




RESEARCH ARTICLE

Evaluation of differences in postgraduate year one pharmacy residency application rubrics

Rebecca Bruning¹ , Allison Butts², Craig Martin³, Sharya Bourdet⁴, Margaret Curtin⁵, Shannon Giddens⁶, James Kalus⁷, Frank Paloucek⁸ , Cathy Walker⁹, Becky Waltman¹⁰, Aaron M. Cook³ 

¹ Moffitt Cancer Centre, Tampa, Florida, United States

² UK HealthCare, Lexington, Kentucky, United States

³ College of Pharmacy, Department of Pharmacy Practice and Science, UK HealthCare, University of Kentucky, Lexington, Kentucky, United States

⁴ Office of Academic Affiliations (14AA), Veterans Health Administration

⁵ Howard County General Hospital, Columbia, Maryland, United States

⁶ Yale New Haven Health, New Haven, Connecticut, United States

⁷ Henry Ford Health, Detroit, Michigan, United States

⁸ Department of Pharmacy Practice, University of Illinois at Chicago, Willowbrook, Illinois, United States

⁹ Johns Hopkins Department of Pharmacy, Baltimore, Maryland, United States

¹⁰ Piedmont Athens Regional Department of Pharmacy, Athens, Georgia, United States

Keywords

Application
Candidate
Postgraduate training
Residency
Rubric

Correspondence

Aaron M Cook
College of Pharmacy
Department of Pharmacy Practice &
Science
University of Kentucky
Lexington
Kentucky
United States
amcook0@email.uky.edu

Abstract

Background: The American Society of Health-System Pharmacists standards require pharmacy residency programmes to systematically evaluate candidates. This study aimed to assess differences among eight PGY1 pharmacy residency application rubrics used to select candidates for interviews. **Methods:** In December 2018, fifty applicants to the University of Kentucky HealthCare's PGY1 Pharmacy Residency Programme were evaluated using eight different rubrics. A subgroup of sixteen applicants had their scores assessed by multiple scorers to analyse inter-rater variability. The main goal was to examine score variability across all applicants. Scores were normalised to a common scale, and statistical analysis included descriptive statistics and ANOVA tests. **Results:** The evaluation of a candidate pool (n = 520) using eight unique rubrics yielded an overall mean score of 66.98 out of 100, with significant score differences across rubrics ($p < 0.001$). Inter-rater variability was low, with a maximum difference of six percent in scores. All rubrics assessed work experience, leadership positions, and publications, but not all included letters of recommendation. Letters of recommendation, work experience, and rotation experiences received the highest weight in the rubrics. **Conclusion:** There was notable variability in scores among eight different PGY1 pharmacy residency application rubrics. While aspects like rotation experiences were highly ranked, others, such as letters of recommendation, varied significantly. Programmes prioritise different elements based on their preferences, leading to differences in applicant evaluations. This allows programmes to find candidates that fit their practice, but applicants should be aware that their portfolios may be assessed differently across programmes.

Introduction

All pharmacy residency programmes are required to create and utilise a systematic approach to evaluate prospective candidates to meet accreditation standards from the American Society of Health-System

Pharmacists (ASHP) (ASHP, 2023). Standard 1.1 of the guidance document for ASHP accreditation standards states that the residency programme must have “*pre-determined, objective criteria for determining which applicants shall be invited to interview*”, which shall be used by all involved in the application review process

(ASHP, 2023). As a result, many programmes have developed screening rubrics as part of their systematic approach. Analysis of the pharmacy residency match trends since 2012 reveals that the number of individuals applying to pharmacy residency programmes has steadily increased up until 2022 (National Matching Services, 2024). Recent years have seen a relative decline in applicants, though the number of applicants still far outnumbers the number of residency positions. A recent systematic review concluded that there is a substantial burden associated with the time and financial aspects of the postgraduate year one (PGY1) selection process in the context of a growing number of applicants (Reed *et al.*, 2021).

There is little published information on what predetermined application criteria are commonly considered or which might be the most important for determining resident success. Most of the data surrounding this topic is from surveys of residency programme directors (Jellinek-Cohen *et al.*, 2012; Gohlke *et al.*, 2014; Hillebrand *et al.*, 2015; Macias-Moriarity *et al.*, 2015; Cho, 2018; Skrupky *et al.*, 2021). These surveys overwhelmingly endorse letters of recommendation (LOR) – especially from colleagues in pharmacy practice – or prior knowledge of the candidate and overall impression based on the curriculum vitae (CV) to be the most important factors for interview invitation. However, some of this data is reflective of the use of formal letters that pre-dates the approach for recommendations used by PhORCAS until revisions in the Fall of 2023. The recommendation format for this portal has moved many recommenders away from writing formal letters; instead, recommenders are prompted to rate and comment on specific characteristics, as well as provide a targeted narrative using the PhORCAS format. The ratings aspects of this format may be of questionable value (Atyia *et al.*, 2020). Others have argued more recently that LOR and letters of intent (LOI) introduce sources of bias and should be utilised with caution when evaluating applications (Reed, 2021).

Additional metrics often considered when evaluating applications for residency may include work experience, grade point average (GPA), advanced pharmacy practice experiences, publications, presentations, volunteer experience, and leadership experience. Similar characteristics are considered in other medical specialties such as Emergency Medicine, Physical Medicine and Rehabilitation, and Internal Medicine (DeLisa *et al.*, 1994; Crane & Ferraro, 2000; Poirier & Pruitt, 2003; Cullen *et al.*, 2011). They demonstrated high value for clinical grades and narrative comments from faculty physicians or colleagues in that specialty within the LOR for determining interview, rank list, and professionalism

once in the programme. Thus, there is great variability in what programmes seem to value in applicants, and the current data describing how applications are evaluated are from self-reported surveys and not objective evaluations of the metrics and weights used in the process. This study sought to investigate score variability amongst different rubrics used to evaluate PGY1 pharmacy residency applicants (Jellinek-Cohen *et al.*, 2012; Gohlke *et al.*, 2014; Cho, 2018). The investigators hoped to shed light on what aspects of the residency applications are most commonly considered, as well as explore other characteristics of application review, such as inter-rater variability and time needed for application evaluation.

Methods

This was a multicentre study which included application evaluation rubrics from five academic medical centres, two community hospitals, and one Veterans Affairs health care system. The centres were chosen to represent some of the diversity seen in PGY1 training programmes with regard to setting, hospital type, and geographic location. The data set included fifty applicants who applied to the University of Kentucky Healthcare (UKHC) Chandler Medical Centre PGY1 pharmacy practice programme in December 2018. The number of applicants was determined after discussion amongst those involved with data collection. These specific applicants were chosen by the primary investigators based on their geography and score distribution compared to the entire cohort of applicants from that application year. Overall, applicants were selected using quota sampling, including applicants from the upper echelon, middle echelon, and lower echelons of scoring from the primary investigators' site to provide some diversity in the qualifications of the applicants. The applications were downloaded from the PhORCAS platform. Representatives from each site shared a copy of their current rubric, which was de-identified and uploaded to a shared drive. The rubrics were adapted to a Research Electronic Data Capture (REDCap) form to facilitate data entry (Harris *et al.*, 2009).

The primary objective was to identify what aspects of residency evaluations were most commonly considered and describe how these aspects were typically weighted across eight different residency application evaluation rubrics. The study also sought to evaluate score variability across the different rubrics utilised to determine which candidates to invite for interviews. Our hypothesis was that there would be low score variability between different residency application

rubric scores for the assessment of prospective pharmacy residency candidates.

Secondary objectives included an evaluation of inter-rater score variability within individual programme-specific rubrics, the time needed to complete application review using each rubric, and the prevalence of and likelihood that longitudinal Advanced Pharmacy Practice Experience (LAPPE) involvement and GPA scoring systems (as opposed to schools that use pass/fail grading) lead to favourable residency application rubric scores.

For the primary objective, rubrics were collected from eight separate residency training programmes. Each discrete item in the rubric that was evaluated and rated was categorised so that items common to other rubrics could be identified. An online version of each rubric was created in REDCap using common data elements or terms and branching logic so that the data entry was individualised to collect only the specific items indicated by each unique rubric (Harris *et al.*, 2009). In this way, each discrete item could also be analogised from one programme to another (e. g., one programme termed abstract submission and publishing as 'scholarly activity' while another had specific fields for publications; these were combined under a common definition in the data entry portal to serve the purposes of both rubrics). An evaluator from each site utilised each of the eight rubrics (including the rubric from their home site) to evaluate all fifty applicants. These evaluators all have extensive experience as residency programme directors, except for one resident investigator.

To investigate the secondary outcome of inter-rater variability, independent evaluators from UKHC repeated scoring of 16 different applications using the rubrics from six of the included sites. Two sites were excluded from the inter-rater variability analysis; UKHC was excluded as the control site, and the other used a grouping process for ranking that could not be replicated by the independent evaluators (Rubric 5). Rubric 5 used a rubric that was not mandatory for all reviewers and was applied to create rankings within applicants with a specific subgroup, such as school of origin or GPA range. The top-ranked applicant from each school was invited to interview. Applicants who were the only one from their school were ranked against each other. The UKHC evaluators looked at four different applicants on these six different rubrics. This process was repeated by four different UKHC evaluators to ultimately have inter-rater variability data for 16 applicants. Overall, there were 190 application scores to evaluate for inter-rater variability (two scores each for 16 applicants on six different rubrics, with two data points missing).

Application evaluation was timed from beginning to end for each rubric. This was recorded in the data entry portal along with the applicant information related to their school's grading scheme and the applicant's participation in a LAPPE programme. Pass/fail grading systems were defined as the entire curriculum being pass/fail. Candidates with partial pass/fail (i.e. only final year) with GPA data from other years were designated as GPA candidates. Applicants with LAPPE programmes were defined as candidates who underwent most, if not all, of their final-year pharmacy rotations at a single institution. Some applicants may have also defined LAPPE participation separately to include additional projects or responsibilities, but this formal designation was not required.

All application scores were standardised on a scale out of 100 to normalise the data since some rubrics had differing maximum point totals. The relative weight of each specific application component was proportionally scaled so that the overall application scores were equivalent across the rubrics. For example, one programme may have allotted 15 points for recommendations out of the total of 50 points for the rubric. To normalise the score to the other rubrics, the total points for that rubric were increased to 100, and the points allotted for recommendations were proportionally increased to 30. In this way, each rubric retained the relative weights of the various application components, but the different rubrics could be evaluated on a more comparable scale.

Microsoft Excel (Microsoft Office, Professional Plus 2019, version 1808) was used for the descriptive statistics and the evaluation of score variability among programmes. An analysis of variance (ANOVA) with multiple comparisons was conducted on the applications scores for all applicants among each of the different rubrics to example the variability in scoring across programmes. Pairwise comparisons using Bonferroni correction were completed to evaluate the differences between different rubrics in the case of a significant difference in score variability overall (Bewick *et al.*, 2004). The dependent variable was characterised as the mean normalised application score, while the independent variable was the different rubric sites. A paired student's T-test was used to evaluate the differences in scoring for each applicant across all the rubrics (i.e., was an applicant's score significantly different from one rubric to another?). A power calculation was not performed.

Results

Overall, 50 applicants were reviewed using eight different application evaluation rubrics. A total of 520 application scores were available from the 50

applicants across the residency programme rubrics. The mean of all application scores in the entire cohort (66.98 out of 100 points) is represented by the grey bar in Figure 1.

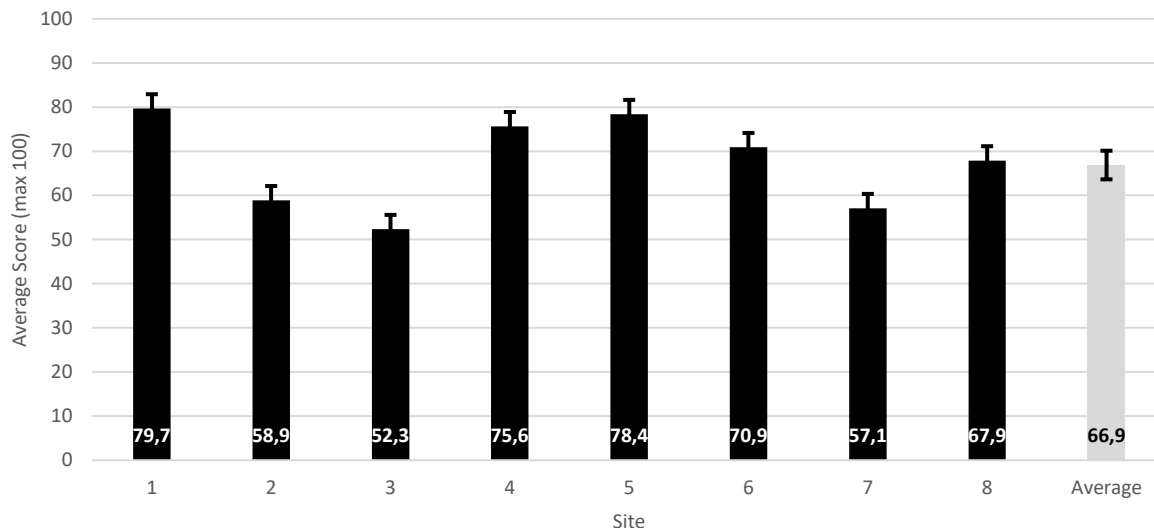


Figure 1: Average normalised score of all applicants by rubric

The overall mean normalised score for all applicants scored on each site is displayed as compared to the overall mean of the entire cohort (grey bar). Error bars indicate five percent error for each site. Each sites’ scores were found to be significantly different from one another with $p < 0.001$.

Table I: Analysis of variance for differences among rubrics

	Sum of squares	Df	Mean square	F	P-Value
Between groups	29879.18	6	4979.86	48.8	< 0.001
Error	29383.1	288	102		
Total	59262.3	294			

There was a significant difference between the overall mean scores on each rubric [$F(6, 288) = 48.8, p < 0.001$], indicating substantial variability amongst the rubrics (Table I). Pairwise comparisons demonstrated significant differences in rubric scores across the board with few exceptions. Rubric 1 compared with rubrics 4 and 5; Rubric 4 compared with rubric 5; rubric 2 compared with rubric 7; and rubric 6 compared with rubric 9 were the only comparisons that were not significantly different.

All rubrics included work experience, leadership, and publications in some capacity, though there was

variability in what was included and to what extent it was weighted across the eight different rubrics (Figure 2). The ten most highly weighted metrics are presented in Figure 2 by the cumulative weight of their importance on each individual rubric (one site was excluded from this evaluation, as this site did not have a standardised rubric to reference with these metrics). Letters of recommendation held the most weight; however, only five rubrics included this aspect of the application. The next highest metric was work experience, which was considered on every rubric and was more consistent in its weight on rubrics, with a mean of 13% of the total score on each rubric.

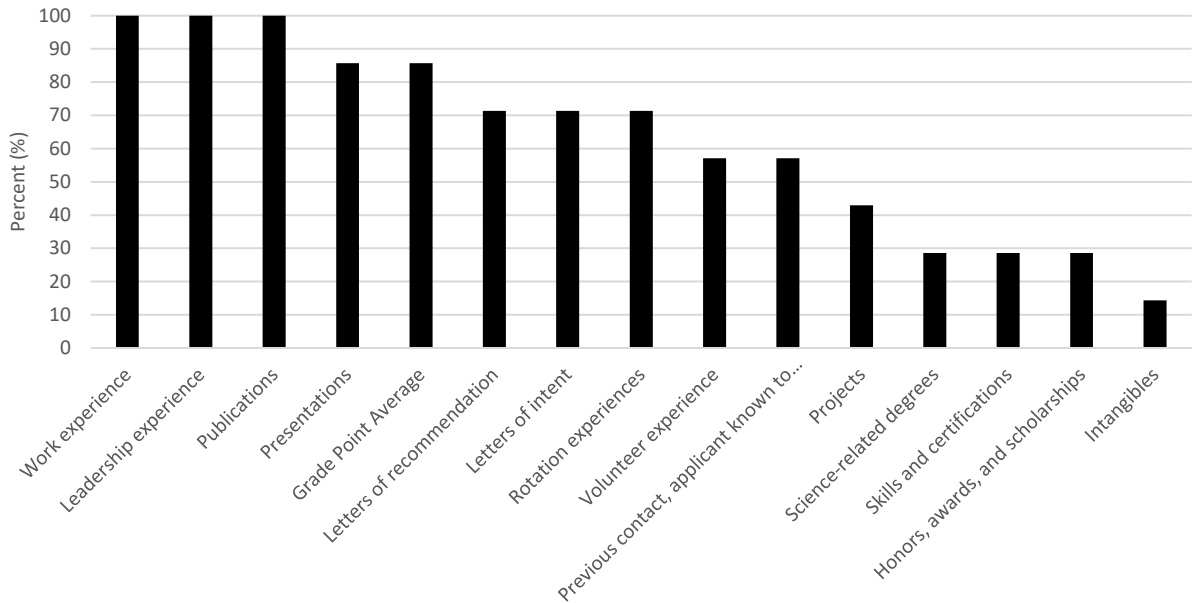


Figure 2: Applicant characteristics evaluated by rubrics

The most highly valued applicant metrics are displayed as a sum of the cumulative weight each metric held on the individual rubrics. The two most highly valued metrics, letters of recommendation (LOR) and work experience, are highlighted to show the individual weights on each rubric. LOR demonstrate high variability as shown by their exclusion from sites two and three, whereas work is more consistently considered on each site. APPE = Advanced Pharmacy Practice Experience, LOI = Letter of Intent, GPA = Grade Point Average.

The overall mean normalised score was also delineated for each candidate, which showed significant differences ($p < 0.001$). As might be expected, the strongest and weakest applicants were consistently scored at the top (94.22) and bottom (39.38,

respectively) of the cohort (candidates 6 and 52). However, the rubrics generated drastically different scores for individual applicants, where some applicants had a range of scores > 50 points (Figure 3).

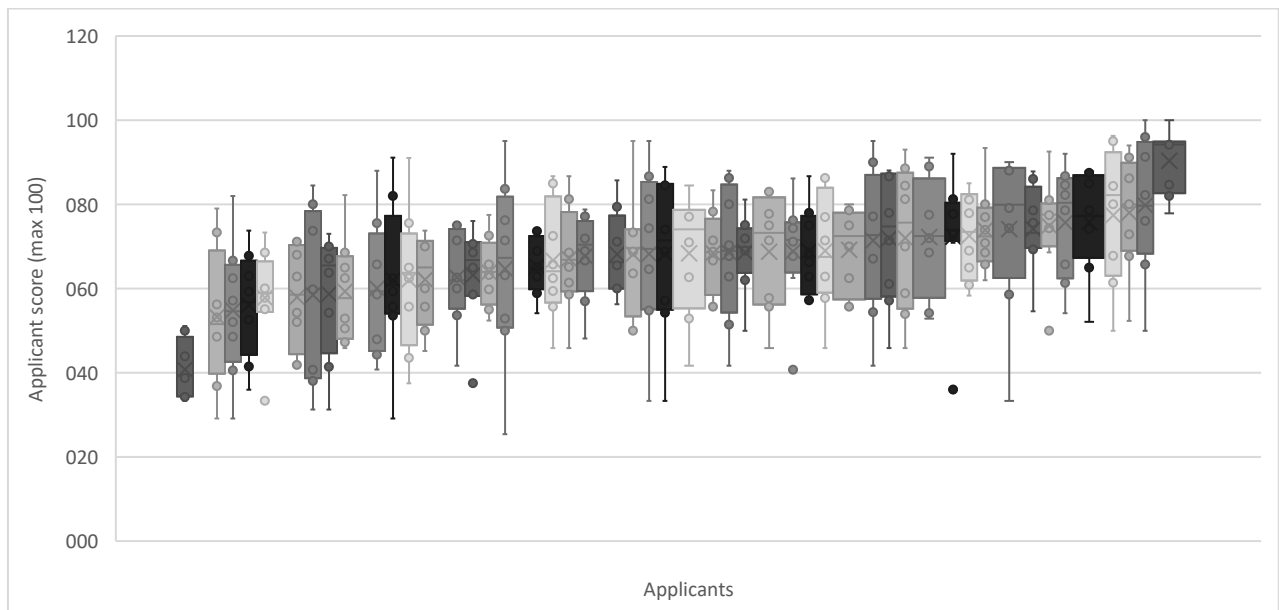


Figure 3: A box and whisker plot of the scores of each application across the different rubrics

Candidates 6 and 52 had lower standard deviations (7.74, 6.97 respectively) than the overall mean standard deviation (15.60), predominantly because of the consistency in scoring on sites three and seven rubrics that was not seen for other candidates.

There were 190 application scores available for comparison of inter-rater variability. Rubrics two and six had the most consistent scores, only differing by 3.5 - 4 points (Figure 4). All other sites had scores differing

by closer to six points between the two evaluators. While this was an exploratory aim and only incorporated a fraction of the entire sample, it suggests that experienced application evaluators can review and score the same applicants and have some relative agreement on scoring. For all 520 application scores, the overall mean time spent grading was 12.4 minutes (SD 10.3) per application. Site 7 required the longest time to score, with a mean of 27 minutes (SD 19) per application (Figure 4).

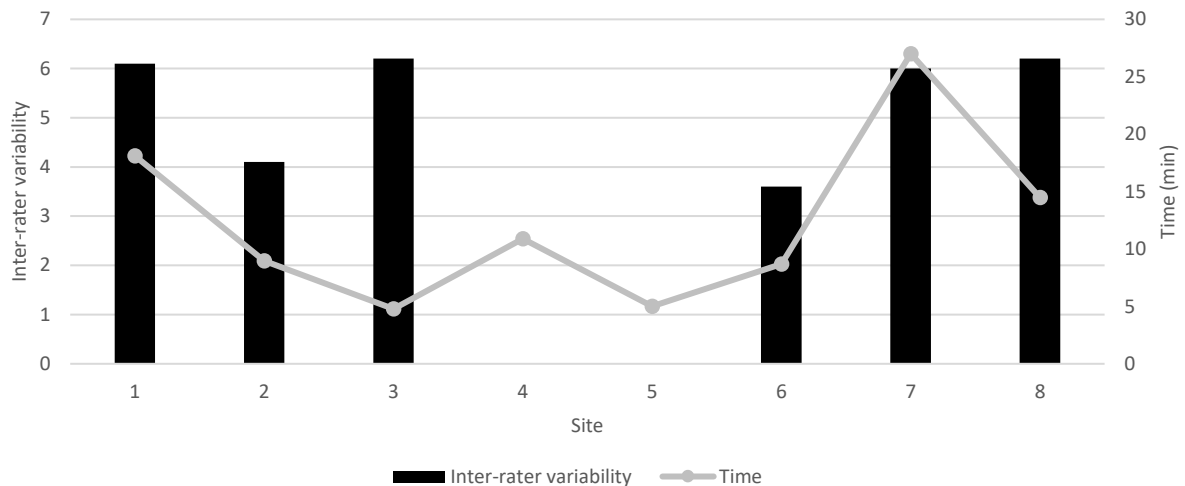


Figure 4: Inter-rater variability and time needed to complete each rubric

Rubric 4 was the reference value, so variability was stated as zero. Rubric 6 was excluded because a traditional score could not be generated by the variability evaluators.

Sites 3 and 5 were the quickest, with time to score averaging around five minutes per application. Anecdotally, the evaluators remarked that the more frequently they used a specific rubric, the less time was required, indicating that practical advantage of having more experienced application evaluators at a given residency site.

There were 13 applicants from the sample that participated in some form of LAPPE. Nine out of these thirteen candidates were scored above the mean score of all applicants in the sample. This demonstrates likely favourable scoring by participation in these programmes, but is only a small subgroup analysis. Only one rubric awarded points specifically for LAPPE participation.

None of the candidates in the sample had a pass-fail grading system, so more investigation on the potential influence of pass/fail grading systems in residency application evaluation is needed. Applicant and programme geography were also noted. Most applicants attended pharmacy school in either the

Southeast or the Midwest. All major geographic regions were represented (N = 19 Southeast; N = 15 Midwest; N = 7 Northeast; N = 5 West; and N = 4 Southwest) by applicants in the sample. The residency programmes included were mostly concentrated in the Southeast, although all regions except for the Southwest were represented (N = 4 Southeast; N = 2 Midwest; N = 1 Northeast; N = 1 West; N = 0 Southwest).

Discussion

This study evaluated fifty different PGY1 residency applications using eight unique rubrics from different residency programmes across the United States. Overall, there were commonalities amongst the characteristics included in each rubric. Aspects such as experiences in the workplace, on rotation, and in leadership positions were considered in each rubric. Other factors, such as letters of recommendation, were highly weighted when considered, but were not included in all of the rubrics in

this study. From a programme standpoint, the differences in what is included and how aspects are weighted are emblematic of each programme's uniqueness and priorities. The differences that make each programme special may also play a role in selecting the next class of residents. From an applicant standpoint, this data underscores the importance of having an understanding of what each programme values and whether this aligns with their own values. This may help applicants better understand how their application may fare in the evaluation process at each individual programme.

Scoring across the rubrics exhibited significant variability. In general, stronger applicants (with more achievements, a broader range of activities and leadership) scored points in nearly all of the rubric aspects and consistently performed well on each of the rubrics. Conversely, applicants who would generally be viewed as weaker "on paper" consistently performed poorly on each of the rubrics. The most variability was seen in the large group of applicants who constituted "the middle". The various rubrics included some aspects, not others; and those aspects included were often weighted differently, so applicants with perceived strengths in certain areas were scored higher by some rubrics and not others. The same applicant may be scored lower by other rubrics, creating a natural 'rank list' feel to the distribution of the applicants in the middle. For example, a student with a poster and a publication may be highly rated by some rubrics (which place more weight on scholarship), whereas other programmes may not value such productivity when it comes to evaluating them for residency training at their site.

Rubric "performance" was addressed in two different ways. First, rubrics 2 and 6 exhibited the lowest variability in scoring, suggesting these are perhaps the most consistent among users. This could be due to a number of factors related to scoring criteria being well-defined, minimising subjective assessments, or maximising objective factors such as GPA or the quantity of scholarly output. Minimising variability in scoring is important so that when the rubric is used across a diverse preceptor and resident pool, some modicum of consistency is maintained. Second was the time required to review each applicant. Rubrics that require a great deal of detail or digging within the application or CV can slow down the reviewer. Since most residents and preceptors are already lacking in free time at work, it seems advisable to make the application review process the most streamlined and efficient as possible. A practical suggestion is to have aspects clearly defined in the rubric and ordered in such a way to mirror how the application is downloaded from PhORCAS (to limit the amount of scrolling to find specific details).

The present study is in keeping with previous publications on the residency application process and factors related to success in obtaining an interview or matching with a residency programme. Previous surveys attempting to identify key aspects of application rubrics or what programmes value in applicants indicated that factors such as the perception of the applicants' ability to learn, a positive recommendation from a colleague in pharmacy practice, previous work experience, excellent pharmacy school grades, leadership positions, rotation experiences, scholarly output, and awards lead to success in obtaining an interview (Jellinek-Cohen *et al.*, 2012; Ensor *et al.*, 2013; Gohlke *et al.*, 2014). Other factors, such as prior degrees, the candidate's letter of intent, and the impression garnered from the letters of recommendation, have also been identified by surveys as important for application success (Macias-Moriarity *et al.*, 2015; Cho, 2018; Hu *et al.*, 2019; Skrupky *et al.*, 2021). These various factors were included in the rubrics evaluated in this study, providing concrete confirmation that these factors are important in application evaluation, though some rubrics did not include every factor.

One interesting aspect of our study was that, while many of the aforementioned characteristics were evaluated in most rubrics, two of the rubrics did not evaluate letters of recommendation and letters of intent in the primary screening. These programmes reviewed the LOI and LOR outside of the formal rubric when determining the interview and rank list. Interestingly, three out of five rubrics evaluated the narrative comments on the LOR, while the other two exclusively scored based on overall rating and characteristics as designated in the reference in PhORCAS (Atyia *et al.*, 2020). Outside of this, there was relative consistency with most, if not all, rubrics, including leadership experience, work experience, publications, presentations, and GPA. This corroborates previous literature surveying programme directors on their preferences for the ideal candidate (Blake *et al.*, 2015; Pate *et al.*, 2023; Warfield *et al.*, 2024). The area where the programmes differed most was more in how they weighted each individual component, as some placed high emphasis on certain aspects while others may have valued it far less (Figure 2). Because the number of residency positions and competition remains high, programme directors and others associated with programmes will still have to go through this time-consuming process and find ways to optimise their candidate selection for interview invitation and rank lists. Of note is the decline in residency applicants over the last several years (National Matching Services, 2024). This factor further amplifies the need to have a rubric that performs well in identifying applicants who are right for the programme.

While the scores tended to be lower on sites three and seven, this is largely attributed to different metrics evaluated and different weights or emphasis placed on those metrics. There was no evidence that these differences emerged solely based on different evaluators. In fact, low inter-rater variability was observed, with a mean six percent score differential between the two evaluators. The concern for inter-rater variability may cause hesitancy for involving more people, which could increase subjectivity, bias, and inefficiency in the evaluation process. While the impact of different evaluators and rubric subjectivity should not be discounted, our observation of minimal inter-rater score variability can provide reassurance that rubrics can be made to be reproducible, particularly in a cohort of experienced application evaluators.

Anecdotally, those involved with the pharmacy residency programme recruitment process have observed potential problems with rubrics. The main issue revolves around a high amount of score compression that has been observed, where the absolute top and bottom candidates may be easy to identify, but those in the middle are much harder to differentiate from one another when utilising the rubric. This differentiation is vital as there is little value to the rubric if it cannot adequately distinguish which candidates to invite for an interview. The use of supplementary essay questions, targeted areas upon which recommenders should focus their narrative, and specific thresholds for GPA, publications, or work experience are all examples of strategies programmes can employ to begin to dissect the 'middle group' of applicants that are often difficult to separate.

The main limitation of this study is that there was only a select sample of applicants investigated from a specific application year, and all applicants applied to the same site. The site they applied to is a large, academic medical centre and therefore certain aspects of the programme may have attracted different applicant characteristics or priorities than those who may seek a different setting, like a community pharmacy, a community hospital, or a Veterans Affairs Medical Centre. A larger, more diverse data set would likely have better illustrated the variability across the application rubrics. Broader representation of different types of residency programmes in different areas of the country could have been beneficial to increase diversity in the analysis of the rubrics. Again, this would likely have resulted in a better illustration of variability across the rubrics, given the numerous individual peculiarities seen in the current cohort. Furthermore, international residency programmes may have a different focus for their learners than what is typical in the United States. Pharmacy training across the globe exhibits tremendous variety with regard to early clinical exposure for

students, which may shift how international residency programmes may prioritise specific aspects of a residency application.

Other limitations included the measurement of time for each rubric evaluation. This may not be reflective of the time and familiarity one might expect from a seasoned application evaluator who has been using the same rubric year after year. Much of the grading associated with the project was dependent on the interpretation of the rubric by the grader. Most of the baseline scores obtained were completed by representatives of the programme, so they were most familiar with their own rubric; however, for the additional scores to determine inter-rater variability, the rubric could have been misinterpreted or interpreted differently than by the other individual most familiar with it. A standard operating procedure was created and shared amongst the group to mitigate these risks. Finally, our investigator group was also interested in evaluating candidate participation in LAPPE programmes and the pass/fail grading schema. These two factors are emerging in the residency landscape and may be aspects that continue to grow in importance and influence how candidates are perceived in the future. The current cohort of applicants did not have a sufficient sample size to have an accurate evaluation of these factors.

Conclusion

There is a significant amount of variability in application scores amongst various PGY1 pharmacy residency programmes based on programme-specific rubrics. This is a valuable depiction of how programmes may personalise their rubrics to make their recruitment process as efficient and site-specific as possible based on applicant metrics and characteristics that the programme most highly values. Additionally, while those involved in the application review process can still be kept to a smaller group, it could be efficient to allow more people to be involved, as inter-rater variability was low, even for those who were initially unfamiliar with the rubric. The higher-than-average scores for most students involved in LAPPE programmes may serve to promote pharmacy schools to increase participation in these longitudinal experiences. Overall, applicants should understand that their application may be evaluated differently across various programmes, as each individual programme may vary in how it values application aspects based on the strengths and priorities of its residency programme and institution. The comparison of relative weights of various aspects of the residency application from real application review rubrics is

unique and also should provide perspective to applicants on the diversity of application review.

Conflict of interest

The authors declare no conflict of interest.

Source of funding

The authors did not receive any funding.

References

- ASHP. (2023). *ASHP accreditation standards for postgraduate pharmacy residency programs*. Retrieved September 7 from <https://www.ashp.org/-/media/assets/professional-development/residencies/docs/examples/ASHP-Accreditation-Standard-for-Postgraduate-Residency-Programs-effective-July-2023.pdf>
- Atyia, S. A., Paloucek, F. P., Butts, A. R., Oyler, D. R., Martin, C. A., Schadler, A. D., & Cook, A. M. (2020). Impact of PhORCAS references on overall application score for postgraduate year 1 pharmacy residency candidates. *American Journal of Health-System Pharmacy*, *77*(15), 1237–1242. <https://doi.org/10.1093/ajhp/zxaa152>
- Bewick, V., Cheek, L., & Ball, J. (2004). Statistics review 9: One-way analysis of variance. *Critical Care (London, England)*, *8*(2), 130–136. <https://doi.org/10.1186/cc2836>
- Blake, E. W., Friesner, D., Gettig, J. P., Hajjar, E., Gentry, E. J., & Kline, J. M. (2015). Comparing pharmacy practice faculty perceptions of first-year post-graduate residency (PGY1) selection criteria to those reported by PGY1 residency directors. *Currents in Pharmacy Teaching and Learning*, *7*, 20–28.
- Cho, J. C. (2018). Selecting candidates for pharmacy residencies: A national survey of residency programme directors. *Journal of Clinical Pharmacy and Therapeutics*, *43*(6), 844–848. <https://doi.org/10.1111/jcpt.12723>
- Crane, J. T., & Ferraro, C. M. (2000). Selection criteria for emergency medicine residency applicants. *Academic Emergency Medicine*, *7*(1), 54–60. <https://doi.org/10.1111/j.1553-2712.2000.tb01892.x>
- Cullen, M. W., Reed, D. A., Halvorsen, A. J., Wittich, C. M., Kreuziger, L. M., Keddiss, M. T., McDonald, F. S., & Beckman, T. J. (2011). Selection criteria for internal medicine residency applicants and professionalism ratings during internship. *Mayo Clinic Proceedings*, *86*(3), 197–202. <https://doi.org/10.4065/mcp.2010.0655>
- DeLisa, J. A., Jain, S. S., & Campagnolo, D. I. (1994). Factors used by physical medicine and rehabilitation residency training directors to select their residents. *American Journal of Physical Medicine & Rehabilitation*, *73*(3), 152–156. <https://doi.org/10.1097/00002060-199406000-00002>
- Ensor, C. R., Walker, C. L., Rider, S. K., Clemente, E. U., Ashby, D. M., & Shermock, K. M. (2013). Streamlining the process for initial review of pharmacy residency applications: an analytic approach. *American Journal of Health-System Pharmacy*, *70*(19), 1670–1675. <https://doi.org/10.2146/ajhp120769>
- Gohlke, A. L., Ray, D. B., El-Ibiary, S. Y., & Barletta, J. F. (2014). Characteristics of the ideal postgraduate year 1 pharmacy practice residency candidate: A survey of residency programme directors. *Journal of Pharmacy Practice*, *27*(1), 84–88. <https://doi.org/10.1177/0897190013504962>
- Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, *42*(2), 377–381. <https://doi.org/10.1016/j.jbi.2008.08.010>
- Hillebrand, K., Leinum, C. J., Desai, S., Pettit, N. N., & Fuller, P. D. (2015). Residency application screening tools: A survey of academic medical centers. *American Journal of Health-System Pharmacy*, *72*(11 Suppl 1), S16–19. <https://doi.org/10.2146/ajhp150093>
- Hu, D., Veenhouwer, D., McCoy, J., & Caselnova, D. A., 3rd. (2019). A screening tool to identify qualified pharmacy residency candidates. *American Journal of Pharmaceutical Education*, *83*(4), 6714. <https://doi.org/10.5688/ajpe6714>
- Jellinek-Cohen, S. P., Cohen, V., Bucher, K. L., & Likourezos, A. (2012). Factors used by pharmacy residency programmes to select residents. *American Journal of Health-System Pharmacy*, *69*(13), 1105–1106, 1108. <https://doi.org/10.2146/ajhp100615>
- Macias-Moriarity, L. Z., Fetterman, J. W., Thomas, M. C., & Stajich, G. V. (2015). Residency programme director's perception of PGY-1 applicants: Results of the National 35½ Second Survey. *Currents in Pharmacy Teaching and Learning*, *7*(4), 465–469. <https://doi.org/https://doi.org/10.1016/j.cptl.2015.04.009>
- National Matching Services, I. (2024, March 2024). *ASHP match statistics*. Retrieved March 26 from <https://natmatch.com/ashprmp/stats.html>
- Pate, A. N., Mills, A. R., Fleming, J. W., Phan, H. K., Street, M., & Pitcock, J. J. (2023). Residency application content and considerations based on residency director review of a fictitious CV: What really matters? *American Journal of Health-System Pharmacy*, *80*(17), 1147–1156. <https://doi.org/10.1093/ajhp/zxad068>
- Poirier, M. P., & Pruitt, C. W. (2003). Factors used by pediatric emergency medicine programme directors to select their fellows. *Pediatric Emergency Care*, *19*(3), 157–161. <https://doi.org/10.1097/01.pec.0000081236.98249.ed>
- Reed, B. N. (2021). Rethinking letters of reference: Narrowing the gap between evidence and practice. *American Journal of Health-System Pharmacy*, *78*(23), 2175–2179. <https://doi.org/10.1093/ajhp/zxab243>

Reed, B. N., Noel, Z. R., Heil, E. L., Shipper, A. G., & Gardner, A. K. (2021). Surveying the selection landscape: A systematic review of processes for selecting postgraduate year 1 pharmacy residents and key implications. *Journal of the American College of Clinical Pharmacy*, *4*(2), 245–256. <https://doi.org/10.1002/jac5.1334>

Skrupky, L. P., Dy-Boarman, E. A., Gurgle, H. E., Isaacs, A. N., McCreary, E. K., Nisly, S. A., Paloucek, F., Peterson, D. M., Smith, A., Schramm, G. E., Education, T., Practice, T., & Network, R. (2021). Letters of reference for PGY1 pharmacy residency candidates: A survey of residency programme directors and opinion statement. *Journal of the American College of Clinical Pharmacy*, *4*(3), 379–389. <https://doi.org/https://doi.org/10.1002/jac5.1370>

Warfield, M. N., Nei, S. D., Cole, K. C., & Krauter, A. K. (2024). Assessment of postgraduate Year 1 residency programme director preferences and priorities in evaluation of pharmacy residency candidates. *American Journal of Pharmaceutical Education*, *88*(12), 101323. <https://doi.org/10.1016/j.ajpe.2024.101323>