Influence of the number, timing, and types of advanced pharmacy practice experiences on residency matching

Christina L. Mnatzaganian, Renu F. Singh, Katharina Brandl, Jennifer M. Namba, Laura A. Hart, Mark Bounthavong, Candis M. Morello, Linda Awdishu, Alex J. Luli, Kelly C. Lee, Nimish Patel

PII: S0002-9459(23)04551-5
DOI: https://doi.org/10.1016/j.ajpe.2023.100613
Reference: AJPE100613

To appear in: American Journal of Pharmaceutical Education

Received date: 14 February 2023
Revised date: 18 October 2023
Accepted date: 24 October 2023

Please cite this article as: Christina L. Mnatzaganian, Renu F. Singh, Katharina Brandl, Jennifer M. Namba, Laura A. Hart, Mark Bounthavong, Candis M. Morello, Linda Awdishu, Alex J. Luli, Kelly C. Lee and Nimish Patel, Influence of the number, timing, and types of advanced pharmacy practice experiences on residency matching, American Journal of Pharmaceutical Education, (2023) doi:https://doi.org/10.1016/j.ajpe.2023.100613

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2023 Published by Elsevier.
Influence of the number, timing, and types of advanced pharmacy practice experiences on residency matching

Authors:

1. Christina L. Mnatzaganian
   cmnatzaganian@health.ucsd.edu

2. Renu F. Singh
   rfsingh@health.ucsd.edu

3. Katharina Brandl
   kbrandl@health.ucsd.edu

4. Jennifer M. Namba
   jnamba@health.ucsd.edu

5. Laura A. Hart
   l1hart@health.ucsd.edu

6. Mark Bounthavong
   mbounthavong@health.ucsd.edu

7. Candis M. Morello
   cmmorello@health.ucsd.edu

8. Linda Awdishu
   lawdishu@health.ucsd.edu

9. Alex J. Luli
   aluli@health.ucsd.edu

10. Kelly C. Lee
    kellylee@health.ucsd.edu

11. Nimish Patel (CORRESPONDING AUTHOR)
    nipatel@health.ucsd.edu

aUniversity of California San Diego, Skaggs School of Pharmacy and Pharmaceutical Sciences, 9500 Gilman Drive, MC 0657, La Jolla, CA 92093-0657, USA
Abstract

Objective

To characterize the association between number, timing, and type of Advanced Pharmacy Practice Experiences (APPEs) and likelihood of postgraduate year one (PGY1) residency match outcomes.

Methods

A retrospective cohort study was performed among PGY1 residency-seeking pharmacy students from graduating years 2018-2021 as identified from the National Matching Services Inc. enrollee list. The number of APPEs of interest (AOI) most likely to align with general PGY1 residencies (acute care, ambulatory care, and elective rotations with significant direct patient care interactions) completed before January of the respective graduation year (GY) was compared between matched and unmatched students to a PGY1 program in any phase. Classification and regression tree (CART) analyses were performed to identify the AOI threshold associated with an increased likelihood of matching.

Results

Among 155 students meeting inclusion criteria, 115 students (74%) matched during the study period. The probability of matching was 36%, 74%, and 83% for students completing two, three or four AOI, respectively. CART analyses identified three or more AOI completed prior to January of the GY as the threshold significantly associated with PGY1 residency matching.

Conclusion

Completing at least three AOI before January of the GY was associated with a significantly increased probability of PGY1 residency matching. These findings may influence students’ preferences for sequencing of APPEs to improve match results, but may be limited by institutional capacity.

Keywords: Postgraduate residency; matching; experiential education; advanced pharmacy practice experience
Abbreviations:

Advanced Pharmacy Practice Experiences (APPEs)
American Society of Health-System Pharmacists (ASHP)
Classification and regression tree (CART)
Doctor of Pharmacy (PharmD)
Graduation year (GY)
National Matching Services Inc. (NMS)
Offices of Experiential Education (OEE)
Postgraduate year one (PGY1)
Residency program director (RPD)
San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences (SSPPS)
University of California (UC)
1. Introduction

Postgraduate residency training allows pharmacy graduates to enhance their knowledge and experience at an accelerated rate, obtain skills in pharmacy specialties, and differentiate themselves in a highly competitive job market. Moreover, professional organizations and employers seeking clinical pharmacists highly value residency training.\textsuperscript{1,2} A position statement from the American College of Clinical Pharmacy in 2006 recommended that all pharmacists who provide direct patient care be residency trained by 2020.\textsuperscript{3} In 2019, a majority of American Society of Health-System Pharmacists (ASHP) Pharmacy Forecast Panelists predicted that nearly all health-systems would require a postgraduate year 1 (PGY1) residency for entry level pharmacist positions.\textsuperscript{3} Despite these endorsements, as well as declines in residency applications and unmatched applicants since 2020, there remains an annual surplus of graduates seeking PGY1 residency training compared to positions available within the ASHP Resident Matching Program.\textsuperscript{4}

Advising students about characteristics of applicants who successfully obtain PGY1 residencies may help pharmacy schools optimize residency matching rates. Top factors associated with interviewing and/or matching to a residency program include the applicant’s perceived ability to learn, compelling recommendations, work experience, high grade point average, strong letter of intent, robust curriculum vitae (CV), as well as higher number of submitted applications and invited or completed interviews.\textsuperscript{5-9} Additional variables include holding leadership positions within a pharmacy school or university committee, receiving awards, engaging in research, networking, and applicant’s perceived interview performance.\textsuperscript{5,10,11} Pharmacy school variables associated with matching include >95\% North American Pharmacy Licensure Examination (NAPLEX) pass rates, smaller class size, public institutions, four-year program versus a three-year program, \(\geq15\) funded faculty, offering graduate degrees in addition to the Doctor of Pharmacy (PharmD) degree, using letter grades rather than pass/fail grades, providing mock residency interviews, affiliation with an academic health center, and U.S. News and World Report rankings of the school.\textsuperscript{12-15}
Given the highly clinical nature of PGY1 training, pharmacy curricula most aligned with clinical care is experiential education, specifically, Advanced Pharmacy Practice Experiences (APPEs). Pharmacy students begin APPEs after their final didactic year, which may not allow sufficient time to rotate through acute care, ambulatory care, and/or elective APPEs with significant direct patient care interactions before PGY1 residency application deadlines. The perception that these APPEs of interest (AOI) need to be completed prior to residency application deadlines has generated concerns among pharmacy school administrators and students. There is limited literature on residency program directors’ (RPDs’) preferences for the number, timing, or types of specific APPEs completed prior to residency application deadlines. Prisco et al reported that while students believed that completing internal medicine and specialty clinical elective experiences prior to the ASHP Midyear Clinical Meeting (MCM) was extremely important, RPDs believed them to be only somewhat important. Censi et al reported a positive association of a successful match with completion of hospital rotations prior to the ASHP MCM.

When assessing for the number of clinical APPEs completed prior to ASHP MCM, Tofade et al found no significant effect on residency matching. However, it was not clear what constituted as a “clinical” APPE. Moreover, a recent study of RPDs by Pate et al determined that in addition to work experience and extracurricular activities, high-quality APPEs documented on applicants’ CVs were perceived to have the highest correlation with residency success, however “high-quality” was not defined. This leaves a gap in knowledge as to which types of APPEs are most aligned with residency matching as the pharmacy profession embraces greater clinical care, defined as a “health science discipline in which pharmacists provide patient care that optimizes medication therapy and promotes health, and disease prevention.” Based on this definition, most APPEs may be considered to be clinical in nature. The purpose of this study was to further characterize the number, timing, and type of APPEs completed prior to residency application submissions that were associated with an increased probability of residency matching.
2. Material and methods

A retrospective cohort study was performed among student pharmacists enrolled in the PharmD program at the University of California (UC) San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences (SSPPS), a four-year public university. Students complete seven consecutive, six-week APPEs from July through May of their final year. During the study period, students were scheduled into APPEs through an electronic lottery system with post-lottery changes granted to students based on availability. The school uses a pass/fail grading system for all didactic and experiential courses. The study population included students graduating in 2018 through 2021 who had registered with ASHP National Matching Services Inc. (NMS). The list of students registered with NMS, provided annually to each pharmacy school, includes the respective school’s students seeking PGY1 residencies, as well as alumni seeking residencies (PGY1 or PGY2). Students who withdrew from NMS or did not rank any programs (ie, did not participate in the match) along with alumni seeking residency were excluded from this study.

Demographic data including age and self-reported gender were obtained from student admission records. AOI were those most likely to align with general PGY1 residencies such as acute care, ambulatory care, and elective rotations with significant direct patient care interactions (i.e., psychiatry, infectious diseases, oncology, and managed care with medication therapy management, etc). Significant direct patient care was defined as comprising at least 60% of rotation time as described during site visits by preceptors to Office of Experiential Education (OEE) faculty members using an internal school standard. The exposure of interest was the number of these types of AOI completed prior to January of the graduation year (GY). This date was selected to align with application deadlines for residency programs participating in the NMS match. APPEs excluded from the analyses of AOI were hospital/health-systems, community, and electives involving less than 60% direct patient care, as they were postulated to be less likely to align with general PGY1 residencies.

The primary outcome of interest was residency match status, which was dichotomized as matched or unmatched. Among students who matched, there was no differentiation between those who matched in Phase I or II, or those matching after completion of the NMS matching period. The relationship between
number of APPEs and residency matching was assessed in three ways. First, the mean number of AOI between matched and unmatched applicants was compared using the independent t-test. Second, the number of AOI as a categorical variable (1, 2, 3 and 4) was compared to the proportions between matched and unmatched students using the chi-square test. Finally, Classification and Regression Tree (CART) analyses identified the threshold in number of AOI associated with an increased probability of matching. Once this threshold was identified, the number of AOI was dichotomized as being above or below the CART-derived breakpoint and was compared between matched/unmatched individuals using the chi-square test. The UC San Diego Human Research Protections Program determined this study was exempt from full review.

3. Results

During the four-year study period, 187 students pursued a PGY1 residency position and enrolled in NMS. Eight students were excluded because they were alumni applying a year after graduating. Additionally, 24 students were excluded because they enrolled in NMS but did not submit a rank list to be eligible for the match (non-participant). In total, 155 students met the inclusion criteria, including 49/67 students (GY 2018), 39/61 students (GY 2019), 37/66 students (GY 2020), and 30/66 (GY 2021).

The mean ± standard deviation (SD) age of the students was 26.8 ± 2.6 years and the majority were female (72%). Over 92% of students completed at least three AOI prior to January of their GY. There were 115 (74%) students who matched during the study period. Among these, 107 (93%) students matched in Phase I and 8 students in Phase II. The proportion of students matching by GY was 71% (2018), 80% (2019), 62% (2020), and 87% (2021). A comparison of match rates between GYs did not significantly differ, p=0.11.

Matching probabilities did not significantly differ between those who did and did not complete a community APPE prior to January of the GY, 57% versus 70%, respectively (p=.26). Similarly, the probability of matching did not significantly differ between those who did and did not complete an institutional/health-system APPE prior to January of the GY, 72.7% versus 75.6% (p=.72).
The mean ± SD number of AOI was significantly higher among matched students than unmatched students (3.36 ± 0.55 versus 3.00 ± 0.72, p<.001). Similarly, when the number of AOI was assessed as a categorical variable, there was a direct relationship between number of AOI completed before January and match status. As the number of AOI increased, there was a corresponding increase in the probability of matching (Table 1, p=.004). Finally, CART analyses identified that the threshold number associated with matching was at least three AOI. Students completing ≥3 AOI prior to January of GY were significantly more likely to match than students completing less than three AOI (78% versus 33%, p<.001).

The completion of an hospital/health-system APPE appeared to modify the association between AOI and residency matching. Specifically, among those who did not complete an institutional/health-system APPE, there was no statistically significant difference between those completing ≥3 versus < 3 AOI (77% versus 50%), p=.25. Conversely, among those who did complete an institutional/health-system APPE, there was a significant difference between those completing ≥3 versus < 3 pre-specified APPEs (78.3% versus 25.0%), p=.02.

4. Discussion

The findings of this study indicate that completion of a higher number of AOI prior to residency application deadlines was significantly associated with matching to PGY1 residency programs in the NMS. To our knowledge, this is the first study to simultaneously evaluate the association between the number and types of APPEs completed prior to January of the GY and the probability of successfully matching with a PGY1 residency program. The greatest probability of matching with a residency program was reported among students completing ≥3 AOI prior to January of the GY.

Previous literature has not simultaneously examined the timing, type, and quantity of APPEs as important criteria for residency programs when evaluating student pharmacists’ applications. Our findings are in congruence with students’ perceptions of the importance of rotation schedule, but do not fully align with RPDs’ perceptions of rotation schedule as reported by Prisco et al. While Tofade et al, found that
the number of “clinical” APPEs had no significant effect on residency matching, our study adds to the
growing literature by defining the types of APPEs that may impact residency matching.\textsuperscript{18} Our findings
indicate that the number and types of APPEs impact the likelihood of residency matching. This may also
reflect the cultivation of other skills valued by RPDs when students complete AOI earlier in the year.

These findings may suggest an opportunity for OEEs to strategically align AOI earlier in the
experiential year for students seeking residency, where possible. Accreditation standards require that
pharmacy schools provide at least 1440 hours of APPEs, with a minimum of 160 hours in each of the
following four practice settings: community pharmacy, hospital/health-system pharmacy, ambulatory
care, and inpatient acute care.\textsuperscript{21} Schools must also offer elective APPEs which may be direct patient care
focused or non-patient care focused.\textsuperscript{21} OEEs are faced with the complex task of balancing student
preferences with site/preceptor availability when scheduling APPEs. The flexibility to optimize schedules
by APPE type before January of the GY may not always be feasible. A strategy to achieve this type of
scheduling could include surveying students about career interests and goals prior to assigning APPEs.
Given that there remains an imbalance in students who match to residency programs with available
positions, such procedural changes may improve students’ matching rates. One limitation to this
approach, as well as our lottery system and post-lottery change requests used to assign rotations, is that
there may be students who do not realize they want to do a residency until they start their APPEs and may
subsequently miss out on taking AOIs earlier in the year.

The retrospective nature of this cohort study presents some limitations that should be considered
when interpreting the findings. While the mean number of rotations was higher among matched versus
unmatched students, there is no inherent application of 3.36 versus 3.00 as it is not possible to complete
partial rotations. These data were presented purely for descriptive purposes. The more direct application
of these findings was when the number of APPEs was evaluated as a categorical variable. Students, at our
school, begin APPEs in July of the fourth year, which limits scheduling to a maximum of four, six-week
APPEs that can be completed before January of GY. The quantitative thresholds associated with matching
may not be applicable to schools that start APPEs at an earlier stage in the year and/or have shorter
rotation blocks. We would encourage these schools to perform a similar type of analysis to determine if
the number of AOI associated with matching is consistent with our findings. Our study period includes
residency match cycles during and after the pandemic onset. The ability to schedule acute care and
ambulatory care rotations, particularly at the beginning of the pandemic, could have been impacted by
scheduling issues and restrictions from health-systems. However, these pandemic-related scheduling
issues were short-lived and unlikely to have impacted the results in an appreciable way. The number of
applicants and unmatched positions have not been static over time. The findings from our study period,
just as those of Tofade et al, may not be timeless as the size of the applicant pool continues to change and
may inherently affect the ability to match with a residency program.

This study was conducted at a single site and the results may not be generalizable to all PharmD
programs in the United States due to numerous variables that influence residency matching. Class sizes
reflected in this study were relatively small (55-67 students/year), which may have allowed for greater
flexibility in scheduling AOI. This is reflected by the small number (12) of students with less than three
of the pre-specified APPEs prior to January of GY. Further, our school uses a pass/fail grading system for
APPEs (which may negatively impact our students’ match rates), has small class sizes, and requires
completion of a research project (which may positively impact match rates), all which may confound our
findings based on previous literature described. Our study also excluded students who may have applied
for residencies but were not offered interviews and therefore were unable to participate in the rankings.
Finally, most RPDs are seeking well-rounded applicants and different types of programs (i.e., PGY1 acute
care vs PGY1 community) may prioritize the timing and number of APPEs differently. These data were
not analyzed in the context of a multivariable regression that comprehensively evaluated all factors
simultaneously to determine which are independently associated with the residency matching.

5. Conclusions

Students attending a four-year public university who completed three or more AOI prior to
January of the graduation year were more likely to match to a PGY1 residency program. These findings
suggest that experiential offices in pharmacy schools may consider scheduling these types of rotations earlier for students interested in applying for a PGY1 residency to enhance their likelihood for matching.

Acknowledgements

We thank administrative support, Ezra Blaize and Jayne Laity, within the Office of Experiential Education for organizing and compiling the data analyzed in this manuscript.

Funding Sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
References


18. Tofade T, Grogg A, Lebovitz L, Brueckl M. A 4-year study of the correlation between numbers
of clinical rotations completed before ASHP midyear to being selected for residency. *Curr Pharm

19. Pate AN, Mills AR, Fleming JW, Phan HK, Street M, Pitcock JJ. Residency application content
and considerations based on residency director review of a fictitious CV: What really matters?


21. Accreditation Council for Pharmacy Education. Accreditation Standards and Key Elements for
the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree (“Standards
### Table 1. Probability of Student Pharmacists Matching by Number of APPEs of Interests Completed

<table>
<thead>
<tr>
<th>Number of AOIs Completed</th>
<th>Number of Matched Students / Total Number of Students Completing that Number of AOIs</th>
<th>Probability of Matching to Residency Program (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0/1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4/11</td>
<td>36.4</td>
<td>.004</td>
</tr>
<tr>
<td>3</td>
<td>66/89</td>
<td>74.2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>45/54</td>
<td>83.3</td>
<td></td>
</tr>
</tbody>
</table>

AOI: Advanced Pharmacy Practice Experience (APPE) of Interest

<table>
<thead>
<tr>
<th>Author</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christina L. Mnatzaganian</td>
<td>Writing - Original Draft</td>
</tr>
<tr>
<td>Renu F. Singh</td>
<td>Data Curation</td>
</tr>
<tr>
<td></td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td>Katharina Brandl</td>
<td>Writing - Original Draft</td>
</tr>
<tr>
<td></td>
<td>Visualization</td>
</tr>
<tr>
<td>Jennifer M. Namba</td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td></td>
<td>Methodology</td>
</tr>
<tr>
<td>Laura A. Hart</td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td></td>
<td>Conceptualization</td>
</tr>
<tr>
<td>Mark Bounthavong</td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td></td>
<td>Methodology</td>
</tr>
<tr>
<td></td>
<td>Conceptualization</td>
</tr>
<tr>
<td>Candis M. Morello</td>
<td>Data Curation</td>
</tr>
<tr>
<td></td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td>Linda Awdishu</td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td></td>
<td>Methodology</td>
</tr>
<tr>
<td></td>
<td>Conceptualization</td>
</tr>
<tr>
<td>Alex J. Luli</td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td></td>
<td>Conceptualization</td>
</tr>
<tr>
<td>Kelly C. Lee</td>
<td>Data Curation</td>
</tr>
<tr>
<td></td>
<td>Writing - Review &amp; Editing</td>
</tr>
<tr>
<td></td>
<td>Methodology</td>
</tr>
<tr>
<td></td>
<td>Conceptualization</td>
</tr>
</tbody>
</table>
Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: