and contraindications, |
| 21 22 | 266 | Additionally, 21.43% (12/56) can conduct reviews at most twice a week, while only |
| 23 24 | 267 | 11 hospitals (11/56, 19.64%) indicated daily reviews. In terms of the patient |
| 25 26 | 268 | population covered by these services, the majority of hospitals (21/56, 37.50%) can |
| 27 28 | 269 | review orders for less than half of their patients, while only 14 hospitals (14/56, |
| 29 | 270 | 25.00%) mentioned that they review all patients' orders. Another point worth noting is |
| 31 22 | 271 | that among hospitals conducting medical order reviews, only 28.57% (16/56) record |
| 33 | 272 | the review process and results in the information system. |
| 34 35 | 273 | |
| 36 37 | 274 | Pharmaceutical ward round: 57 hospitals (57/78, 73.08%) indicated that they |
| 38 39 | 275 | conducted regular pharmaceutical ward round for all transplant patients. Regarding |
| 40 41 | 276 | the form of these ward rounds, 31 hospitals (31/57, 54.39%) indicated that they use |
| 42 42 | | |
| 45 | 277 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, |
| 43 44 45 | 277 278 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with |
| 43 44 45 46 47 | 277 278 279 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant |
| 43 44 45 46 47 48 49 | 277 278 279 280 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the |
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| 43 44 45 46 47 48 49 50 51 52 53 | 277 278 279 280 281 282 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the frequency of these ward rounds, 31 hospitals (31/57, 54.39%) mentioned that the frequency for each transplant patient is three or more times per week, 21 hospitals |
| 43 44 45 46 47 48 49 50 51 52 53 54 55 | 277 278 279 280 281 282 283 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the frequency of these ward rounds, 31 hospitals (31/57, 54.39%) mentioned that the frequency for each transplant patient is three or more times per week, 21 hospitals (21/57, 36.84%) indicated a frequency of two or fewer times per week, and only 5 |
| 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 | 277 278 279 280 281 282 282 283 284 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the frequency of these ward rounds, 31 hospitals (31/57, 54.39%) mentioned that the frequency for each transplant patient is three or more times per week, 21 hospitals (21/57, 36.84%) indicated a frequency of two or fewer times per week, and only 5 hospitals (5/57, 8.77%) conduct daily pharmaceutical ward rounds. Moreover, only 17 |
| 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 | 277 278 279 280 281 282 283 283 284 285 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the frequency of these ward rounds, 31 hospitals (31/57, 54.39%) mentioned that the frequency for each transplant patient is three or more times per week, 21 hospitals (21/57, 36.84%) indicated a frequency of two or fewer times per week, and only 5 hospitals (5/57, 8.77%) conduct daily pharmaceutical ward rounds. Moreover, only 17 hospitals (17/57, 29.82%) mentioned the existence of a standardized template to help |
| 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 | 277 278 279 280 281 282 283 283 284 285 286 | both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.11%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.51%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the frequency of these ward rounds, 31 hospitals (31/57, 54.39%) mentioned that the frequency for each transplant patient is three or more times per week, 21 hospitals (21/57, 36.84%) indicated a frequency of two or fewer times per week, and only 5 hospitals (5/57, 8.77%) conduct daily pharmaceutical ward rounds. Moreover, only 17 hospitals (17/57, 29.82%) mentioned the existence of a standardized template to help record the form and content of the ward rounds, although this template was not |

uniformly applied across transplant centers. Additionally, 15 hospitals (15/57, 26.32%)
indicated that they would record pharmaceutical ward round-related content in the
system.

Medication education: As shown in Figure 3, 53 surveyed hospitals (53/78, 67.95%) respondents indicated that they would provide medication education to their patients, focusing primarily on medication dosage (41/53, 77.36%), drug delivery time (40/53, 75.47%), adverse drug reaction and solutions (40/53, 75.47%), lifestyle guidance (39, 73.58%), solutions for missed doses (37/53, 69.81%), storage of medications (36/53, (67.92%) and others (3/53, 5.66%). Regarding the coverage of patient groups by medication education, a large majority of the hospitals (22/53, 41.51%) would provide medication education to more than half of the patients, wihle 18 hospitals (18/53, 33.96%) would provide medication education to less than half, and 13 hospitals (13/53, 24.53%) would educate all patients. Various educational methods were utilized, with verbal combined with written or video education being the most commonly used (34/53, 64.15%), followed by solely verbal education (17/53, 32.08%), and solely written education (2/53, 3.77%). Additionally, 30 hospitals (30/53, 56.60%) indicated that there was a standardised template for documenting medication education, and 14 hospitals (14/53, 26.42%) mentioned that it would be documented in the hospital's system.

Post-transplant phase (ambulatory):

Long-term pharmaceutical management after transplantation is also crucial. However, only 14 hospitals (14/78, 17.95%) indicated that they have developed pharmacist-managed clinic for transplant patients. The average time taken to establish these clinics was 27.43 months (IQR: 6.75-34.50 months). Among these clinics, 9 hospitals (9/14, 64.29%) had a standardized template for documenting outpatient pharmacy services, and 12 hospitals (12/14, 85.71%) documented the outpatient process in the information system.

318 Other pharmacist activities

Most hospitals (64/78, 82.05%) indicated they were involved hospital-wide pharmaceutical management tasks, such as various pharmaceutical data reporting and hospital-wide medical order reviews. The average transplant pharmacist daily time spent on pharmaceutical management tasks was 3.01±1.58 hours. Only one transplant center expressed having a dedicated pharmacy management team responsible for such matters. Regarding teaching responsibilities, 62 respondents (62/78, 79.49%) participated in teaching jobs, including trainee pharmacist (3/78, 4.84%), pharmacy student (15/78, 24.19%), and those who are both (44/78, 70.97%). The time spent on teaching jobs was 1.47 ± 0.72 hours. Additionally, nearly all respondents (64/78, 82.05%) were involved in scientific research as part of their daily routine, spending an average of 2.02 ± 1.28 hours on research activities.

331 Pharmacist opinions regarding practice

Almost all respondents (71/78, 91.03%) perceived a moderate shortage in the number of transplant pharmacists, with only one respondent perceiving a mild shortage. Six respondents (6/78, 7.69%) denied the lack of transplant pharmacists. Regarding the current state of pharmacy services in China, 65 respondents (65/78, 83.33%) perceived a lack of transplant pharmacy services. The main reasons for the lack of pharmacy services were identified as heavy workload in other daily tasks, lack of performance incentives, the shortage of transplant pharmacists and lack of legal and regulatory support, with degree 5 accounting for more than 60% of the total, especially concerning the high daily workload (degree 5 at 67.69%) (see Figure 4).

342 Impact of transplant centre volume on pharmacy services

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There are essentially no differences in the average number of transplant pharmacists
and the proportion of pharmacy services for patients between transplant centers
(Table 2). However, in the evaluation phase, as the number of transplants increases,
the probability of pharmacists performing medication reconciliation decreases, the
difference was statistically significant.

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350 Transplant pharmacist full-time equivalents (FTE)

In current transplant hospitals in China, based on the existing number of transplants 351 and pharmacists, we have calculated an average of 0.81 pharmacists per 100 352 transplant patients. To determine the full-time equivalent (FTE) of our transplant 353 pharmacists, we considered comprehensive pharmacy services including medication 354 reconciliation during evaluation, daily pharmaceutical ward rounds and medical order 355 reviews during transplant phases, and pre-discharge medication education throughout 356 a patient's hospital stay. The average patient length of stay was 17.23 ± 8.38 days. 357 358 Overall, combined with the current status of the work of transplant pharmacists in China, pharmacists need to juggle teaching jobs, scientific research and hospital-wide 359 pharmaceutical management tasks, there was a median of 2.6 transplant pharmacists 360 FTE positions per 100 transplants. Assuming that pharmacists are only required to 361 perform pharmacy services and teaching, the FTE would become 1.24 per 100 362 transplants. 363

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366 Discussion

This is the first survey of transplant pharmacists in China, which comprehensively described and assessed the daily activities of transplant pharmacists in China, while also calculating the current demand for transplant pharmacists. The data suggested that the development of transplantation pharmacy in China was still lacking.

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The importance of transplant pharmacists has been confirmed by many studies [3][6],

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however there are currently few surveys on the transplant pharmacist workforce. In 2015, a national survey of transplant pharmacists in the United States described the main service activities performed by pharmacists during the different stages of transplantation, highlighting the typical responsibilities of pharmacists practising within the field of transplantation, and illustrating that the level of pharmacist involvement varies significantly across transplant centres and stages of transplantation. The survey also calculated that there were currently 1.4 FTE positions for transplant pharmacists per 100 transplants. In 2021, a study from Brazil on thoracic transplant [11], illustrated that in their transplant centers with pharmacists (n = 12), there is not a full-time professional dedicated to their transplant program, and the activity of transplant pharmacists is significantly lower than that of transplant centres in the United States. It is clear that the activities of transplant pharmacists in the patient care team reflect a known benefits, Cen ZF's study [12] have indicated that physicians' perceptions and experiences are positively correlated with the frequency of their interactions with clinical pharmacists. With the development of transplantation technology, the need for transplant pharmacists will further increase [13].

The results of the survey show that there are still many deficiencies in transplant pharmacy services in China, which are mainly reflected in the following areas. Firstly, our research found that there is a significant shortage of transplant pharmacists in China. Our study results indicate that there is currently an average of 0.81 pharmacists per 100 transplant patients, whereas in comparison, the United States has 1.4 full-time equivalent (FTE) positions for transplant pharmacists per 100 transplants[10], showing a noticeable decrease in numbers. Enseignement Superieur (ABES) . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies.

 Secondly, we found that even with the presence of transplant pharmacists, there are
deviations in pharmacy services, with important pharmacy services missing,
consistent with foreign studies [10,11]. For example, only 53.84% of transplant
centres assess patients for adherence, and 48% only perform once. Transplant patients

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> 403 require lifelong immunosuppressive therapy, and patient compliance with 404 immunosuppression is closely related to the development of rejection, particularly 405 antibody-mediated rejection and resulting premature graft failure [14][15]. This is 406 significantly inadequate compared to pharmacy services in other countries [16-[18].

> At the same time the number of patients covered by transplant pharmacy services in
> China is low, with most transplant centres only able to provide pharmacy services to
> less than 50% of transplant patients.

Lack of standardisation and information technology is also a current problem in China, standardisation and informatization are important components of pharmacy services, which are significant for the uniform calculation of what pharmacists do as well as for measuring the value of their work. In the United States, the relevant regulatory agencies (UNOS and CMS) [7] have made having transplant pharmacists a mandatory requirement of the transplant patient care team and have issued guidelines to guide their daily work, while in China there is still a lack of corresponding standard documents. Only a small number of hospitals in China had templates for pharmacy services and were able to link to the hospital system, but these templates were developed by individual hospitals and were not standardised, and that in the future standard operating procedures (SOPs) regarding transplant pharmacists should be developed, it can guide and standardise the daily work of the transplant pharmacists [19]. At the same time, linking to the hospital system means that the pharmacist's entire care process can be recorded by the electronic system, making the care process more systematic [20], therefore efforts should be made to form an electronic working system about transplant pharmacists.

 Regarding the reasons for the low availability of transplant pharmacist services, a study [11] suggested that the main reasons were the low frequency of pharmacist involvement in the transplant team and the low level of training and experience in the field of transplantation, our study showed that it is mainly the heavy workload in Page 17 of 25

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other daily tasks in China, 67.69% respondents having the highest level of perception for this reason. We revealed that almost all transplant pharmacists in China are currently required to take on work other than patient care, including pharmaceutical routine work, teaching jobs, and scientific research, which takes up the vast majority of their working time. In this case, we calculated the FTEs as 2.6, if only pharmacy service-related work is performed, FTE of transplant pharmacists would be reduced to 1.24 per 100 transplants, close to the findings in the United States. This also confirms the heavy workload of transplant pharmacists in China, especially with other daily work tasks. Therefore, reducing the time spent on other activities and developing a service model of a resident pharmacist would help to alleviate the current dilemma.

The next reason was lack of performance incentives, with 66.15% respondents having the highest rating for this reason. In our survey, we found that pharmacy services for transplant patients are not currently valued by hospitals and the nation, with many transplant centres reporting a lack of performance incentives. However, key performance indicators (KPIs) are essential to enhance the value of pharmacy services, and the implementation of performance appraisal is an inevitable choice for high-quality and sustainable development of hospitals [21][22]. Therefore for pharmacy services, hospitals should develop refined performance appraisal indicators to motivate transplant pharmacists and improve efficiency.

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Inadequate pharmacy services due to lack of pharmacists, as perceived by some transplant centres, with 61.54% respondents having the highest rating for this reason. In current transplant hospitals in China, based on the existing number of transplants and pharmacists, we have calculated an average of 0.81 pharmacists per 100 transplant patients, while in reality we need 2.6 full-time pharmacists for every 100 transplant patients. Therefore, increasing the number of transplant pharmacists is also a crucial step in improving pharmacy services.

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Interestingly, our study found that almost all pharmacists believe that "Insufficient
demand from clinicians or patients for pharmacy services" is not a factor hindering
the provision of pharmacy services. This indicates that both physicians and patients
have high expectations of clinical pharmacists as knowledgeable drug therapy experts.

Although this was the largest survey of transplant pharmacists conducted in China, it still has some limitations. Firstly, pharmacy services are diverse and complex, and we were only able to investigate common and important aspects of pharmacy services. However, in clinical practice, the scope of pharmacy services can be much more extensive and intricate. Secondly, our study encompassed an overall assessment of pharmacy services for all types of organ transplants, without categorizing them based on specific transplant types, as most general hospitals in China can provide multiple types of organ transplants. In the future, it would be beneficial to include the type of transplanted organ as a factor in the analysis, as it can significantly impact pharmacy services.

478 Conclusions

Our national workforce survey demonstrated the activities of transplant pharmacists in providing pharmacy services to patients at different stages of transplantation and highlighted a significant lack of transplant pharmacy services in China. At the same time, current pharmacy services lack standardization and digitalization. To address the current status of transplant recipient pharmacy services in China, reducing other workloads of transplant clinical pharmacist, increasing performance incentives, expanding the number of transplant pharmacists, and developing standardized service protocols are crucial steps.

487 Acknowledgements

488 No.

489 Notes

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| 490 | Funding: This research did not receive any specific grant from funding agencies in |
|-----|--|
| 491 | the public, commercial, or not-for-profit sectors. |
| 492 | |
| 493 | Consent for publication: Not applicable. |
| 494 | |
| 495 | Ethics approval: Not applicable. |
| 496 | |
| 497 | Patient and public involvement: Patients and/or the public were not involved in the |
| 498 | design, or conduct, or reporting, or dissemination plans of this research. |
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| 501 | Availability of data and materials |
| 502 | The datasets generated and/or analyzed during the current study are not publicly |
| 503 | available considering the privacy but are available from the corresponding author on a |
| 504 | reasonable request. |
| 505 | |
| 506 | Authors' contributions |
| 507 | HY was responsible for study conceptualization and design, data analysis and |
| 508 | interpretation, manuscript preparation, manuscript editing; XY was responsible for |
| 509 | data acquisition, data analysis, manuscript preparation and manuscript editing; XPH |
| 510 | was responsible for data acquisition, KFM, PC, XDL and QQ were responsible for |
| 511 | data acquisition, data analysis and manuscript editing; WJH and FZ were responsible |
| 512 | for data acquisition; GZW and RRW were responsible for data acquisition and |
| 513 | manuscript preparation; ZLA were responsible for study design, study |
| 514 | conceptualization, design and interpretation. |
| 515 | |
| 516 | Competing interests |
| 517 | The authors declare that they have no competing interests. |
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| 520 | Eth | nics approval and consent to participate |
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| 521 | Not | t applicable. |
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| 57 58 | 608 | Table1 Basic information of transplant pharmacists |
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| Characteristic | | Total Transplant pharmacists |
|------------------------|--------------------------|------------------------------|
| | | (n=97) |
| Age, Median (IQR) | | 36 (IQR: 33-39) |
| Educational background | | |
| N (%) | | |
| | Undergraduate | 9 (9.28) |
| | Postgraduate | 74 (76.29) |
| | Doctor | 10 (10.31) |
| | Unknow | 4 (4.12) |
| Technical title | | |
| N (%) | | |
| | Primary | 5 (5.15) |
| | Intermediate | 59 (60.82) |
| | Deputy senior | 25 (25.77) |
| | Senior | 6 (6.19) |
| | Unknow | 2 (2.06) |
| Length of employment, | / | 4 (IQR: 2-6) |
| Median (IQR) | | |
| Transplanted organs | | |
| N (%) | | |
| | Kidney and/or pancreas | 87 (89.69) |
| | Liver | 68 (70.10) |
| | Heart | 33 (34.02) |
| | Lungs | 26 (26.80) |
| | Intestines | 3 (3.09) |
| | More than one organ type | 65 (67.01) |



Figure 1 Percent Hospitals Providing Activity During Transplant Evaluations Phase (ADR: adverse drug reaction)

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Figure 3 Percent Hospitals Providing Concrete Activity About Medication Education During Transplant Phase

What Is the Current Status of Transplant Pharmacy Services in China? A Nationwide Cross-sectional Survey

| Journal: | BMJ Open |
|--------------------------------------|--|
| Manuscript ID | bmjopen-2024-093542.R1 |
| Article Type: | Original research |
| Date Submitted by the Author: | 20-Apr-2025 |
| Complete List of Authors: | Yang, Hui; Beijing Chao-Yang Hospital Capital Medical University, Pharmacy; National Alliance of Transplant Pharmacists Yu, xin; Beijing Chao-Yang Hospital Capital Medical University, Pharmacy; Capital Medical University Beijing Obstetrics and Gynecology Hospital Hu, Xiaopeng; Beijing Chao-Yang Hospital Capital Medical University, Urology Ma, Kuifeng; The First Affiliated Hospital of Zhejiang University School of Medicine, Clinical Pharmacy; National Alliance of Transplant Pharmacists Chen, pan; The First Affiliated Hospital of Sun Yat-sen University, Pharmacy; National Alliance of Transplant Pharmacists Liu, Xiangduan; Zhengzhou University People's Hospital, Pharmacy; National Alliance of Transplant Pharmacists Qian, Qing; Changzhou First People's Hospital, Pharmacy; National Alliance of Transplant Pharmacists Hou, wenjing; Capital Medical University Affiliated Beijing Friendship Hospital, Pharmacy; National Alliance of Transplant Pharmacists Zeng, fang; Huazhong University of Science and Technology Tongji Medical College Union Hospital, Pharmacy; National Alliance of Transplant Pharmacists Wang, guangzhao; The First People's Hospital of Yulin, Pharmacy; National Alliance of Transplant Pharmacists Wang, Rongrong; The First Affiliated Hospital of Zhejiang University School of Medicine, Clinical Pharmacy; National Alliance of Transplant Pharmacists AN, zhuoling; Beijing Chao-Yang Hospital Capital Medical University, Pharmacy |
| Primary Subject Heading : | Public health |
| Secondary Subject Heading: | Health services research |
| Keywords: | Health Surveys, Pharmacists, Health Services |
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| 3 4 | 1 | What Is the Current Status of Transplant Pharmacy Services in China? A |
| 5 6 | 2 | Nationwide Cross-sectional Survey |
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| 35 | |
| 36 | Abstract |
| 37 | Background: Pharmacists are vital to the multidisciplinary care for transplant patients, |
| 38 | but the workforce of their work in China remains unclear. |
| 39 | Objective: To assess the current status of transplant pharmacists' work in China |
| 40 | through a national workforce survey to evaluate service provision across |
| 41 | transplantation stages and pharmacist capacity. |
| | |
| 42 | Design, setting, and participants: Nationwide cross-sectional questionnaire |
| 43 | baesd-study (March 25-April 1, 2024) involving 91 transplant centers performing >90% |
| 44 | of China's organ transplants. |
| 45 | Main outcomes and measures: Pharmacy items and duration provided to patients by |
| 46 | pharmacists at each transplant center and used to calculate full-time equivalents |
| 47 | (FTEs). |
| | |
| 48 | Results: Service provision varied substantially across centers, with only 0.8 |
| 49 | pharmacists per 100 transplant patients nationally. Current workforce require 2.6 |
| 50 | FTEs/100 transplants for comprehensive services, reducible to 1.2 FTEs if |
| 51 | non-clinical duties are excluded. Key challenges included service inconsistency, |
| 52 | limited patient coverage, and inadequate standardization/digitalization. Primary |
| 53 | barriers were excessive non-service workloads and insufficient performance |
| 54 | incentives. Addressing these issues is an effective way to change the current status of |
| 55 | pharmacy services for transplant recipients in China. |
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| 3 4 | 57 | Conclusions: A national workforce survey revealed significant gaps in transplant |
| 5 6 | 58 | pharmacy services in China, particularly in standardization and digitalization. To |
| 7 8 | 59 | address these issues, key steps include reducing non-essential workloads for |
| 9 10 | 60 | transplant clinical pharmacists, enhancing performance incentives, expanding the |
| 11 12 | 61 | number of transplant pharmacists, and developing standardized service protocols. |
| 13 14 | 62 | |
| 15 16 | 63 | Strengths and limitations of this study: |
| 17 | 64 | • Nationally representative data from 91 hospitals covering >90% of China' s |
| 18 19 | 65 | transplant volume. |
| 20 21 | 66 | • Combined structured quantitative metrics (e.g. FTEs calculations) with qualitative |
| 22 23 | 67 | open-ended questions. |
| 24 25 | 68 | • Diversity and complexity of clinical practices may extend beyond the scope |
| 26 27 | 69 | captured |
| 28 29 | 70 | |
| 30 31 | 70 | |
| 32 | 71 | Kouwards, Transplantation: Survey: Dharmonists: Dharmony services: Full time |
| 34 25 | 72 | Reywords. Transplantation, Survey, Tharmaeists, Tharmaey Services, Tun-time |
| 35 36 | /3 | equivalent |
| 37 38 | 74 | |
| 39 40 | 75 | Introduction |
| 40 | 76 | Solid organ transplantation is a well-established treatment option for patients with |
| 42 43 | 77 | end-organ dysfunction[1]. A 10-year update report provides robust evidence |
| 44 45 | 78 | highlighting the substantial survival benefits of solid organ transplantation, while also |
| 46 47 | 79 | demonstrating the measurable progress in clinical outcomes of organ transplantation |
| 48 49 | 80 | since 2012 [2]. This progress owes much to the implementation of a multidisciplinary |
| 50 51 | 81 | approach to post-transplant care, wherein transplant pharmacists play a pivotal role |
| 52 | 82 | [3][6]. |
| 55 54 | 83 | |
| 55 56 | 84 | In 2020, the American Society of Health-System Pharmacists (ASHP) issued |
| 57 58 | 85 | comprehensive guidelines regarding pharmacy services for solid organ transplants [7] |
| 59 60 | 05 | These guidelines underscored the indispensable role of transplant pharmacists or |
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pharmacologists within transplant centers, emphasizing their necessity for meeting
accreditation standards. Moreover, the guidelines elucidated the operational model for
transplant pharmacists, providing clarity on their functions and responsibilities within
the transplantation process.

Despite the progress seen in many countries, transplant pharmacy services in China
are still in their infancy, characterized by ongoing exploration and development [8].
As the demand for transplant pharmacists to actively participate in transplant care
grows [4], there has been a corresponding increase in the number of professionals in
this field, leading to a diversification of pharmaceutical services provided.

Nevertheless, there remains a crucial gap in understanding the current landscape of transplant pharmacy services in China [8]. To date, there has not been a nationwide survey conducted to comprehensively assess the number of transplant pharmacists and the scope of pharmaceutical services being offered. Furthermore, a unified set of practice standards outlining the roles and responsibilities of transplant pharmacists throughout the continuum of care is lacking. However, due to differing national contexts, guidelines from other countries only serve as a point of reference and may not be directly applicable.

Therefore, it is imperative to gain a thorough understanding of the current status of
transplant pharmacists and their working patterns in China. Therefore, the primary
objective of this survey was to conduct a comprehensive assessment of the current
situation of transplant pharmacists in China. This research aims to provide a reference
and foundation for the development of standardized practices in the field.
Additionally, it seeks to assist various programs in evaluating their transplant
pharmacy services and staffing.

115 Methods

116 Survey design

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| 117 | The questionnaire (Supplemental Material 1) was developed by all executive committee |
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| 118 | members of the National Alliance of Transplant Pharmacists through multiple online |
| 119 | meetings. The alliance, established on December 18, 2022, with the mission of |
| 120 | enhancing pharmacists' capabilities in medication therapy management for solid organ |
| 121 | transplant recipients, ensuring medication safety, and improving patients' quality of |
| 122 | life. Initially comprising 69 members, the alliance had grown steadily by addressing |
| 123 | the clinical demands of China's transplant medicine, aligning with the patient-centered |
| 124 | development trend of pharmaceutical care, and leveraging policy support. Through |
| 125 | academic collaboration, standardization initiatives, and educational outreach, it |
| 126 | expanded to 88 members by October 2024. These members are distributed across 64 |
| 127 | transplant centers in 25 provincial-level administrative divisions (73.5%, 25/34) in |
| 128 | China. |
| 129 | All opinions were collected and collated by the working group, which consisted of |
| 130 | one executive committee member and her students. The objectives of the survey are |
| 131 | set out below, with a focus on the first four: |
| 132 | 1. Describe the demographic information of transplant pharmacists currently practicing in China. |
| 133 | 2. Obtain detailed information about the daily practice activities of transplant pharmacists in |
| 134 | most hospitals in China during all phases of transplantation (i.e. evaluation phase, transplant |
| 135 | phase, and the post-transplantation phase (ambulatory)), as well as activities outside of transplant |
| 136 | patient care (e.g. pharmacy management, teaching and scientific research). |
| 137 | 3. Obtain the opinions of transplant pharmacists on the current daily practice of transplant |
| 138 | pharmacy services. |
| 139 | 4. Calculate the current full-time equivalents (FTEs) of transplant pharmacists in China using the |
| 140 | survey data. |
| 141 | The questionnaire was structured into four sections: Basic information, including age, |
| 142 | education background, job title and name of organizational unit, etc; Daily practice |
| 143 | activities of transplant pharmacists, referring to the ASHP Guidelines on Pharmacy |
| 144 | Services in Solid Organ Transplantation [7] (there is no relevant guideline in China), |
| 145 | we have divided the pharmacy services into three phases, including evaluation phase, |
| 146 | transplant phase and post-transplant phase (ambulatory), covering tasks such as |
| | |

assessment of medication adherence, reviewing and adjusting prescriptions, conducting pharmacy visits, providing patient education, and managing transplant pharmacy clinics, etc; pharmacy management, teaching, and research work, these activities were defined as non-transplant specific duties, reflecting the institutional role of the pharmacist rather than the direct provision of transplantation services. This distinction is consistent with the current scope of pharmacy practice in most Chinese hospitals. In addition, transplant pharmacists' opinions on current pharmacy services. The questionnaire incorporated both qualitative and quantitative questions, including single- and multiple-choice questions, as well as open-ended questions. Following several rounds of revisions, a small number of questionnaires were distributed to members within the National Transplant Alliance for a pilot test. After reviewing the data and feedback from respondents, further revisions were made, resulting in the completion of a final draft. The ultimate survey obtained executive approval from the National Transplant Pharmacists Alliance.

162 Survey participants and dissemination 🌽

To ensure data representativeness and maximize participation, the survey targeted transplant pharmacists from all hospitals within the National Transplant Alliance, as well as the top 50 hospitals in China based on transplant volume, totaling 91 hospitals. Data indicates that transplants conducted in these top 50 hospitals encompass 90% of all transplant recipients in China [9]. Therefore, the number of organ transplants performed in the hospitals surveyed exceeds 90% of the total transplant volume in China. One transplant centre discussed among themselves to submit only 1 questionnaire that was reflective of their hospital's pharmacy services. Employing the online questionnaire method (https://www.wenjuan.com/s/UZBZJvxSu9B/), the survey questionnaires were disseminated via the Wechat groups of National Transplant Alliance, with respondents independently completing them, for transplant pharmacists who were not part of the alliance, we contacted either the director of the pharmacy department or the transplant pharmacist at that transplant center directly via WeChat, seeking their help in completing the questionnaire and adding the transplant

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follows:

Hours (8h).

Data analysis

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pharmacist's WeChat for follow-up reminders. The questionnaire was launched on

March 25. 2024 and the working group closely monitored participation. After a

week-long period (March 25, 2024 - April 1, 2024), non-responsive instances

additional three days, the survey concluded.

prompted the creation of a follow-up initiative, wherein a member of the working

Data from all respondents were saved using Microsoft Excel, excluding transplant

pharmacists who did not provide direct pharmacy services. Descriptive statistics were

utilized to summarize demographic and practice activities. Based on the number of

transplantation is not performed, sort by liver transplantation, heart transplantation

comparative analyses of quantifiable indicators were performed using SPSS version

22. Continuous data were expressed as means (standard deviation, SD) or medians

(interquartile range, IQR), and group comparisons were executed using the t-test.

between-group comparisons performed using Chi-square tests. A P-value of <0.05

was considered statistically significant. In addition to, the formulas for FTEs are as

Actual Transplant Pharmacist Ratio = (Total Number of Transplant Pharmacists /

(Daily Transplant Pharmacy Service Duration + Pharmacy Management Duration +

Teaching Activities Duration + Research Activities Duration) / Standard Working

Categorical variables were described as frequencies and percentages, with

and small bowel transplantation), grouping hospitals by capacity volume, and

kidney and/or pancreas transplants in the hospitals in 2023 (if kidney and/or pancreas

group directly solicited participation from pharmacists in identified hospitals. After an

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206 Daily Patient Pharmacy Service Duration =

Annual Total Number of Transplants) × 100

FTEs = Actual Working Hours / Standard Working Hours =

207 [(Sum of estimated time for all transplant pharmacy service items per patient since
208 admission × Average Hospital Stay Duration of Patients) × Annual Total Number of

- 209Transplants] / one year (365 days)

Results

A total of 91 hospitals participated in the survey (response rate of 100.0%), of which
13 hospitals (14.3%) indicated that they haven't perform organ transplants in recent
years. Therefore, our survey was conducted in the remaining 78 hospitals.
Additionally, 9 hospitals (9/78, 9.9%) did not have a transplant pharmacist involved
in the care of transplant patients. It was noteworthy that 8 of these 9 hospitals were
among the top 50 hospitals in China in terms of the number of transplants performed.

Participant demographics

There were a total of 97 transplant pharmacists in these 78 hospitals, with a median age of 36 years (IOR: 33-39 years). The majority of pharmacists (74, 76.3%) held postgraduate degrees and intermediate technical titles (59, 60.8%). On average, they had 5 years of clinical employment (IQR: 2-7 years), with 32 out of 97 pharmacists (33.0%) having over 5 years of experience. Additionally, 27 pharmacists (27.8%) indicated that they held teaching qualifications in clinical pharmacy and had been qualified for an average of 4 years (IQR: 2-6 years). Most transplant pharmacists provided care for the kidneys (87, 89.7%), followed by the liver (68, 70.1%), heart (33, 34.0%), lungs (26, 26.8%), and intestines (3, 3.1%). It was also noted that a majority of respondents reported caring for more than one organ type (65, 67.0%), showed as Table 1.

232 Table 1 Basic information of transplant pharmacists

| Characteristic | Total Transplant pharmacists |
|-------------------|------------------------------|
| | (n=97) |
| Age, Median (IQR) | 36 (IQR: 33-39) |

| Educational background | | |
|------------------------------|--------------------------|--------------|
| N (%) | | |
| | Undergraduate | 9 (9.3) |
| | Postgraduate | 74 (76.3) |
| | Doctor | 10 (10.3) |
| | Unknow | 4 (4.1) |
| Technical title | | |
| N (%) | | |
| | Primary | 5 (5.2) |
| | Intermediate | 59 (60.8) |
| | Deputy senior | 25 (25.8) |
| | Senior | 6 (6.2) |
| | Unknow | 2 (2.1) |
| | | |
| Lenth of employment, Median | | 5 (IQR: 2-7) |
| (IQR) | | |
| Length of teaching | / | 4 (IQR: 2-6) |
| qualifications, Median (IQR) | | |
| Transplanted organs | | |
| N (%) | | |
| | Kidney and/or pancreas | 87 (89.7) |
| | Liver | 68 (70.1) |
| | Heart | 33 (34.0) |
| | Lungs | 26 (26.8) |
| | Intestines | 3 (3.1) |
| | More than one organ type | 65 (67.0) |
| | | |

235 Evaluation phase

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Sixty out of 78 the hospitals (76.9%) perform medication reconciliation on their patients upon first encounter, the specific elements involved in medication reconciliation were illustrated in Figure 1. Nearly half of the respondents (32/60, 53.3%) indicated that medication reconciliation was conducted at least twice during a patient's hospital stay. The main focus areas during medication reconciliation include medication history (57/60, 95.0%), history of adverse reactions (56/60, 93.3%), medical history (53/60, 88.3%), allergy history (53/60, 88.3%), laboratory results (46/60, 76.7%), and others (1/60, 1.7%). However, more than half of the hospitals (32/60, 53.3%) stated that they are only able to provide such services to less than half of the patients. Additionally, 26 hospitals (26/60, 43.3%) mentioned that they provide medication reconciliation services to more than half of their transplant patients, while only 2 hospitals (2/60, 3.3%) stated that they provide medication reconciliation services to all patients. The majority of hospitals (37/60, 61.7%) indicated that there is no standard template for recording medication reconciliation, and 78.3% hospitals (47/60) were unable to integrate the appropriate content into the hospital information system.

More than half of the transplant centers (42/78, 53.8%) reported assessing patients for medication adherence, with the most frequently used scale was the Morisky Adherence Scale (33/42, 78.6%) [10]. Additionally, 17 transplant centers (17/42, 40.5%) reported assessing patients only once, mostly during hospitalisation. Seven hospitals (7/42, 16.7%) assess patients' adherence twice, mainly during the patient's hospitalisation and at the time of the patient's discharge; ten hospitals (10/42, 23.8%) assess patients three times, at the first time of seeing the patient, during the patient's hospitalisation and at the time of the patient's discharge; eight hospitals (8/42, 19.1%) assess patients throughout the whole process, at the first time of seeing the patient (pre-hospitalization or clinic prior to transplant), during the patient's hospitalisation, at the time of the patient's discharge and the later follow-up visit, at a minimum of four times.

Transplant phase

Of all respondents, 60 hospitals (60/78, 76.9%) indicated that they provided pharmacy services during the transplant phase. Figure 2 depicted the pharmacist's activities during the transplantation phase, focused individualized pharmacy services (57/60, 95.0%), pharmaceutical ward round (57/60, 95.0%), medical order review (56/60, 93.3%), and medication education (53/60, 88.3%). Among hospitals providing perioperative pharmacy services, only a few respondents (14/60, 23.3%) offer this care to all recipients. The majority of hospitals (23/60, 38.3%) can provide the above pharmaceutical services to less than half of the patients. Additionally, 28 hospitals (28/60, 46.7%) mentioned that they paid extra attention to patients who were retransplanted.

Of all respondents, 84.6% of the hospitals (66/78) provided therapeutic drug monitoring (TDM) and 59.0% of the hospitals (46/78) provided pharmacogenetic testing services for the relevant drugs.

Medical order review: Among all the surveyed hospitals, a total of 56 hospitals(56/78, 71.8%) conducted regular medical order reviews. Regarding the frequency of these reviews, most hospitals (33/56, 58.9%) conduct reviews three times a week or more for indications, dosage, repeat medications, drug interactions, and contraindications, Additionally, 21.4% (12/56) can conduct reviews at most twice a week, while only 11 hospitals (11/56, 19.6%) indicated daily reviews. In terms of the patient population covered by these services, the majority of hospitals (21/56, 37.5%) could review orders for less than half of their patients, while only 14 hospitals (14/56, 25.0%) mentioned that they review all patients' orders. Another point worth noting is that among hospitals conducting medical order reviews, only 28.6% (16/56) record the review process and results in the information system.

Pharmaceutical ward round: Fifty-seven hospitals (57/78, 73.1%) indicated that they
 conducted regular pharmaceutical ward round for all transplant patients. Regarding

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the form of these ward rounds, 31 hospitals (31/57, 54.4%) indicated that they use both joint ward rounds with physicians and independent pharmaceutical ward rounds, while 24 hospitals (24/57, 42.1%) conduct the ward rounds in conjunction with physicians. Additionally, only 2 hospitals (2/57, 3.5%) indicated that the transplant pharmacist conducts solely independent pharmaceutical ward rounds. Regarding the frequency of these ward rounds, 31 hospitals (31/57, 54.4%) mentioned that the frequency for each transplant patient is three or more times per week, 21 hospitals (21/57, 36.8%) indicated a frequency of two or fewer times per week, and only 5 hospitals (5/57, 8.8%) conduct daily pharmaceutical ward rounds. Moreover, only 17 hospitals (17/57, 29.8%) mentioned the existence of a standardized template to help record the form and content of the ward rounds, although this template was not uniformly applied across transplant centers. Additionally, 15 hospitals (15/57, 26.3%) indicated that they would record pharmaceutical ward round-related content in the system.

Medication education: As shown in Figure 3, 53 surveyed hospitals (53/78, 68.0%) respondents indicated that they would provide medication education to their patients, focusing primarily on medication dosage (41/53, 77.4%), drug delivery time (40/53, 75.5%), adverse drug reaction and solutions (40/53, 75.5%), lifestyle guidance (39, 73.6%), solutions for missed doses (37/53, 69.8%), storage of medications (36/53, 67.9%) and others (3/53, 5.7%). Regarding the coverage of patient groups by medication education, a large majority of the hospitals (22/53, 41.5%) would provide medication education to more than half of the patients, while 18 hospitals (18/53, 34.0%) would provide medication education to less than half, and 13 hospitals (13/53, 24.5%) would educate all patients. Various educational methods were utilized, with verbal combined with written or video education being the most commonly used (34/53, 64.2%), followed by solely verbal education (17/53, 32.1%), and solely written education (2/53, 3.8%). Additionally, 30 hospitals (30/53, 56.6%) indicated that there was a standardised template for documenting medication education, and 14

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hospitals (14/53, 26.4%) mentioned that it would be documented in the hospital's system.

Post-transplant phase (ambulatory):

Long-term pharmaceutical management after transplantation was also crucial. However, only 14 hospitals (14/78, 18.0%) indicated that they have developed pharmacist-managed clinic for transplant patients. The average time taken to establish these clinics was 27.4 months (IQR: 6.8-34.5 months). Among these clinics, 9 hospitals (9/14, 64.3%) had a standardized template for documenting outpatient pharmacy services, and 12 hospitals (12/14, 85.7%) documented the outpatient process in the information system.

Other pharmacist activities

Most hospitals (64/78, 82.1%) indicated they were involved hospital-wide pharmaceutical management tasks, such as various pharmaceutical data reporting and hospital-wide medical order reviews. The average transplant pharmacist daily time spent on pharmaceutical management tasks was 3.0 ± 1.6 hours. Only one transplant center expressed having a dedicated pharmacy management team responsible for such matters. Regarding teaching responsibilities, 62 respondents (62/78, 79.5%) participated in teaching jobs, including trainee pharmacist (3/78, 4.8%), pharmacy student (15/78, 24.2%), and those who are both (44/78, 71.0%). The time spent on teaching jobs was 1.5±0.7 hours. Additionally, nearly all respondents (64/78, 82.1%) were involved in scientific research as part of their daily routine, spending an average of 2.0±1.3 hours on research activities.

Pharmacist opinions regarding practice

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| 3 4 | 352 | Almost all respon | idents (71/78, 91.0%) perceived a moderate shortage in the number | | | | | | | | |
| 5 6 353 of transplant pharmacists, with only one respondent perceiv | | | | | | | | ving a mild shortage. Six | | | |
| 7 8 | 354 | respondents (6/78 | 8, 7.7%) d | 7.7%) denied the lack of transplant pharmacists. Regarding the | | | | | | | |
| 9 10 | 355 | current state of pl | narmacy se | ervices in C | China, 65 r | espondents | (65/78, 83.3%) |) perceived | | | |
| 11 12 | 356 | a lack of transpla | ant pharma | acy service | es. The ma | in reasons | for the lack of | pharmacy | | | |
| 13 14 | 357 | services were ide | ntified as | heavy wor | kload in of | ther daily t | asks, lack of po | erformance | | | |
| 15 16 | 358 | incentives, the sh | nortage of | transplant | pharmacis | sts and lac | k of legal and | regulatory | | | |
| 17 | 359 | support, with degree 5 accounting for more than 60% of the total, especially | | | | | | | | | |
| 19 | 360 | concerning the high | gh daily w | orkload (de | egree 5 at 6 | 57.7%) (see | Figure 4). | | | | |
| 20 | | | | | | | | | | | |
| 22 23 | 361 | | | | | | | | | | |
| 24 25 | 362 | Impact of transp | lant centi | re volume | on pharma | acy service | S | | | | |
| 26 27 | 363 | There were no dif | ferences in | n the average | ge number | of transpla | nt pharmacists | and the | | | |
| 28 29 | 364 | proportion of pha | rmacy serv | vices for pa | tients betw | veen transp | splant centers (Table 2). | | | | |
| 30 31 | 365 | However, in the e | valuation | phase, as tł | ne number | of transpla | nts increases, th | e | | | |
| 32 | 366 | probability of pha | rmacists p | erforming | medicatior | n reconcilia | tion decreases, | the | | | |
| 33 34 | 367 | difference was sta | difference was statistically significant ($P < 0.05$). | | | | | | | | |
| 35 36 | 368 | | | | | | | | | | |
| 37 38 | 369 | Table 2 Impact of | Table 2 Impact of transplant centre volume on pharmacy services | | | | | | | | |
| 39 40 | | | | | | | | | | | |
| 41 42 | | | Number o | f transplants | performed p | er year |), | Time per patient per | | | |
| 43 Gharacteri | stics | | (n=numbe | r of transpla | nt centers) ^a | | P-value | session (minute) | | | |
| 45 46 | | | 0-100 | 101-200 | 201-300 | >300 | | | | | |
| 47 48 | | | (n=35) | (n=25) | (n=9) | (n=9) | | | | | |
| 49 Ayerage n | 49 Awerage numbers of pharmacist | | | 1.0 | 1.7 | 1.1 | 0.255 | - | | | |
| 51 52 Medication | | | | | | | | | | | |
| 53 | | adherence | 62.9% | 44.0% | 55.6% | 44.4% | | | | | |
| 54 55 | | assessment | (22/35) | (11/25) | (5/9) | (4/9) | 0.484 | _ | | | |
| 56 57 | | Medication | 88 60/ | 64 0% | 66 70/ | AA 404 | | | | | |
| 58 -59 - | 1 | | 00.070 | 04.070 | (()0) | 44.470 | 0.02(* | | | | |
| Evaluation phase reconciliation | | (31/35) | (16/25) | (6/9) | (4/9) | 0.026* | 21.0 ± 13.1 | | | | |

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| 2 | | | | | | | | | | | | | | |
|---|--|--------------|---------------|--------------|----------------|----------------|--|--|---|--|--|--|--|--|
| 3 | | | | | | | | | | | | | | |
| 5 6 Pharmaceutical 7 | 71.4% | 64.0% | 100.0% | 77.8% | | | | | | | | | | |
| 7 8 ward round (| (25/35) | (16/25) | (9/9) | (7/9) | 0.211 | 13.3±9.3 | | | | | | | | |
| 9 Medical order | 71.4% | 60.0% | 100.0% | 77.8% | | | | | | | | | | |
| 11 12 review (| (25/35) | (15/25) | (9/9) | (7/9) | 0.144 | 15.8±12.3 | | | | | | | | |
| 13 Medication (| 68.6% | 60.0% | 88.9% | 66.7% | | | | | | | | | | |
| 15 Transplant phase education (| (24/35) | (15/25) | (8/9) | (6/9) | 0.466 | 10.2 ± 6.3 | | | | | | | | |
| Post-transplant Pharmacist-mana | 11.4% | 16.0% | 22.2% | 44.4% | | | | | | | | | | |
| phase ged clinic (| (4/35) | (15/25) | (2/9) | (4/9) | 0.140 | - | | | | | | | | |
| 21 370 * <i>P</i> -value of <0.05 v | was consi | dered statis | stically sign | nificant | | | | | | | | | | |
| $\frac{22}{23}$ 371 a. Percentage (%)= | =(Number | of center | s providin | g the servi | ce in the gro | up/ Total | | | | | | | | |
| 24 372 number of centers i | n the gro | up)×100% | | | | | | | | | | | | |
| 25 373 26 | | | | | | | | | | | | | | |
| 27 374 Transplant pharm 28 | nacist full | l-time equi | valents (F | TEs) | | | | | | | | | | |
| Based on the existing number of transplants and pharmacists, we had calculated an | | | | | | | | | | | | | | |
| 376 average of 0.8 pharmacists per 100 transplant patients. To proposed the FTEs 377 calculation framework based on current practice patterns of Chinese transplant 378 pharmacists, pharmacists need to juggle hospital-wide pharmaceutical management 379 tasks, teaching jobs and scientific research, there was a median of 2.6 transplant | | | | | | | | | | | | | | |
| | | | | | | | | 38 39 380 pharmacists FTEs positions per 100 transplants. It's important to note that the average | | | | | | |
| | | | | | | | | 4041 381 patient length of sta | ig an idealized | | | | | |
| | | | | | | | | 4243 382 workflow of transpl | workflow of transplant pharmacists providing direct pharmacy services and education | | | | | |
| 44 45 383 only, the FTEs wou | only, the FTEs would become 1.2 per 100 transplants. | | | | | | | | | | | | | |
| 46 47 384 | | | | | | | | | | | | | | |
| 48 49 385 Discussion | Discussion | | | | | | | | | | | | | |
| 5051386This is the first su | This is the first survey of transplant pharmacists in China, which comprehensively | | | | | | | | | | | | | |
| 52 53 387 described and asses | ssed the | daily activi | ties of tran | nsplant phar | macists in Chi | na, while | | | | | | | | |
| 54388also calculating the | also calculating the current demand for transplant pharmacists. The data suggested | | | | | | | | | | | | | |
| 5657389 that transplant phar | macy ser | vices in Ch | ina remain | underdevel | oped. | | | | | | | | | |
| 58 390 59 60 | | | | | | | | | | | | | | |

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The importance of transplant pharmacists has been confirmed by many studies [3][6]. however there are currently few surveys on the transplant pharmacist workforce. In 2015, a national survey of transplant pharmacists in the United States described the main service activities performed by pharmacists during the different stages of transplantation, highlighting the typical responsibilities of pharmacists practising within the field of transplantation, and illustrating that the level of pharmacist involvement varies significantly across transplant centres and stages of transplantation. The survey also calculated that there were currently 1.4 FTEs positions for transplant pharmacists per 100 transplants[11]. In 2021, a study from Brazil on thoracic transplant [12], illustrated that in their transplant centers with pharmacists (n = 12), there is not a full-time professional dedicated to their transplant program, and the activity of transplant pharmacists is significantly lower than that of transplant centres in the United States. It is clear that the activities of transplant pharmacists in the patient care team reflect a known benefits, Sam' s systematic review included 12 studies involving 1,837 patients, demonstrated that in the solid organ transplant setting, pharmacists can improve medication adherence, reduce medication errors, and thereby enhance patient outcomesError! Reference source not found. With the development of transplantation technology, the need for transplant pharmacists will further increase [13].

 The results of the survey show that there are still many deficiencies in transplant pharmacy services in China, which are mainly reflected in the following areas. Firstly, our research founds that there is a significant shortage of transplant pharmacists in China. Our study results indicate that there is currently an average of 0.8 pharmacists per 100 transplant patients, whereas in comparison, the United States has 1.4 FTEs positions for transplant pharmacists per 100 transplants showing a noticeable decrease in numbers [11].

419 Secondly, we found that even with the presence of transplant pharmacists, there are420 deviations in pharmacy services, with important pharmacy services missing,

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consistent with foreign studies [11][12]. For example, only 53.8% of transplant centres assess patients for adherence, and 48.0% only perform once. Transplant patients require lifelong immunosuppressive therapy, and patient compliance with immunosuppression is closely related to the development of rejection, particularly antibody-mediated rejection and resulting premature graft failure [14][15]. This is significantly inadequate compared to pharmacy services in other countries [16][17][18].

At the same time the number of patients covered by transplant pharmacy services in
China is low, with most transplant centres only able to provide pharmacy services to
less than 50% of transplant patients.

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Lack of standardisation and information technology is also a current problem in China. Standardisation and informatization are important components of pharmacy services, which are significant for the uniform calculation of what pharmacists do as well as for measuring the value of their work. The clinical pharmacist training program implemented in China follows a "residency pharmacist training + specialized clinical pharmacy training" model. In most regions of China, pharmacists are required to complete a 3-year residency in pharmacist training. If they wish to pursue a career as clinical pharmacists, they must undergo 1 year of specialized clinical pharmacy training, with transplant pharmacy (or immunopharmacology) being a separate specialty. Hospitals that meet specific requirements can be approved as clinical pharmacy training bases, recruiting clinical pharmacists nationwide according to the approved training direction. In principle, only pharmacists who have obtained clinical pharmacy certification are eligible to practice as clinical pharmacists. However, in the area of transplant pharmacy training, clinical pharmacists in transplant centers are currently trained independently by the transplant centers themselves, with no unified training model. Systematic training in this field is still in its early stages. In the United States, the relevant regulatory agencies (UNOS and CMS) [7] have made having transplant pharmacists a mandatory requirement of the transplant patient care team,

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with clear training modalities [11] and have issued guidelines to guide their daily work. While in China, there is still a lack of corresponding standard documents. Only a small number of hospitals in China had templates for pharmacy services and were able to link to the hospital system, but these templates were developed by individual hospitals and were not standardised, and that in the future standard operating procedures (SOPs) regarding transplant pharmacists should be developed, it can guide and standardise the daily work of the transplant pharmacists [19]. At the same time, linking to the hospital system means that the pharmacist's entire care process can be recorded by the electronic system, making the care process more systematic [20], therefore efforts should be made to form an electronic working system about transplant pharmacists.

Regarding the reasons for the low availability of transplant pharmacist services, a study [12] suggested that the main reasons were the low frequency of pharmacist involvement in the transplant team and the low level of training and experience in the field of transplantation, our study showed that it is mainly the heavy workload in other daily tasks in China, 67.7% respondents having the highest level of perception for this reason. We revealed that almost all transplant pharmacists in China are currently required to take on work other than patient care, including pharmaceutical routine work, teaching jobs, and scientific research, which takes up the vast majority of their working time. In this case, we calculated the FTEs as 2.6, if only pharmacy service-related work is performed, FTEs of transplant pharmacists would be reduced to 1.2 per 100 transplants, close to the findings in the United States. This also confirms the heavy workload of transplant pharmacists in China, especially with other daily work tasks. Therefore, reducing the time spent on other activities and developing a service model of a resident pharmacist would help to alleviate the current dilemma.

 The next reason was lack of performance incentives, with 66.2% respondents having the highest rating for this reason. In our survey, we found that pharmacy services for Page 21 of 39

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transplant patients are not currently valued by hospitals and the nation, with many transplant centres reporting a lack of performance incentives. However, key performance indicators (KPIs) are essential to enhance the value of pharmacy services, and the implementation of performance appraisal is an inevitable choice for high-quality and sustainable development of hospitals [21][22]. Therefore for pharmacy services, hospitals should develop refined performance appraisal indicators to motivate transplant pharmacists and improve efficiency.

Inadequate pharmacy services due to lack of pharmacists, as perceived by some transplant centres, with 61.5% respondents having the highest rating for this reason. In current transplant hospitals in China, based on the existing number of transplants and pharmacists, we have calculated an average of 0.8 pharmacists per 100 transplant patients, while in reality we need 2.6 full-time pharmacists for every 100 transplant patients. Therefore, increasing the number of transplant pharmacists is also a crucial step in improving pharmacy services.

Interestingly, our study found that almost all pharmacists believe that "Insufficient
demand from clinicians or patients for pharmacy services" is not a factor hindering
the provision of pharmacy services. This indicates that both physicians and patients
have high expectations of clinical pharmacists as knowledgeable drug therapy experts.

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Although this is the largest survey of transplant pharmacists conducted in China , it still has some limitations. First, the participating hospitals may not fully represent all transplant centers in China, potentially limiting the generalizability of our findings. Second, the data collected from pharmacists relied on self-reported measures, including estimated time spent on specific activities, which could introduce recall or social desirability bias. Third, while we investigated common and important aspects of pharmacy services, the diversity and complexity of clinical practices may extend

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beyond the scope captured in this study. Finally, our analysis did not stratify
pharmacy services by specific organ transplant types, despite their potential impact on
service demands. Future studies should incorporate organ-specific categorizations and
employ objective metrics to validate self-reported data.

Conclusions

Our national workforce survey demonstrates the activities of transplant pharmacists in providing pharmacy services to patients at different stages of transplantation and highlights a significant lack of transplant pharmacy services in China. At the same time, current pharmacy services lack standardization and digitalization. To address the current status of transplant recipient pharmacy services in China, reducing other workloads of transplant clinical pharmacist, increasing performance incentives, expanding the number of transplant pharmacists, and developing standardized service protocols are crucial steps.

524 Acknowledgements

- 525 We thank all pharmacists for their voluntary participation in this study.

527 Notes

Funding: This work is supported by Beijing Municipal Administration of Hospitals
Incubating Program (PG2025003).

Consent for publication: Not applicable.

533 Patient and public involvement: Patients and/or the public were not involved in the
534 design, or conduct, or reporting, or dissemination plans of this research.

536 Availability of data and materials

537 The datasets generated and/or analyzed during the current study are not publicly538 available considering the privacy but are available from the corresponding author on a

| 2 | | |
|----------|-----|---|
| 3 4 | 539 | reasonable request. |
| 5 6 | 540 | |
| 7 8 | 541 | Authors' contributions |
| 9 10 | 542 | HY was responsible for study conceptualization and design, data analysis and |
| 11 12 | 543 | interpretation, manuscript preparation, manuscript editing; XY was responsible for |
| 13 14 | 544 | data acquisition, data analysis, manuscript preparation and manuscript editing; XPH |
| 15 16 | 545 | was responsible for data acquisition, KFM, PC, XDL and QQ were responsible for |
| 17 18 | 546 | data acquisition, data analysis and manuscript editing; WJH and FZ were responsible |
| 19 20 | 547 | for data acquisition; GZW and RRW were responsible for data acquisition and |
| 21 22 | 548 | manuscript preparation; ZLA were responsible for study design, study |
| 23 24 | 549 | conceptualization, design and interpretation. ZLA was responsible for the overall |
| 25 26 | 550 | content as a guarantor. |
| 27 | 551 | |
| 29 30 | 552 | Competing interests |
| 31 32 | 553 | The authors declare that they have no competing interests. |
| 33 24 | 554 | |
| 35 36 | 555 | Ethics approval and consent to participate |
| 30 37 | 556 | This study was reviewed and formally approved by the Medical Ethics Committee of |
| 38 39 | 557 | [Beijing Chao-Yang Hospital] (No. 2024-科-951). |
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| 28 29 | 641 | Figure legends |
| 30 | 642 | Figure 1 Percent Hospitals Providing Activity During Transplant Evaluations |
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| 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 | 643 644 645 646 647 648 649 650 651 652 653 654 655 | Phase (ADR: adverse drug reaction) Figure 2 Percent Hospitals Providing Activity During Transplant Phase (Individualized pharmacy services: holistic assessment of the patient and customized pharmacy services for the patient) Figure 3 Percent Hospitals Providing Concrete Activity About Medication Education During Transplant Phase Figure 4 Participants' perceptions of Specific Reasons for the Lack of Pharmacy Services (Note: The higher the degree, the higher the level of consent, for example "degree 1" means strongly agree and "degree 5" means strongly disagree ; Reason 1: Heavy workload in other daily tasks; Reason 2: Lack of performance incentives; |
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| 1 2 | | |
|---|-----|--|
| 3 4 | 658 | Reason 5: Insufficient demand from clinicians for pharmacy services; |
| 5 6 | 659 | Reason 6: Insufficient demand from patient for pharmacy services) |
| 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 | 659 | Reason 6: Insufficient demand from patient for pharmacy services) |



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The Survey on the Current Status of Pharmaceutical Care for Solid

Organ Transplant Recipients

Dear Transplant Pharmacist,

To gain a deeper understanding of the current status of pharmaceutical care provided by transplant pharmacists in China, and to better meet the needs of patients while improving healthcare quality and patient satisfaction, we invite you to complete this questionnaire. Your insights are crucial for advancing the development of transplant pharmaceutical care in China. We sincerely appreciate your participation and valuable feedback, which will contribute to the growth of transplant pharmacy services in our country! This questionnaire was part of the research project titled "Development and Application of Evidence-Based and Implementation Science-Informed Pharmaceutical Care Guidelines for Solid Organ Transplant Recipients" approved by the Ethics Committee of Beijing Chaoyang Hospital (Approval No. 2024-KE-951). Thank you for supporting our research!

Please read this informed consent document carefully before deciding whether to participate:

Informed Consent

1. Participation in this study is entirely voluntary. You may refuse to participate without providing a reason.

2. This survey focuses solely on the current status of pharmaceutical care and will not affect your personal or professional life, nor will it result in adverse events.

3. Your privacy will be protected. Personal information will remain confidential and accessible only to researchers involved in this study. Survey records will be stored securely within the research team. Results and data may be published, but no identifiable information about you or your institution will be disclosed.

4. For any questions, please contact the project leader:

Yang Hui, Number: 010-85231077.

If you voluntarily agree to participate, please answer the following questions after reviewing the above information:

Part I: Demographic Information

- 1. Your age (years): [Open-ended Question]
- 2. Your highest educational qualification: [Single Choice]
 - \circ Doctorate
 - Master's degree
 - \circ Bachelor's degree

| 1 | |
|----|---|
| 2 | |
| 3 | \circ Other |
| 4 | 0 Other |
| 5 | |
| 6 | 3. Name of your institution: [Open-ended Question] |
| 7 | |
| 8 | |
| 9 | 4. Your professional title:[Single Choice] |
| 10 | • Senior-level |
| 11 | • Associate Senior-level |
| 12 | |
| 13 | o Intermediate-level |
| 14 | Junior-level |
| 15 | |
| 16 | 5 Veera of experience as a transplant pharmacist [Open anded Operation] |
| 17 | 5. Years of experience as a transplant pharmacist.[Open-ended Question] |
| 18 | |
| 19 | 6. Do you hold qualifications as a transplant pharmacy educator? [Single Choice] |
| 20 | |
| 21 | |
| 22 | • No |
| 23 | |
| 24 | 7 Years since obtaining educational qualifications (if applicable). [Open-ended |
| 25 | Quartiar] |
| 26 | Question] |
| 27 | |
| 28 | 8. Daily standard working hours (e.g., 8 hours): [Open-ended Question] |
| 29 | |
| 30 | |
| 31 | 9. Does your institution employ other transplant pharmacists?[Single Choice] |
| 32 | • Yes |
| 33 | o No |
| 34 | |
| 35 | |
| 36 | 10. Please provide basic information about other transplant pharmacists in your |
| 37 | institution: |
| 38 | Format: Aga/Title/Education/Vears of experience/Transplant educator status (if |
| 39 | Format. Age/ Inte/Education/ Tears of experience/ Inanspiant educator status (if |
| 40 | yes, specify qualification years). |
| 41 | Example: 34 years/Clinical Pharmacist/Master's degree/5 years/Educator (3 |
| 42 | vears) or Not an educator |
| 43 | [Open anded Question] |
| 44 | [Open-ended Question] |
| 45 | |
| 46 | 11. Transplant procedures performed at your institution and the number of surgeries |
| 47 | in 2023:[Multiple Choice] |
| 48 | |
| 49 | Please select organs involved and specify the number of surgeries for each in |
| 50 | 2023. |
| 51 | \Box Heart (cases) |
| 52 | |
| 53 | \Box Kidney (cases) |
| 54 | \Box Liver (cases) |
| 55 | \Box Lung (cases) |
| 56 | \Box Small intestine (cases) |
| 5/ | |
| 58 | |
| 59 | Part II: Daily Practices of Transplant Pharmacists Across Transplant Stages |
| 60 | |
| | |

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Note: Please describe the overall workload of transplant pharmacists at your institution.

12. Do you assess patients' medication adherence? [Single Choice]

- Yes
- o No

13. Timing of adherence assessments:[Multiple Choice]

- □ First patient encounter
- □ During hospitalization
- □ At discharge education
- □ During follow-up
- \Box Other

14. Tool used for medication adherence assessment: [Single Choice]

- Morisky Medication Adherence Scale
- Medication Adherence Report Scale (MARS)
- Basel Assessment of Adherence Scale
- Other

First time seeing the patient

15. Do you conduct medication reconciliation to understand the patient's baseline status? [Single Choice]

- Yes
- \circ No

16. Content covered during medication reconciliation: [Multiple Choice]

- □ Medical history
- □ Medication history
- □ Adverse drug reaction history
- □ Allergy history
- □ Laboratory results
- \Box Other

17. Frequency of medication reconciliation during hospitalization: [Single Choice]

- \circ 1 time
- 2 times
- 3 times
- 4 times
- 5 times

18. Scope of medication reconciliation services: [Single Choice]

- All patients
- Some patients (>50%)
- \circ Some patients (\leq 50%)

19. Average time spent per patient per reconciliation (minutes): [Single Choice]

- 0 <5
- o 5–10
- 10**-**20
- 20**–**30
- o 30–40
- o 40–50
- o 50–60
- o >60

20. Documentation format for reconciliation:[Single Choice]

- Standard template
- No standard template
- \circ Other

21. Is reconciliation documentation entered into the hospital information system? [Single Choice]

- $\circ \, Yes$
- o No

Perioperative Period

22. Average length of hospital stay for transplant patients (days): [Open-ended Question]

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23. Does your hospital perform therapeutic drug monitoring (TDM) for transplant-related medications? If yes, specify the drugs: [Single Choice]

○ Yes (____)
 ○ No

24. Does your hospital perform pharmacogenetic testing for transplant-related medications? If yes, specify the drugs: [Single Choice]

○ Yes (____)
 ○ No

25. Do you provide pharmaceutical care during the perioperative period? [Single Choice]

∘ Yes ∘ No

26. Pharmaceutical care services provided: [Multiple Choice]

- □ Medication order review
- $\hfill\square$ Pharmacist-led ward rounds
- \square TDM

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- □ Personalized pharmaceutical care
- \Box Patient education
- □ Pharmacogenetic testing guidance
- □ Cost-benefit analysis support
- □ Other

27. Scope of perioperative pharmaceutical care: [Single Choice]

- All patients
- \circ Some patients (>50%)
- \circ Some patients (\leq 50%)

28. Are re-transplant recipients given special attention? If yes, specify focus areas: [Single Choice]

- Yes
- o No

Medication Order Review

29. Frequency of medication order review: [Single Choice]

- Daily
- $\circ \geq 3$ times/week
- $\circ \leq 2$ times/week

30. Content of medication order review: [Multiple Choice]

- □ Indications

Dosage/administration
Duplicate therapy
Drug interactions
Compatibility
Other
31. Scope of medication order review: [Single Choice]

- All patients
- \circ Some patients (>50%)
- \circ Some patients (\leq 50%)

32. Average time spent per patient per review (minutes): [Single Choice]

- 0 < 5
- 5−10
- 10**-**20
- 20**–**30
- o 30–40
- 40–50
- 50–60
- o >60

33. Is the review process/results recorded in the hospital information system? [Single Choice]

- Yes
- o No

Pharmacist-Led Ward Rounds

- 34. Rounds format: [Single Choice]
 - Independent pharmacist rounds
 - Joint rounds with physicians
 - $\circ \text{ Both }$
- 35. Frequency of rounds per patient: [Single Choice]
 - \circ Daily
 - $\circ \geq 3$ times/week
 - $\circ \leq 2$ times/week

36. Average time per patient for independent rounds (minutes): [Single Choice]

R.

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- 0 < 5
- o 5–10
- 10**–**20
- 20**–**30
- o 30–40
- 40**–**50
- **50**–**6**0
- o >60

37. Average time per patient for joint rounds (minutes): [Single Choice]

- 0 < 5
- 0 5-10
- 10**-**20
- 20**–**30
- o 30–40
- 40–50
- o 50–60
- o >60

38. Is there a standardized template for rounds? [Single Choice]

- Yes
- $\circ \mathrm{No}$

39. Are rounds documented in the hospital information system? [Single Choice]

- Yes
- \circ No

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Patient Education

- 40. Content of patient education: [Multiple Choice]
 - \Box Dosage/administration
 - □ Timing of administration
 - \square Managing missed doses
 - \square Medication storage
 - □ Adverse reactions and management
 - □ Lifestyle guidance
 - \Box Other

41. Education delivery format: [Multiple Choice]

- \square Verbal
- □ Printed materials
- \Box Video
- \Box Verbal + printed materials
- \Box Other

42. Average time spent per patient per education session (minutes): [Single Choice]

(elien

- o <5
- o 5–10
- 10**–**20
- 20**–**30
- o 30–40
- o 40–50
- o 50–60
- $\circ > 60$

43. Is there a standardized education template? [Single Choice]

- Yes
- o No

44. Is education documented in the hospital information system? [Single Choice]

- Yes
- $\circ \mathrm{No}$

Post-Transplant Phase

45. Does your hospital have a dedicated transplant pharmacy clinic? [Single Choice]

- Yes
- \circ No
- 46. Start date of the clinic (if applicable): [Open-ended Question]
- 47. Services provided in the clinic: [Multiple Choice]

| 1 | |
|----------|--|
| 2 | |
| 3 | □ Medication therapy evaluation (e.g., efficacy, adverse reactions) |
| 4 5 | □ Therapeutic interventions (e.g., resolving drug-related problems, |
| 6 | deprescribing reconciliation) |
| 7 | Developing personalized medication records (prescription/OTC drugs herbs |
| 8 | |
| 9 | supplements) |
| 10 | □ Adherence assessment |
| 11 | □ Personalized education |
| 12 | □ Lifestyle guidance |
| 15 | □ Follow-up |
| 15 | \Box Other |
| 16 | |
| 17 | |
| 18 | 48. Average weekly patient volume (cases/week): [Open-ended Question] |
| 19 | |
| 20 | 49. Clinic fee per patient (pre-reimbursement, RMB): [Open-ended Question] |
| 21 | |
| 22 | 50 Pharmacist qualifications for clinic: [Single Choice] |
| 25 | o Clinical Dharmanist |
| 25 | • Clinical Pharmacist |
| 26 | • Associate Chief Pharmacist |
| 27 | • Chief Pharmacist |
| 28 | |
| 29 | 51. Average consultation time per patient: [Single Choice] |
| 30 | $0 < 5 \min$ |
| 31 20 | $\sim 5.10 \text{ min}$ |
| 32 | |
| 34 | ○ 10–20 min |
| 35 | $\circ 20-30 \text{ min}$ |
| 36 | • 30–40 min |
| 37 | ○ 40–50 min |
| 38 | ○ 50–60 min |
| 39 40 | $\circ > 60 \text{ min}$ |
| 41 | |
| 42 | 52 Clinic documentation format: [Single Choice] |
| 43 | 52. Chine documentation format. [Single Choice] |
| 44 | • Standard template |
| 45 | • No standard template |
| 46 | • Other |
| 47 78 | |
| 49 | 53. Are clinic records entered into the hospital information system? [Single Choice] |
| 50 | O Yes |
| 51 | $\sim N_{\rm O}$ |
| 52 | \circ 110 |
| 53 | |
| 54 | 54. Additional follow-up methods (if applicable): [Multiple Choice] |
| 55 56 | □ Phone |
| 57 | \square SMS |
| 58 | □ Hospital app |
| 59 | \Box Patient education groups |
| 60 | men ennemen Proube |
| | |

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□ None

- □ Other
- 55. Average frequency of follow-up per patient: [Single Choice]
 - 1–2 times/week
 - \circ 1–2 times/month
 - 1–2 times/year
 - \circ No routine follow-up
 - \circ Adjusted based on discharge time

Part III: Non-Transplant Responsibilities Note: Please describe your workload unrelated to transplant care.

56. Time spent daily on pharmacy management (e.g., data reporting, order review) (hours): [Open-ended Question]

- 57. Do you teach pharmacy students? [Single Choice]
 - Yes
 - o No
- 58. Do you train pharmacy residents? [Single Choice]
 - ∘ Yes ∘ No
- 59. Daily time spent on teaching/training (hours): [Open-ended Question]
- 60. Daily time spent on research (hours): [Open-ended Question]

Part IV: Opinions on Pharmaceutical Care

61. Do you believe there is a shortage of transplant pharmacists in China? [Single Choice]

- Yes
- o No
- 62. Severity of the shortage: [Single Choice]
 - Severe
 - \circ Moderate
 - \circ Mild

63. Do you believe there is a lack of transplant pharmaceutical care services in China? [Single Choice]

- Yes
- o No

64. Causes of the shortage (rate 1-5, with 1 = least significant, 5 = most significant):

| auses Degree 1-5 | | | | | |
|---------------------------------------|----|-----|----|-----|----|
| Insufficient legal/policy support: | 01 | o 2 | 03 | o 4 | 05 |
| Lack of institutional incentives: | 01 | o 2 | 03 | 04 | 05 |
| Shortage of transplant pharmacists: | 01 | o 2 | 03 | 04 | 05 |
| Heavy workload limiting service time: | 01 | o 2 | 03 | 04 | 05 |
| Low demand from clinicians: | 01 | o 2 | 03 | 04 | 05 |
| Low patient demand: | 01 | o 2 | 03 | o 4 | 05 |

65. Are there other reasons for the lack of services? [Single Choice]

• Yes, please specify:

o No

Thank you for your participation!

Your responses are invaluable to our research. We wish you success in your work and happiness in life!

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