Executive Summary

The Review Committee was impressed with the graduate students, faculty and administration in the College of Pharmacy graduate programs. The faculty members are generally well-funded and enjoy strong national reputations, and the graduates are well-placed in industry, government and academia. A reduction in the number of Ph.D. graduates in recent years was noted; this was primarily a result of a split with the IDP program and variability in external funding generated by College faculty. Several areas of concern were noted, and some of these need to be addressed immediately.

- There is a critical shortage of faculty in specific disciplines
- A plan for succession should be developed so that existing faculty can step into leadership roles that become vacant due to retirements, promotions or separations.
- Long term strategic plans within each track and a shared vision for the College are needed.
- Some of the facilities are in dire need of improvement, and other facilities, while being excellent, are a long distance from the main campus.
- There is a lack of teaching opportunities for students interested in academic careers.

Introduction

An Academic Program Review of the College of Pharmacy Graduate Programs was carried out on September 13 and 14, 2011. Following an earlier review of the self-study report, the joint external and internal reviewers met with Vice Provost for Academic Affairs Dr. Gail Burd and administrators, faculty and students of the College of Pharmacy Graduate Programs. The instructions to the reviewers were to address the strengths and weaknesses of each of the educational programs of the College with the exception of the PharmD program, with attention to the faculty productivity and outreach to the scientific community and general community, student success and program assessment, with recommendations for improvement of any perceived weaknesses.

Separate meetings were held on day one with: Senior Vice President for Health Sciences and Dean Dr. Lyle Bootman; the self-study committee consisting of the directors of the five tracks which support the respective PhD programs; eight members of the Pharmacology & Toxicology (Pharm-Tox) faculty; four members of the Drug Discovery and Development (DDD) faculty; five members of the combined Pharmaceutics & Pharmacokinetics (PPK) and Pharmaceutical Economics, Policy & Outcomes (Pharmaceutical EPO) faculty; the department heads of Pharmaceutical Sciences and Pharmacy Practice and Science; four PharmD students engaged in research; seven Pharm-Tox students; six DDD students; and four PPK and ten Pharmaceutical EPO students. On day two the review committee members met with: graduate student representatives; the Graduate Program Coordinator and Assistant Dean of Finance and
Facilities; Associate Dean of Academic and Student Affairs, Department Head and Assistant Department Head of Pharmacy Practice and Sciences; other College of Pharmacy faculty and the Associate Dean for Research and Graduate Studies. The findings of the review committee were then shared during a closing session with the Vice President for Academic Affairs and Provost and the Vice Provost for Academic Affairs.

As has occurred with other colleges within the University of Arizona, the College of Pharmacy has had reductions in its overall budget based on a lower level of state funding over the recent past, including a reduction in indirect cost returns from 30% to 25%. Anticipated remodeling of portions of the older Skaggs Building has not taken place. Potential new developments within the College of Pharmacy that may impact the College of Pharmacy graduate programs include the addition of a four-year undergraduate (B.S.) Pharmaceutical Sciences degree program, a greater emphasis on clinical research integrated with other health sciences colleges, and the transformation of the current Health Outcomes and PharmacoEconomic Research (HOPE) Center into an interdisciplinary program across the health sciences and business colleges.

The Pharmacology and Toxicology Graduate Track is a highly regarded and nationally recognized track within the College of Pharmacy. Its major focus is on mechanisms of toxicity of therapeutic drugs and environmental agents. Currently 30 graduate students are enrolled in the program who are taught and mentored by 14 core and 7 associate faculty. It enjoys strong extramural support including funding from two training grants, a center grant, a Superfund grant, and a binational center grant.

Strengths
- Dedicated faculty who are active in research and nationally recognized within the field of toxicology.
- Committed leadership at both the track and the College level.
- Well-trained students who are given opportunities to present their research locally as well at national meetings and who publish in well-regarded journals in the field.
- Financial support and stability provided by the College and strong extramural funding including multi-year training, center and Superfund grants
- Access to core facilities with modern state-of-the-art equipment
- Effective procedures to assess and monitor the progress of each graduate student
- A large group of alumni who are pleased with the quality of the education that they received at the University of Arizona

Weaknesses
- Aging facilities that lack critical infrastructure for conducting modern research in pharmacology and toxicology.
- Faculty that are spread across multiple buildings.
- A sub-optimal process for matching students with faculty mentors described as analogous to the game of musical chairs
- While overall salaries have risen substantially, the base salaries have not risen in recent years
• Perceived variable expectations in the standards of work required to graduate.
• Lack of coursework covering regulatory toxicology/pharmacology

Recommendations
• Develop and implement plans for a new building designed for pharmacological and toxicological research that will allow the faculty to work in close proximity. Implement procedures to update and acquire shared equipment for student and faculty use.
• During student recruitment and throughout the student’s first year, actively work to match prospective students with faculty mentors.
• Increase coverage in regulatory toxicology and pharmacology either through the offering of an elective course or through a major emphasis in the seminar series.
• An assessment should be conducted on the newly revised curriculum as well as a review of recent dissertations to ensure that the desired student learning outcomes have been achieved.
• Make arrangements for interested students to serve as teaching assistants in the Pharm.D. or pre-pharmacy programs or other programs on campus. Teaching opportunities with local community colleges or university extension programs could also be explored.

The Pharmaceutical Economics, Policy, and Outcomes (EPO) Track is an established program with a history of innovative research in patient-reported outcomes and health care utilization and cost. There are currently five faculty teaching and mentoring sixteen graduate students at the master and doctoral level.

Strengths
• The Program has an excellent reputation within the field, especially with regard to patient-reported outcomes. The EPO program was one of the first such programs established in the field.
• The Program has been very successful in attracting an adequate graduate student population. The graduate student population is diverse, with broad domestic and international representation.
• The existing faculty has maintained active research programs, with considerable external peer-reviewed grants. These grants have been used to finance graduate support through their use as research assistants.
• Existing faculty provide ongoing service to the academic community, including participation in leadership positions in national scholarly associations.
• The program provides ample graduate student access to professional activities, including conferences and seminars. The program also emphasizes industry internships and fellowships that provide useful experience for future employment.
• Graduate students appear to publish abstracts at national meetings, and some have success in peer-reviewed publications prior to graduation.
• The current graduate student population expressed considerable satisfaction with the Program courses and overall advising.
Weaknesses

- The Program has experienced substantial faculty loss since the last Academic Program Review. The loss of senior faculty, through retirement, and junior faculty through resignation, has saddled a relatively small faculty with substantial teaching and advising/mentoring responsibilities. This creates significant problems in a number of areas. First, the faculty feels differentially burdened compared with other COP graduate faculty. This is particularly true with regard to teaching responsibilities, as EPO faculty average 3-5 courses per year, including significant responsibility in the PharmD program. Second, the faculty has a large number of students to advise, mentor, and support on research projects. Third, the faculty will have difficulty dedicating the time to write competitive grants. Fourth, it is more difficult for students to match with faculty mentors.

- Students have noted that they do not have access to coursework in other units on campus to augment EPO classes.

- The lack of health economists on the College of Pharmacy faculty has limited training in this key area in the field.

- The loss of key faculty in patient-reported outcomes has affected the level of training in this important area.

- While the faculty has demonstrated consistently strong publication records, they could consider submissions to higher impact journals.

- Grant funding appears to have dropped recently, which makes graduate student support difficult.

- Graduate students provide annual progress reports to faculty, but it is not clear that assessment procedures are in place to determine attainment of standard analysis skills in a consistent, measurable approach.

- Graduate students do not have access to archival data sets (particularly administrative claims) that can be used for thesis and dissertation research. As a result, many students must wait until data of this nature can be acquired.

Recommendations

- The EPO Program is at a critical juncture because of the loss of faculty and internal disagreements within the existing faculty that limit collaboration. This program must develop a strategic plan that articulates their vision for program identity that will distinguish it from the top programs in the country. Several options seem clear from our discussions: a/ substantial faculty lines need to be opened (on the order of 3-5 new faculty); b/ the number of graduate students in the program should be reduced; c/ the Program should be integrated into a broader University effort to build presence in health outcomes assessment. The considerable resource constraints recently experienced by the University and COP make the first option unlikely. However, it may be possible to integrate the EPO faculty into a broader health sciences and University-wide strategy to build a collaborative health outcomes and comparative effectiveness center. The HOPE Center may provide an important organizing entity for such an effort.

- In the short term, the EPO program faculty should be relieved of some teaching responsibilities in the PharmD program, and the use of adjunct faculty for teaching some EPO courses should be considered. If reduced teaching loads are not possible
for the existing EPO faculty, reduction in graduate student admissions should be considered. This could be accomplished through annual reductions, or by restricting admissions to every other year.

- The EPO program should develop a strategy with the COP (and HOPE Center) to develop core computing capacity that can be shared among faculty and graduate students, as well as other University collaborators. This capacity should include the acquisition of commercially-available administrative claim data sets, as well as core publicly available data sets. Similarly, it would be useful to obtain access to UA HealthCare datasets to assist in conducting research to improve care.

The Drug Discovery and Development Track, formerly known as Medicinal Chemistry, program has gone through significant change in the last decade and has recently refocused their vision in the arena of Drug Discovery and Development (DDD). There are currently six faculty members in DDD and thirteen graduate students.

**Strengths**

- The department has a strong reputation within the field. The current faculty, though small, has an exceptional record of funding and a strong publication record.
- The new Oro-valley Bio5 facilities that focus on chemistry-driven drug discovery provide excellent long term opportunities for building synthetic chemistry and university wide drug discovery efforts.
- The DDD students in the program have a strong publication record and have been awarded nationally competitive fellowships and awards.
- Many of the faculty and graduate students are actively involved in the Biological Chemistry Program (supported by a NIH Training grant) with the Department of Chemistry and Biochemistry.

**Weaknesses**

- The program has seen a loss of five faculty, many of them senior, within the last five years. There is a need for mid-career faculty to take on a more senior leadership role both within DDD and within Pharmacology and Toxicology as a whole.
- The dispersal of this small group of faculty across the North campus as well as two faculty members located at Oro Valley provides a challenge for both faculty and graduate students.
- There is a great deal of breadth in areas of expertise within the faculty but this leads to a lack of overlapping strengths, which appears to impact recruiting the best students to DDD.
- Many students voiced a lack of sufficient core classes that provide a cohesive vision of expected expertise in Drug Discovery and Development.

**Recommendations**

- The addition of several new faculty in DDD that complements the existing strength and builds into the newly available resources at Oro Valley will strengthen the program.
• Joint appointments to the DDD program from faculty across campus with shared interests will increase visibility of the program and also provide additional opportunities for graduate students.
• Development of a cohesive curriculum for the DDD track that goes beyond the current course offerings provided by this group of faculty.
• Formalization of faculty mentoring for first year students to assist in research rotations that leads to the choice of suitable laboratories in the DDD track.

The Pharmaceutics and Pharmacokinetics Track is in the Department of Pharmaceutical Sciences and awards M.S. and Ph.D. graduate degrees in Pharmaceutical Sciences. This track has only two full-time faculty members involved in graduate training, one of whom has been in academia for over 40 years. The senior faculty member enjoys an excellent reputation in the pharmaceutical sciences community and continues to produce Ph.D. graduates that are highly sought by the pharmaceutical industry. The junior faculty member (Associate Professor) has a growing reputation in the field and is also producing Ph.D. graduates. These two faculty members fill a small but important niche in the training of pharmaceutical scientists. This track also has one part-time faculty member who is primarily responsible for teaching pharmacokinetics and is no longer active in research. The survey of the graduates of this track indicate a high level of satisfaction with their education and felt that it prepared them very well for their current positions.

There are currently eight graduate students in this track. They all appear to very happy and satisfied with the training they are receiving; some of them worked in the pharmaceutical industry prior to entering the graduate program at UA and have a good perspective of how the education they are receiving is helpful in their future careers. They receive a solid training in mathematical and physical methods which play important roles in the development phase of pharmaceutical products. They view the small size of the program as an asset instead of a deficit, and have many opportunities to use facilities and equipment in the engineering, materials science and chemistry departments. However, they are somewhat disconnected to students in other tracks in the College of Pharmacy. Because the program is small, assessment occurs on a regular basis. The graduate classes typically have only 4-5 students; thus, the contact between the professor and students is intimate. Students write annual reports and give regular seminars on which they receive feedback.

Strengths
• Long, distinguished history of training students in this track.
• Faculty with excellent reputations; graduates are well-placed.
• Alumni are very satisfied and occupy important positions.
• The intense training in physical pharmacy is not offered at many institutions.

Weaknesses
• The faculty is very small, with two members approaching retirement.
• They lack breadth in other areas of pharmaceutics, e.g., targeted drug delivery
• Facilities are limited.
• Available funding in this area is not extensive.

Recommendations
• Training in pharmaceutics and pharmacokinetics are the only tracks that originated in Colleges of Pharmacy. It would be a tragedy to see these become diminished or disappear.
• Of particular importance in instruction in pharmacokinetics, something that is essential to any scientist in other areas including pharmacology, toxicology and drug discovery.
• Plans should begin immediately to attract two new faculty members who can carry on the mantle of this track.

The Clinical Research Track is a newly established program that appears to fill a gap in the pharmaceutical science area within the College of Pharmacy, and is a natural add-on to enable early-stage clinical development of internally derived compounds.

Strengths:
• This is an area of potential growth and increased student interest. Building up of this track will increase collaborations with clinical researchers in the Colleges of Pharmacy and Medicine and bridge the activities between the basic science and clinical faculty.

Weaknesses:
• Students have been slow to recognize the track, though interest appears to be budding from Pharm.D. candidates.
• Facilities to enable overnight monitoring of patients for early phase clinical trials as well as university administrative barriers appear limiting in the scope and execution of clinical research.

Recommendations:
• Recommend planning for appropriate facilities in collaboration with the College of Medicine to enable short-term housing and monitoring of Phase 1 study volunteers/patients.
• The desire for Track flexibility is noted, but we recommend a more rigorous definition of core classes to provide students a more firm expectation of program requirements at the M.S. and Ph.D. level. We believe this is central to more successful recruitment and assessment of the Track.
• The incoming Pharm.D. students should be made aware of the Pharm.D. – M.S./Ph.D. Dual Degree program for opportunities to conduct clinical research.
Outreach Activities:

Outreach refers to educational efforts, leadership, and sharing of knowledge off-campus, for example in the local community and throughout the State.

The following is a list of outreach activities in the College of Pharmacy that meet the goals of the College and the needs of Arizona.

- The Drug Discovery and Development (DDD) faculty are involved in the KEYS (Keep Engaging Youth in Science) program for high school student summer internship at the University of Arizona, and other similar programs in Arizona.
- The DDD faculty actively participate in speaking programs for the community, such as Leukemia and Lymphoma Program, National Foundation for Cancer Research, and the Arizona Cancer Center, in both Tucson and Phoenix.
- Many of the Pharmacology and Toxicology (PAT) faculty are involved with its NIEHS-sponsored Southwest Environmental Health Sciences Center. This requires Center members to participate in Summer High School Teachers training workshops, judges at Science Fairs, K – 12 curriculum development, and presentations to community groups.
- Some of the PAT faculty are part of the NIEHS Superfund Program that has an Outreach to Mexico component (training Mexican graduate students and workshops in Mexico).
- PAT graduate students have judged at science fairs and in the teaching and training of high school teachers.
- Many of the PAT students have participated in the training and mentoring of undergraduate or high school interns. The faculty of Pharmaceutics and Pharmacokinetics (PAP) put on week-long workshops in either pharmacokinetics or pharmaceutics at various sites. When in Tucson, the graduate students attend and often present.
- All of the PAP faculty serve on peer review editorial boards and review scientific manuscripts for multiple journals.
- Dr. Myrdal serves as an expert committee member for the United States Pharmacopoeia (USP)
- Dr. Myrdal is the advisor for the Arizona Student Chapter of the American Association of Pharmaceutical Scientists (AAPS).
- The Pharmaceutical Economics, Policy, and Outcomes (PEOP) graduate program actively participates in the training programs in Pharmacoeconomics and Outcomes Research. Attendance at these programs ranges from 15 to 45 individuals from governmental organizations, the pharmaceutical industry, managed care organizations and academia. Between 1 - 3 programs have been offered each year, with both faculty and graduate students as presenters.
- PEOP faculty and graduate students collaborate with scientists at the Critical Path Institute in identifying significant drug-drug interactions, especially those that cause torsades de pointes.
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