

# Transplant Pharmacy: 30 Years of Improving Patient Care

Gilbert J Burckart

The specialty practice of transplant pharmacy is not as old as *The Annals*, but amazingly, 30 years have passed since the specialty came to be. I doubt that anyone at that time realized what a tremendous impact that transplant pharmacy would have on the evolution of solid organ transplantation and the care of transplant patients today. The impact was driven by research that allowed new immunosuppressive drugs to be used safely, by patient care programs that facilitated the management of patients with complex drug interactions and organ failure, and by educational programs that taught patients how to use their long lists of drugs and educated health professionals about these new agents.

Some of the credit for the early success of the transplant pharmacists involved goes to the insight of great surgeons such as Dr. Thomas Starzl at the University of Pittsburgh and Dr. John Najarian at the University of Minnesota. Although some refinement of surgical techniques was going on in the 1980s, they realized that the success of organ transplantation lay in understanding and properly using new immunosuppressants that were unlike any drugs that had been used previously. Therefore, they actively sought good pharmacy faculty members, provided them with resources, and made them full members of the team that cared for transplant patients.

## Early Transplant Pharmacy

The first report of a pharmacist involved with a renal transplant team was published by John Mitchell at The Ohio State University Hospitals in 1976.<sup>1</sup> The services described are very much like many of the services provided today, including drug therapy monitoring, education of the other team members, and patient education and counseling.

At the University of Pittsburgh, in 1982, 3 pharmacy faculty members—Raman Venkataramanan, Richard Ptachcin-

ski, and I—started our cyclosporine blood concentration monitoring program with the small heart transplant program. Our original laboratory was in an old stockroom, and high-performance liquid chromatography equipment was limited. Without an integrator, one of us had to take home reams of strip chart records and a ruler every night and spend the evening measuring peak heights and calculating concentrations to report the next morning. Starzl soon learned of this service and called us to his office. He began to have us monitor cyclosporine concentrations in the larger liver transplant program. With Starzl's support and a grant from the Sandoz Research Institute, we were able to expand the program and gain National Institutes of Health funding from 1985 onward. I am sure that most, if not all, programs have similar stories of pharmacists' individual efforts that produced long-term changes in their organ transplant programs.

Transplant programs have always been in competition with one another, and it was only natural that the early transplant pharmacy groups were also competitive. The competition for those of us at the University of Pittsburgh was the University of Minnesota and a pharmacy group led by Dan Canafax. Two of Canafax's early students, Shi-Hui Pan and David Min, are still actively caring for transplant patients. Gary Yee worked in bone marrow transplantation, but was also an early cyclosporine researcher.

## Pharmacy's Contribution to Organ Transplantation

Pharmacy has contributed to both basic research on immunosuppressive agents and to applied research on caring for organ transplant patients. Cyclosporine and tacrolimus were uniquely difficult drugs to manage, and pharmacy provided research into pharmacokinetics,<sup>2-4</sup> drug interactions,<sup>5-7</sup> metabolites,<sup>8,9</sup> and therapeutic drug monitoring.<sup>10,11</sup> More recently, pharmacy has been able to document ways to improve patient adherence,<sup>12-15</sup> improve blood pressure control,<sup>14</sup> provide economically sound drug therapy,<sup>16,17</sup> and provide patient education on their medications.<sup>18,19</sup>

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Thus, pharmacists have contributed to every aspect of drug therapy management in organ transplant patients, and patient and graft survival rates have continued to increase slowly in the past 2 decades.

### Transplant Pharmacy Practice Today

Therapeutic drug monitoring, the avoidance of adverse effects, and the management of drug interactions are a critical part of transplant pharmacy. Monitoring concentrations of cyclosporine, tacrolimus, sirolimus, and mycophenolic acid is an art and a science that transplant pharmacists are continually improving.

One measure of the success of an area of specialty practice is that it does not lock practitioners into a constricted set of duties but gives them the freedom to contribute to the area in many ways. Transplant pharmacy has certainly been successful in this way in that transplant pharmacists are involved in a wide range of activities. I am aware of contributions being made by pharmacists who are primarily practitioners, by practitioner educators, and by researcher educators.

There are many examples of each type of practice, but I will mention the ones with which I am most familiar. At one extreme, Shi-Hui Pan is a practitioner working for the department of surgery at Cedars–Sinai Medical Center in Los Angeles. Shi-Hui manages the drug therapy for a select group of liver transplant patients in the inpatient area, primarily, but she also manages problems in a weekly outpatient clinic. Drug therapy and dosing decisions are made by her and are supported by the physicians with whom she works. Bob Dupuis, at the University of North Carolina, is a model of the practitioner educator, a role that is filled by a large contingent of transplant pharmacists today. Bob previously participated in inpatient rounds with the kidney and liver transplant teams and now primarily attends an outpatient transplant clinic. In addition to teaching pharmacy students and residents, Bob conducts research projects, develops drug treatment protocols for the transplant patients, and is on call for drug therapy management problems. My own situation is that of a researcher educator, and much of my time is spent writing protocols and manuscripts, meeting with clinicians and other researchers, and assisting graduate students and fellows with ongoing projects.

Other markers for success include the growing number of training programs for transplant pharmacists and recognition in the United Network for Organ Sharing guidelines of the need to have a pharmacist involved with transplant patient care. The success of transplant pharmacy is also reflected in the number of people who attend the American Transplant Congress yearly (ATC). At the yearly reception for transplant pharmacists, 50–60 people routinely attend the ATC meeting, which leads me to believe that the number of transplant pharmacists worldwide may number in

the hundreds. Transplant pharmacy certainly appears to have spread globally.<sup>20,21</sup>

### The Future for Transplant Pharmacy

Having made such a large contribution to the care of organ transplant patients over the past 30 years, transplant pharmacy cannot rest. Several developments that will require energy and expertise to incorporate science into patient care are ongoing in transplantation. One of these developments is pharmacogenomics, in which DNA polymorphisms from the transplant recipient and the donor will be used to develop algorithms for the initiation of immunosuppressive drug therapy. Polymorphisms in *CYP3A5*, *ABCB1*, UDP-glucuronosyltransferases, inosine monophosphate dehydrogenase, and cytokines have to be prospectively evaluated. Concurrently, gene arrays from peripheral blood may become the therapeutic drug monitoring of the future, which will require new knowledge to apply this information to transplant patient care situations. The other development is the increasing use of biologicals for immunomodulation, and the manner in which these new agents are used will determine their success in transplantation. The optimal use of agents such as belatacept and alemtuzumab in transplant patients has not been worked out.

Educational programs to train transplant pharmacists are critically needed. Residencies, fellowships, and PhD programs can contribute to the future practitioners, educators, and researchers needed to accomplish the difficult task ahead. If you consider all that has been accomplished in transplant pharmacy thus far, there is no doubt that transplant pharmacists will meet these challenges in the future.

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