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RESEARCH ARTICLES

Prepharmacy Years in College and Academic Performance in a Professional Program

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Objective. This study investigated whether there was a significant difference in the cumulative grade point average (GPA) of individual students at the end of their first 3 professional years in the doctor of pharmacy curriculum as a function of previous years in college.

Methods. The cumulative GPA for the first- through third-professional years was calculated for the 2004-2007 graduating classes. Previous college education was classified as 2 years, 3 or more years without a bachelor's degree, and bachelor's degree or higher. Students with 2 years of prepharmacy education were classified as early assurance (EA) versus non-early assurance. Specifically, non-early assurance students were those who transferred in after 2 years but did not participate in the early assurance program. Statistical differences in the cumulative GPA were calculated using MANOVA with repeated measures followed by a LSD Post-Hoc test.

Results. Students with a bachelor's degree performed better academically, especially in the first professional year of the program compared to those with other levels of education including those who entered through our EA program. There was a consistent decrease in cumulative GPA during the second-professional year, but no additional change in the third-professional year.

Conclusions. Students who obtain a bachelor's degree perform better academically presumably because of previous college experiences.

Keywords: grades, early assurance, bachelors, academics, students

INTRODUCTION

Students who enter doctor of pharmacy programs in the United States vary in their educational backgrounds, ranging from a minimum of no college, with entry into the program immediately from high school; admittance after 2 years of college with or without an associate degree; admittance with 3 or more years of college but no college degree; to completion of a baccalaureate degree or higher prior to admission. According to the 2004-2005 application pool data reported by the American Association of Colleges of Pharmacy, 70.2% of students who applied to pharmacy programs reported having 3 or more years of college (includes those with Bachelor's degrees or higher), while 29.8% applied to the PharmD program with 0-2 years of college.[1] Given this disparity in educational backgrounds, the question arises as to whether students with different backgrounds and experiences in colleges and universities vary in their ability to succeed in our professional programs as measured by their individual cumulative GPA in the required PharmD courses. Specifically, the present study examined the cumulative GPA value as defined as the individual sequential grade point average for each student per professional year in required PharmD courses. This value is calculated by determining the total quality points a student has achieved based upon their grades in all the courses they have completed divided by the total number of hours in these courses.

Previous studies have examined various factors and their relationship to student academic success in pharmacy programs that either awarded a bachelor's degree or a doctorate degree. For example, based upon grades from the pharmaceutical science courses, pharmacy practice courses, elective courses, and advanced pharmacy practice experience (APPE) courses at the University of Arkansas College of Pharmacy, Granberry and Stiegler noted an overall increase in mean GPA of 1% per year over the 20-year period beginning in 1982.[2] McCall, on the other hand, examined the correlation between prepharmacy variables and academic success and found that students entering the doctor of pharmacy program at Texas

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Tech University with a bachelor of science degree were academically superior as measured by the mean cumulative GPA compared to students arriving with a bachelor of arts degree.[3] Similarly, Chisholm concluded that student's having a bachelor's degree prior to entering the University of Georgia College of Pharmacy had better grades in the first year of the program than the students without a bachelor's degree.[4] Furthermore, in a later study done in 2001, Chisholm reported that of the students dismissed in their first year of pharmacy school, none were students holding a bachelor's degree, suggesting that students who entered the pharmacy program holding a bachelor's degree were less likely than students without a bachelor's degree to be dismissed from the program due to poor grades.[5]

Beginning in 1998, the University at Buffalo implemented an early assurance program for freshman entering the professional program with only 2 years of college. These students must complete a series of required courses (Table 1) and achieve a grade point average of 3.0 or better. Students who enter the early assurance program and meet all the stringent requirements are automatically admitted into the school. The early assurance program requires 2 semesters each of general biology, general chemistry and organic chemistry along with laboratories. Two semesters each of calculus and physics (laboratory optional) and 1 semester of statistics are also required. Students in this program may not receive a grade lower than a C in any course and must maintain a 3.0 cumulative GPA throughout their preprofessional years. The School of Pharmacy and Pharmaceutical Sciences requires a total of 48 credit hours of prerequisite coursework minus any required general education courses. The goal of the entering curriculum is to provide a sound educational foundation in the biological and physicochemical sciences, provide an opportunity to develop critical thinking skills, and demonstrate ability of students to perform in a laboratory environment.

Table 1. Early Assurance (EA) Program at the University at Buffalo – Pharmacy Prerequisites

Course Number	Course Name	Semester Credit Hours
BIO 200	General Biology I with lab	4
BIO 201	General Biology II with lab	4
CHE 101	General Chemistry I with lab	5
CHE 102	General Chemistry II with lab	5
CHE 201	Organic Chemistry I with lab	5
CHE 202	Organic Chemistry II with lab	5
MTH 121	Calculus I	4
MTH 122	Calculus II	4
PHY 101	Physics I	4
PHY 102	Physics II	4
STA 119	Statistics	4
	Total	48

*Students admitted to the Class of 2004 were required to keep a 3.30 cumulative GPA in the first year of their prerequisite courses and a 3.20 cumulative GPA in the second year of their prerequisite courses. All other classes admitted were required to keep a 3.00 cumulative GPA in the prerequisite courses. This does not include any general education classes required by the University at Buffalo.

Over the past 5 years, we have seen a dramatic increase in the number of applicants with 3 or more years of college or with a bachelor's degree. Faculty members have expressed a potential concern that students with only 2 years of college prior to entering the doctor of pharmacy program may not be as academically successful compared to other students who have 3 or more years of college prior to admission.

It is anticipated that students who enter the program through the early assurance mechanism perform similarly to those who enter the program with other educational backgrounds. The goal of this investigation was to assess whether there was a difference in students' cumulative GPAs at the end of the first- through third-professional years (P1-P3) as a result of student educational level when starting the program. Specifically, we analyzed differences in the cumulative GPA of students who were admitted through our early assurance program; those with 2 years of college but not in our early assurance program; those with 3 years of college but had not obtained a bachelors degree; and those who have obtained a bachelor's degree or higher.

METHODS

This study was exempted from the University at Buffalo Institutional Review Board approval because the goal was the assessment and improvement of curricular design. The cumulative GPA, defined as the total quality points a student has achieved based upon their grades in all the courses divided by the total number of hours in these courses, was calculated at the end of the first-, second- and third-professional years for students who were admitted and started in the professional program in the fall of 2000, 2001, 2002, and 2003. These groups were selected because they represent the first cohort of students who came through the early assurance program starting at the University at Buffalo in 1998. For this cohort of early assurance students, the required grade point average was 3.0. We evaluated the grades obtained in the required courses of 395-403 students who graduated from 2004-2006 or would be graduating in 2007. The calculation of the cumulative GPA for each year was required courses in the pharmaceutical sciences, clinical sciences, and social-administrative sciences. The list of courses included in this assessment is shown in Table 2.

The level of previous college education was classified into 4 groups: students with only 2 years of college who

Table 2. Courses Included in Calculating the Cumulative GPA

First Professional Year
BCH 403 Biochemical Principles
MCH 311 Medicinal Chemistry
MIC 301 Fundamentals of Microbiology
PGY 451 and 452 Human Physiology 1 and 2
PHC 312 Physical Pharmacy
PHM 311 Pharmacy Calculations
PHM 315 and 316 Pharmaceutical Care 1 and 2
PHM 430 Pharmacy Law
Second Professional Year
BCP 511 and 512 Principles of Pharmacology
PHC 531 and 532 Introduction Pharmacokinetics and Biopharmaceutics 1 and 2
PHM 510 and 511 Pharmacotherapeutics 1 and 2
PHM 517 and 518 Pharmaceutical Care 1 and 2
PHM 531 and 532 Professional Practice 1 and 2
Third Professional Year
PHC 517 Pharmacogenomics
PHC 517 Principles of the Human Genome, Pharmacogenomics and Bioinformatics
PHC 533 Applied Clinical Pharmacokinetics
PHM 512 and 512 Pharmacotherapeutics 3 and 4
PHM 508 Pharmacy Informatics
PHM 509 Patient Assessment
PHM 572 Pharmacy Management

are either in our Early Assurance Program (EA); students with only 2 years of college and who did not participate in the early assurance program generally having transferred from another college (2Y); students with at least 3 years of college, but without a bachelor's degree (3Y+); and students with a bachelor's degree or higher (BD).

Statistical differences among student classifications were calculated using a MANOVA with repeated measures followed by a LSD Post-hoc test.

RESULTS

Over the period of this study 34.5% of the students were early assurance (EA), 17.6% had only 2 years of college but were not in the early assurance program (2Y), 15.1% had 3 or more years of college without a degree (3Y+), and 32.8% had a bachelor's degree (BD). In the current investigation, the required GPA for admittance via the early assurance mechanism did not change from 1998-2001. The number of EA students remained approximately the same over the 4 years ranging from 31 to 39 students per year, while the percentage of EA students in the program showed a slight decline (46% to approximately 30%) owing to increased enrollments (Table 3). Meanwhile, the percentage of students admitted with a bachelor's degree or higher increased approximately 2.5 fold over these same 4 years. There was no appreciable difference between the entering grade point average of the EA students and that of all other students combined, with grades ranging from 3.2 to 3.5 for the EA, and 3.2 to 3.4 for all others combined.

The present study only investigated the P1-P3 years since these years encompass the didactic and laboratory coursework. Analysis of variance indicated a significant effect on the cumulative GPA as a function of the entering status ($p = 0.0009$) (Figure 1). The BD students showed a consistently higher cumulative GPA compared to the EA students, 2Y, and 3Y+ students in the P1 year. The BD students had a higher cumulative GPA compared to the 2Y students, but were not statistically different from the EA or the 3Y+ students in the second-professional year (P2). The 2Y students performed better than the EA students; however the BD students performed better than the 2Y students in the P3 year.

The grades at the end of each professional year, independent of the entering status of each student, are presented in Figure 2. The cumulative GPA of students at the end of the P1 year increased for the classes of 2004 through 2006, then leveled off with the class of 2007. For each year there is a general decrease in students' cumulative GPAs in the P2 year compared to the P1 year (Figure 1). This pattern was seen in all groups regardless of educational background (Figure 1). Nonetheless, there has been a trend towards increasing cumulative GPA in

Table 3. Student Entering Grades and Level of Education

Year Admitted University at Buffalo	Year Admitted Pharmacy	Year Graduated Pharmacy	EA Students Admitted	Min. GPA EA	% EA	No. Students Admitted Excluding EA Students	Percentage of Students With Degree(s)	Year Admitted University at Buffalo	Year Admitted Pharmacy
1998	2000	2004	39	3.0	46	45	19	1998	2000
1999	2001	2005	34	3.0	35	62	25	1999	2001
2000	2002	2006	31	3.0	27	86	36	2000	2002
2001	2003	2007	35	3.0	33	71	47	2001	2003

EA students = students admitted with only 2 years of college through the early assurance program

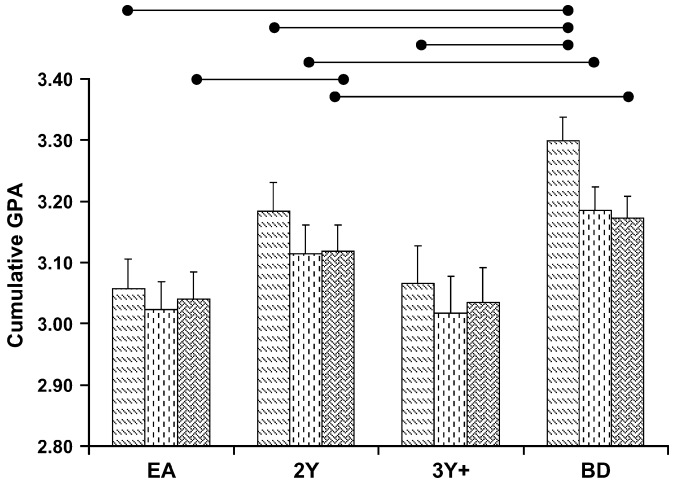

Figure 1. Cumulative grade point average at the end of the P1 through P3 Years as a function of entering educational level. Values are Mean and SEM. Legend: Horizontal Striped Bar – P1 Year; Vertical Striped Bar – P2 Year; and Cross-Hatched Bar – P3. Bars indicate statistically significant differences with $p = 0.05$ or less. EA are early assurance, 2Y are students admitted after 2 years, but not early assurance, 3Y+ are students with 3 years of college, but no bachelor's degree and BD are students with a bachelor's degree.

the P2 year, with grades ranging from 2.9 for the class of 2004 to 3.2 for the class of 2007.

Figure 3 presents a breakdown of the cumulative GPA as a function of the entering status individually for each of the 4 graduating classes. The greatest differences between the EA, 2Y, 3Y+, and BD students were observed in the class of 2004. EA and 2Y students' grade point averages

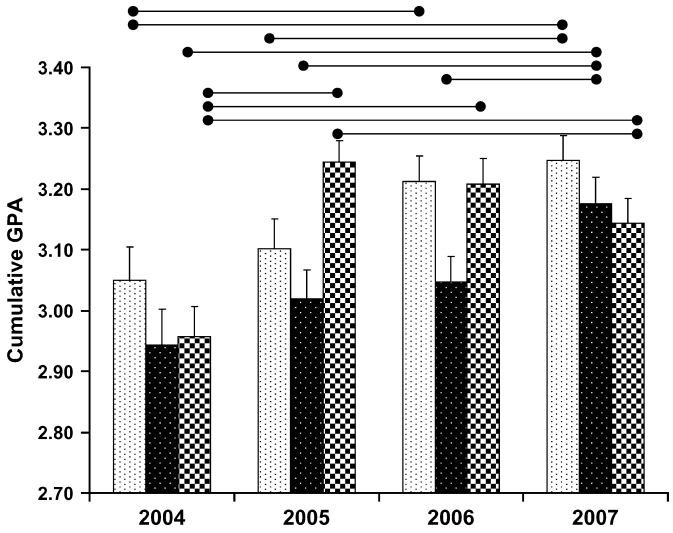

Figure 2. Cumulative grade point average for all groups of students at the end of the P1, P2, and P3 years. Values are mean and SEM. Legend: Open stickled bars = P1; closed stickled bars = P2; and cross-hatched bars = P3. Bars indicate statistically significant differences with $p = 0.05$ or less.

were significantly lower than those of the BD students at the end of both the P1 (EA vs BD, $p = 0.0007$; 2Y vs BD; $p = 0.0096$) and P2 years (EA vs BD, $p = 0.014$; 2Y vs BD; $p = 0.022$). Specifically, for the EA students the cumulative GPAs at the end of the P1 and P2 years were 2.9 and 2.8 and for the 2Y for the P1 and P2 year were 2.9 and 2.8 compared to the BD students with a 3.4 and a 3.2 at the end of P1 and P2 year, respectively. By the P3 year, there appears to be a normalization of the grades for all groups with the cumulative GPA for the EA, 2Y, 3Y+, and BD students, having a 2.9, 2.9, 3.2, and 3.0, respectively. The 3Y+ students' GPAs were statistically higher than those of the EA and 2Y students in the P3 year (EA vs 3Y+, $p = 0.033$; 2Y vs 3Y+; $p = 0.045$).

In contrast, there were no differences in any of the groups or during any of the professional years for the class of 2005. For the class of 2006, the only difference was seen in the P3 year between the EA and 2Y students ($p = 0.003$) as well as the 2Y and BD students ($p = 0.043$). Interestingly and similar to the class of 2005, there was no difference between the EA students compared to the BD students at each of the professional years for the class of 2007. The lowest performing students in all 3 years were the 3Y+ students.

DISCUSSION

The goal of this investigation was to determine whether there were any differences in academic success as measured by the cumulative GPA in the first 3 professional years. This is the first report specifically investigating the differences between an early assurance program for students compared to other entering educational levels. Our findings suggest that students who enter the doctor of pharmacy program with a bachelor's degree do better academically, particularly in the P1 year, compared to those who enter through our early assurance mechanism or with other educational levels. This could be explained in part by the increased maturity and educational experiences associated with students who have already taken upper-level courses while completing their bachelor's degree. This explanation would be applicable to other doctor of pharmacy programs where students with only 2 years of undergraduate education are transitioned into the graduate professional program with more rigorous expectations, including being given courses at a higher academic level, increased expectations for critical thinking and problem solving, and more individual responsibility for their own learning. Alternatively, in our program and perhaps in other professional programs, those students with bachelor's degrees may have had some first-professional year courses waived, thus having fewer courses each semester compared to students with

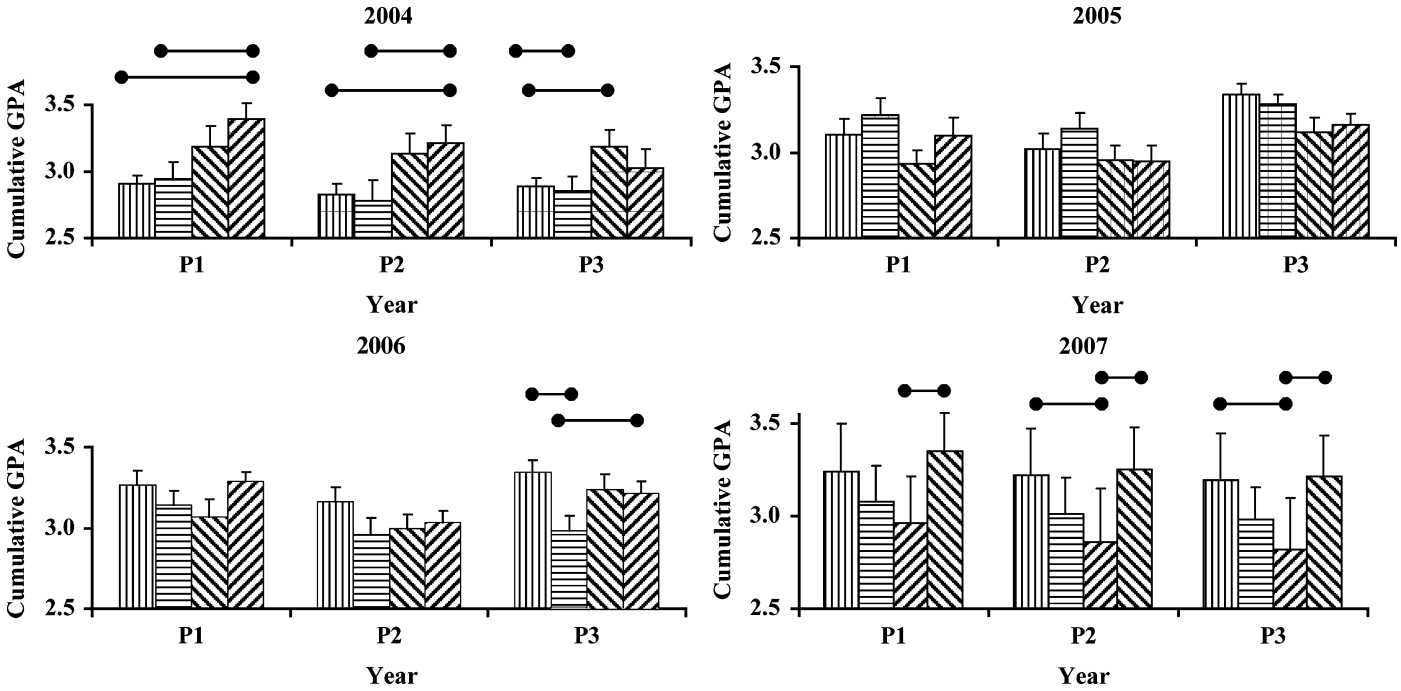

Figure 3. Cumulative grade point average at the end of the P1, P2 and P3 years for the classes of 2004-2007. Values are the mean + SEM. Legend: Vertical Bar = early assurance students (EA); horizontal bar = students with 2 years of college, not enrolled in the early assurance program (2Y); Right-slashed bar = students with 3 or more years of college, but no bachelor's degree (3Y+); and left-slashed bar indicates students with bachelor's degree (BD). Bars indicate statistically significant differences with $p = 0.05$ or less.

other educational backgrounds. Our findings are consistent with those of Chisholm who showed that students who had a bachelor's degree faired better than those who had not obtained a bachelor's degree prior to entering a pharmD program.[4]

There was a consistent decrease in students' cumulative GPA during the P2 year. This could be a function of those courses being more academically rigorous and more pharmacy intensive. Specifically, the P2 year includes an increased emphasis on courses in which the majority of students may not have had previous educational experiences (eg, pharmacokinetics, pharmacology, pharmacotherapeutics, pharmacy care; Table 2). We did not observe any changes in the cumulative GPAs of any of the students during their P3 year. With the exception of the 3Y+ students, there was a trend toward a higher cumulative GPA as a function of years in college over the 3 professional years. The EA students were noted to have the lowest cumulative GPA compared to the 2Y and the BD students. The 3Y+ cumulative GPAs were intermediate to the EA students. Overall, these findings suggest the possibility that students with more years or experiences in college prior to starting the doctor of pharmacy program are able to perform at a higher academic level.

There has been a trend toward overall increasing cumulative GPAs from the classes of 2004 to 2007 (Figure 2). These findings are consistent with the findings presented by Granberry, who also noted an increase in the overall GPA of students over a 20-year period.[2] It is possible the current findings are largely driven by 2 factors: (1) an increase in the number of BD students each year, and (2) an increase in the number of applications, which has raised the competitiveness of the applicant pool.

The availability of an early assurance program is often an important recruiting tool for a university offering a pharmacy program. This type of program can enable an institution to recruit students with the potential to be successful directly from high school or with only 2 years of prepharmacy college experiences. In many situations, these students admitted through this mechanism are the most academically talented students entering the university as college freshmen (personal communication). Furthermore, students in an early assurance program are provided with the opportunity to work with a prepharmacy advisor, participate in a prepharmacy list-serve, and become involved in a prepharmacy club.

In the present study, EA students were only required to maintain a 3.0 cumulative GPA in the required 11 science and math-based courses. Our findings suggest that EA, 2Y, and 3Y+ students are not clearly distinguishable in their academic record. This could be a function of the EA students only needing a 3.0 cumulative GPA, while the 2Y and 3Y+ students needed higher entering prepharmacy grades in order to be competitive in the admission

process. Since the fall of 2003, we have been gradually increasing the minimum cumulative GPA for the required prepharmacy coursework in order to admit only the most academically talented students to our program. Specifically, these requirements for early assurance for freshman were 3.2, 3.3, and 3.5 for those entering the University in 2003, 2004, and 2005, respectively. These changes may also minimize differences between the various student cohorts entering our program.

Limitations

A potential limitation of the present study is that we only investigated students who successfully completed the first 3 professional years and were on track to graduate within 4 years. We did not include those students who left the program or fell behind to the next professional class due to academic difficulties, leave of absences, entering combined degree programs such as a PharmD/MBA, illness, or other personal reasons such as working too many hours as an intern. We generally lose less than 5% of our students in each academic year. There is no difference in the entering educational background between those students who leave the program and those who fall behind 1 or more years. In addition, these studies only looked at a cohort of students over a 4-year period. With the increased applicant pool associated with a centralized application process and increased interest in pharmacy, it is possible that the student academic success may be increasing overall as to minimize the differences between students with different educational backgrounds and experiences. Furthermore, we did not investigate the type of bachelor's degrees and their impact on academic success in the doctor of pharmacy program. Lastly, although certain students may have been waived from microbiology, physiology, and/or biochemistry, we did not exclude them from this study. It would only be possible for students with 3 or more years of college or bachelor degrees to be waived from these courses. This accounts for less than 10% of our students. Those students would have had a lighter course load compared to the other students in this study, which could explain why the students with bachelor's degrees had the biggest drop in their cumulative GPA in the P2 year.

CONCLUSIONS

These present findings suggest that students who have completed a bachelor's degree are more likely to demonstrate a higher cumulative GPA compared to other students who may not have the same level of academic experiences. This observation is noted specifically in the first-professional year and continues through the second- and third-professional years. It is possible that the additional years in college, particularly in the junior and senior years, allow students the opportunity to further develop their study skills, refine and improve their critical thinking and problem-solving skills, enhance their oral and written communication skills, and gain experience with balancing their coursework with other activities.

There are several implications of these findings to our admissions criteria and the impact on student success in our programs. First, this type of analysis is critical to individual institutions in order to determine admission criteria that would enable the admission of students capable of being successful in our programs, thus minimizing attrition from our colleges and schools. Second, these types of studies can be extended to look at other measures of student success, such as leadership and involvement in professional organizations and college or school activities and subsequent entrance into postdoctoral opportunities, including residencies, fellowships, and graduate studies.

Finally, early assurance programs can be a valuable means to attracting talented students to our professional programs; however, it might be necessary to include a third additional prepharmacy year to ensure we admit students who can be successful in our programs. In this third prerequisite year we could require them to take additional upper-level science courses in anatomy and physiology, genetics, and biochemistry.

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