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RESEARCH ARTICLE

REVISED A cross-sectional study of the use and effectiveness of the Individual Development Plan among doctoral students [version 2; referees: 2 approved, 1 approved with reservations]

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Abstract

Background: The Individual Development Plan (IDP) was introduced as a tool to aid in career planning for doctoral trainees. Despite the National Institutes of Health and academic institutions creating policies that mandate the use of IDPs, little information exists regarding the use and effectiveness of the career planning tool.
Methods: We conducted a multi-institutional, online survey to measure IDP use and effectiveness. The survey was distributed to potential respondents via social media and direct email. IDP survey questions were formatted using a five-point Likert scale (strongly agree, agree, neutral, disagree and strongly disagree). For data analysis purposes, responses were grouped into two categories (agree versus does not agree/disagree). The data were summarized as one-way frequencies and the Pearson chi-square test was used to determine the statistical significance of univariate associations between the survey variables and an outcome measure of the effectiveness of the IDP.
Results: Among all respondents, fifty-three percent reported that they are required to complete an IDP while thirty-three percent reported that the tool is helpful to their career development. Further, our data suggests that the IDP is most effective when doctoral students complete the tool with faculty mentors with whom they have a positive relationship. Respondents who are confident about their career plans and who take advantage of career development resources at their institution are also more likely to perceive that the IDP is useful for their career development.
Conclusion: Given the nuanced use and effectiveness of the IDP, we call for additional research to characterize the overall use and effectiveness of the IDP and to determine whether there are unintended negative consequences created through the use of the tool. Furthermore, we recommend an enhancement of career development infrastructure that would include mentorship training for faculty in order to provide substantially more career planning support to trainees.

Open Peer Review

Referee Status: ✔ ? ✔

	Invited Referees 1	2	3
REVISED **version 2** published 05 Jul 2018	✔ report	? report	✔ report
version 1 published 11 Jun 2018	✘ report	? report	? report

1 **Christopher L. Pickett**, Rescuing Biomedical Research, USA

2 **Jessica K. Polka**, Whitehead Institute, USA

3 **Zeba Wunderlich**, University of California, Irvine, USA

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Comments (0)

Keywords
biomedical research, career development, career planning, doctoral students, individual development plans, PhD training

This article is included in the Science Policy Research gateway.

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Author roles: Vanderford NL: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Supervision, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Evans TM**: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Supervision, Writing – Review & Editing; **Weiss LT**: Data Curation, Formal Analysis, Investigation, Methodology, Software, Writing – Review & Editing; **Bira L**: Conceptualization, Investigation, Writing – Review & Editing; **Beltran-Gastelum J**: Investigation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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First published: 11 Jun 2018, **7**:722 (doi: 10.12688/f1000research.15154.1)

REVISED **Amendments from Version 1**

In response to the reviewers' critiques, we have made several changes to the article of which the most substantial are: 1) we have revised the IDP effectiveness analysis to focus only on those respondents that completed an IDP; 2) we have added a description of the study's limitations that speaks to several of the reviewers' critiques/comments; and 3) we have neutralized the tone of the article. We have uploaded a new Figure 2 and new Supplementary File 2 and Supplementary File 3. We have also responded to each reviewers' report.

See referee reports

Introduction

The spotlight is bright today on the sustainability of the biomedical enterprise, especially regarding the support and general career outcomes of early career investigators and trainees[1–3]. There is a significant supply of PhDs and a weak market demand for faculty positions, and the majority of doctoral trainees are moving into non-faculty positions in academia, industry, government agencies, or entrepreneurship[4,5]. Greater career development support has been suggested by many as a key area of need to better support PhDs entering into this diverse workforce[6].

In 2002, the U.S. Federation of American Societies for Experimental Biology created the Individual Development Plan (IDP) as a multi-component career planning worksheet that guides doctoral trainees through a self-assessment of skills, provides a platform for the exploration of scientific career paths, aids in the development of short- and long-term career goals, and prompts the creation of action plans to achieve those goals[7]. In 2012, *Science Careers* launched a free online version of the IDP called myIDP[8]. In 2014, following the recommendation of the National Institutes of Health (NIH)'s Biomedical Research Workforce Working Group, the NIH implemented a policy requiring the reporting of IDP use by graduate students and postdoctoral researchers in grant progress reports[9]. Subsequently, many academic institutions have instituted policies dictating the use of the IDP for PhD trainees. Despite these policy implementations, studies investigating the use and effectiveness of the IDP have been limited to one report that was published in 2014, which studied 233 current postdoctoral researchers, 27 former postdoctoral researchers, and 337 mentors. This study demonstrated the low use of the IDP among postdoctoral researchers (19%) and their mentors (9%), but the perceived value of the instrument was high for those who had used the tool (71% for postdoctoral researchers and 90% for mentors)[10]. There have been recent calls to study the IDP more closely and for the NIH and other stakeholders to share the data collected on its use[11].

Herein, we describe the assessment of the use and effectiveness of the IDP among a sample of U.S. doctoral students. We surveyed doctoral students from at least 98 different U.S. universities in the spring and early summer of 2016 (March through June). We collected data from 663 respondents in PhD programs in the life/biological/medical (76.5%) or physical/applied sciences (23.5%), with the majority of respondents being female (70.9%) compared to their male (29.1%) counterparts (Supplementary File 1 and Supplementary File 2). We report that approximately half (53.6%) of the respondents are required to use the IDP while about one third (33.7%) report that the tool is helpful to their career development. Further, our results suggest that the IDP is most effective when graduate students complete the tool with faculty mentors with whom they have a positive relationship. Confidence regarding career plans and use of institutional career development resources are also associated with respondents being more likely to indicate that the IDP is helpful to their career development.

Methods

Human subjects

This research was approved by the University of Kentucky (protocol 15-1080-P2H) and University of Texas Health San Antonio (protocol HSC20160025X) institutional review boards as a component of a health and wellbeing study. Respondents read a cover page and consented to the study by clicking the online survey web link. Subjects responded anonymously and were ensured of confidentiality.

Survey methodology

The survey was conducted online using the secure web application REDCap. The survey was distributed to potential respondents through social media (primarily Twitter and LinkedIn) and direct email to subjects enrolled in life/biological/medical or physical/applied sciences doctoral programs across a number of different U.S. institutions (Supplementary File 1). Eligibility criteria included being currently enrolled in a life/biological/medical or physical/applied sciences doctoral program at a U.S. institution at the time the survey was conducted. Responses were collected over a three-month period, March 2016 to June 2016. The overall study sample size was dictated by the number of respondents fitting the eligibility criteria.

Data analysis and statistical methods

Subjects were asked to respond to the IDP questions using the five-point Likert scale strongly agree, agree, neutral, disagree and strongly disagree. For data analysis, strongly agree and agree responses were grouped together as an agree category and neutral, disagree, and strongly disagree were grouped together in a does not agree/disagree category. The survey questions relevant to this study are included as Supplementary File 4.

One-way frequencies for all respondents were calculated across all of the survey variables (Supplementary File 2). To obtain a measure of IDP effectiveness, the Pearson chi-square test was used to assess the univariate association between all the survey variables and the outcome "I Find the IDP Process Helpful to my Career Development" only among the subset of respondents who completed an IDP (that is, those respondents who agreed with question 2 or 3 within the survey) (Supplementary File 3).

All summaries and statistical analysis were performed in SAS 9.4.

Limitations

There are a number of limitations associated with this analysis. First, this is a cross-sectional study of a convenience sample and the results may not be generalizable. For instance, the IDP use and effectiveness rates reported herein may not be representative of those across all types of trainees within the U.S. research enterprise. As a cross-sectional study that was conducted through the use of an online survey that was deployed by email and through social media, there may be some level of subject selection bias that could lead to data and outcome bias. Additionally, since the design of the study was aimed at understanding the general use and overall effectiveness of the IDP, there may be other, perhaps more specific, nuances that may not be captured by this analysis. The data was also captured over a short period of time, and thus, respondents' experience with the IDP outside of this timeframe may not have been captured. Some disciplines (for example, biomedical versus physical science) may also place different levels of emphasis on IDP use, and likewise, policies surrounding IDP use may vary across different disciplines. Respondents may not understand their institution's official policies on the use of the IDP. The structure of the IDP worksheet and the procedures by which institutions enforce or recommend its use also likely vary across and perhaps even within institutions and this may influence the tools use and effectiveness even within a single institution. Lastly, the outcome measure used herein to understand the effectiveness of the IDP is subjective and is only one measure that may assess how impactful the IDP is on trainees' career development. Future studies should analyze more defined measures of IDP outcomes including those that would allow for an understanding of the tool's impact on academic and professional success (for example, planning that leads to research output) and career planning and decision making. Despite this study's limitations, this is the first investigation of IDP use and effectiveness in the doctoral student population and thus this work provides a baseline understanding of the IDP in this population and it should promote additional research on the topic.

Results

IDP use

Overall usage rates of the IDP among all the survey respondents was 53.6%, while 37.4% reported completing the IDP with their faculty advisor. Interestingly, 26.1% reported that they have, at some point, completed the tool but have not discussed it with their advisor. Further, 33.6% of respondents feel that they can have an honest conversation with their advisor via the IDP process and 33.7% feel that the IDP is helpful to their career development (Figure 1 and Supplementary File 2). In the 2014 study, only 8% of postdoctoral researchers were required to complete an IDP, although overall usage among respondents was approximately 19%, and the perceived value of the tool was 71% among the postdoctoral researchers that had used the tool[10].

IDP effectiveness

To gain an understanding of the effectiveness of the IDP, we analyzed the univariate association between all the survey variables and the outcome "I Find the IDP Process Helpful to my Career Development" only among the subset of respondents who completed an IDP (Supplementary File 3). Across several measures, positive mentorship relationships associate with the effectiveness of the IDP. For example, 66.7% of those respondents who indicated that they could have an honest conversation with their PI/advisor via the IDP process versus 34.9% who could not do so found the IDP helpful to their career development ($p < 0.0001$). Likewise, 53.1% of those who reported that their PI/advisor is an asset to their academic and professional career versus 42.7% of those who did not agree with this statement found the IDP process helpful ($p < 0.05$). And, 59.9% of those who said their PI/advisor positively

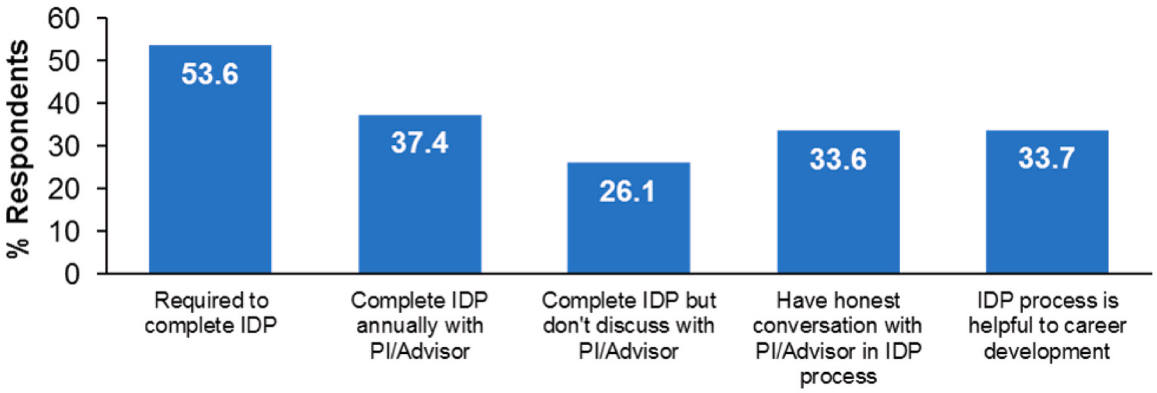

Figure 1. The rates of Individual Development Plan use among doctoral students. One-way frequencies for all survey respondents are shown for the variables measuring whether respondents are required to complete an IDP, complete an IDP annually with their PI/advisor, complete an IDP but do not discuss it with their PI/advisor, can have an honest conversation with the PI/advisor in context of the IDP, and whether the IDP process is helpful to their career development. One-way frequencies for all other survey variables can be found in Supplementary File 2.

impacts their emotional or mental wellbeing versus 41.9% of those who did not agree ($p < 0.01$) found the IDP to be helpful (Figure 2 and Supplementary File 3). These data corroborate anecdotal testimonies suggesting that supportive mentors can positively influence one's IDP experience whereas non-supportive mentors can have the opposite impact[12].

Further, 57.1% of those respondents that are confident about their career prospects versus 46.3% of those who were not ($p < 0.05$) reported the IDP process as being helpful to their career development (Supplementary File 3). Lastly, respondents who attend career development programs at their institution are more likely to report the IDP as helpful to their career development (Supplementary File 3).

Dataset 1. Individual Development Plan survey data

http://dx.doi.org/10.5256/f1000research.15154.d206394

Columns Q1–Q26 correspond to the questions listed in Supplementary File 4.

Discussion

More than 15 years after the creation of the IDP and 4 years after the NIH required its use, do we know if the tool is working as it was intended? Unfortunately, the answer is no. The study focusing on postdoctoral researchers from 2014[10] and the current study cannot fully answer this question, but rather these studies should serve to elicit further discussion on how to best use the IDP, especially in relation to the enforcement of the tool's use and its use with PIs/advisors. Further, this work should stimulate additional research on the general use and effectiveness of the tool.

Should policymakers, leaders of academic institutions, individual faculty, career development specialists, and even trainees find it concerning that IDP use and effectiveness is not well understood despite the tool's general acceptance and use at countless U.S. universities and the NIH's requirement for reporting on the use of the IDP? Should we not have known more about such an instrument prior to it being mandated as a policy? Is there potential harm being done by the mandated use of IDPs? Anecdotally, some doctoral students and postdoctoral researchers report that faculty sometimes reject non-academic career trajectories within the context of the IDP and these faculty try to force trainees toward an academic career path[12]. Such mentorship relationships may partially explain the cause of the high rates of anxiety and depression in the doctoral student population[13]. We believe that these questions and issues highlight the need for more work to be done in order to better understand the IDP and its effective use.

We have noticed that the structure of some IDPs has changed over time. For example, the University of Kentucky College of Medicine's IDP has excluded the career exploration section of the tool[14], which was prominently included in its original design. How widespread is such a change to the IDP? Could such a change have been made to appease stakeholders who are most interested in training PhDs to pursue faculty careers? Could such a change be driving a general increase in IDP usage among faculty mentors? These questions should be addressed in future research.

Given the NIH's adoption of the IDP, we believe that the agency should support a more extensive longitudinal study with a larger sample size to understand the barriers that are preventing some trainees and mentors from using the IDP and to better understand the effectiveness of the IDP as doctoral students and postdoctoral researchers move through their PhD education and training experience. The IDP's impact on specific outcomes, including career path decision making and long-term

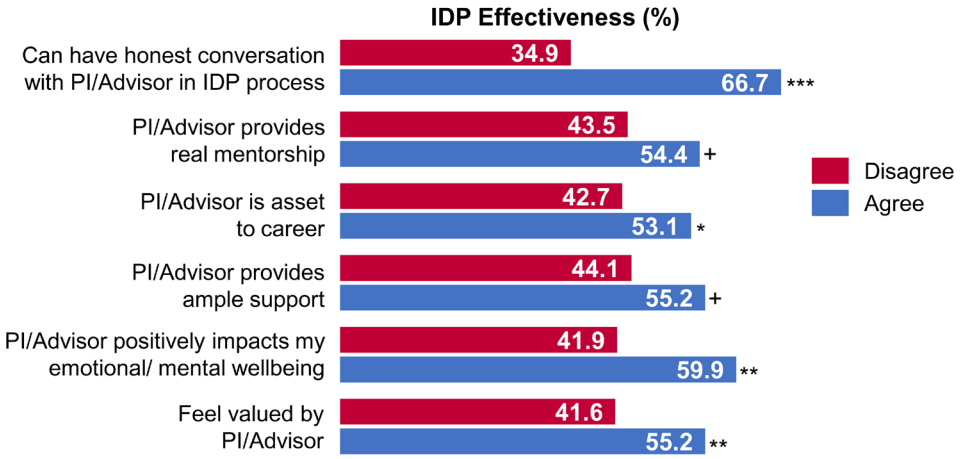

Figure 2. The effectiveness of the Individual Development Plan by advisor/mentor relationship. IDP effectiveness was assessed among the subset of respondents who completed an IDP by determining the univariate associations between the PI/advisor- and trainee-related survey variables and the outcome "I Find the IDP Process Helpful to my Career Development." The Pearson chi-square test was used to measure statistical significance. *** $p < 0.0001$; ** $p < 0.01$; * $p < 0.05$; + $p \leq 0.07$.

career outcomes, should be studied. Future work should also determine if there are any unintended negative consequences associated with IDP use.

Career development support and related infrastructure for PhD trainees has been suggested as a being critical to sustaining the biomedical workforce[6]. Based on our findings that positive mentorship relationships and use of career development programming are associated with a greater likelihood of trainees finding the IDP effective, we call for policymakers, funding agencies, and universities to establish and test new interventions that will support the career development of PhD trainees. For example, our data point to a need to focus attention on mentorship training for faculty and building career development infrastructure. If the NIH is to require the use of the IDP, they should require training of mentors on how to best support the career development of their mentees to obtain maximum impact, and institutional career development infrastructure is needed to achieve this. The NIH BEST program laid the foundation for building career development infrastructure at a limited number of institutions[15]. The National Institute of General Medical Sciences has recently incorporated career development components into their pre-doctoral T32 mechanism[16], which is another good start to developing more widespread career development infrastructure. Other grant mechanisms should likewise be established so that a greater number of institutions can obtain NIH funds that will drive the creation of innovative career development programs across the U.S. Such programs should serve the needs of doctoral students and postdoctoral researchers and train faculty on the fine science and art of mentorship. Programmatic evaluation should be established to test the effectiveness of any interventions put into place and the results should be disseminated.

The NIH and several professional societies have been conducting "Train-the-Trainer" events to provide career and professional development training to faculty and staff. We recommend the extensive expansion of this program and evaluation of its effectiveness. The NIH could mandate such training for all faculty who pay doctoral students or postdoctoral researchers from NIH funds. Generally, it would likewise be prudent for universities to mandate that all faculty employing/supervising graduate students and postdoctoral researchers complete such training. The training could be developed and offered at each university through institutional career development offices. Studies should be developed to test whether such an intervention enhances the career development of trainees.

Ultimately, the sustainability of the biomedical enterprise hinges upon the next generation of PhDs entering the diverse workforce. We should work to support this group of scientists with sufficient career development support at the same level of rigor and reproducibility that we strive for everyday as we conduct our experiments. The IDP is likely useful for supporting the career development of PhDs, but more work is needed to understand how best to use the tool.

Data availability

Dataset 1. Individual Development Plan survey data. Columns Q1–Q26 correspond to the questions listed in Supplementary File 4. DOI: 10.5256/f1000research.15154.d206394[17].

Competing interests

No competing interests were disclosed.

Grant information

N.L.V. is supported by the University of Kentucky's Cancer Center Support Grant (NCI P30CA177558) and the Center for Cancer and Metabolism (NIGMS P20GM121327).

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Acknowledgements

The authors thank the Markey Cancer Center Research Communications Office for graphic design and formatting assistance; Dr. Paula Chambers, Versatile PhD, for her comments on and aid in distributing the study survey; and the Graduate School of Biomedical Sciences at the University of Texas Health San Antonio for providing partial funding for the study.

Supplementary material

Supplementary File 1. Self-reported institution of all respondents.

Click here to access the data.

Supplementary File 2. One-way frequencies of all respondents, separated by demographic characteristics.

Click here to access the data.

Supplementary File 3. Univariate analysis of the survey's variables and the perception of Individual Development Plan helpfulness among respondents who completed an IDP.

Click here to access the data.

Supplementary File 4. Example copy of the survey questions relevant to this study.

Click here to access the data.

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Data Source

Open Peer Review

Current Referee Status: ✔ ? ✔

Version 2

Referee Report 23 July 2018

doi:10.5256/f1000research.16898.r35804

?

Jessica K. Polka
Whitehead Institute, Cambridge, MA, USA

Thanks for your thoughtful response. I appreciate the new analysis and written sections of the article, which greatly improve the work.

The only reason I am not yet selecting "approved" is that I think it is important to resolve the issue Dr. Wunderlich has raised about confusion surrounding the 53% figure.

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Referee Report 10 July 2018

doi:10.5256/f1000research.16898.r35803

✔

Christopher L. Pickett
Rescuing Biomedical Research, Washington, DC, USA

The authors have done a commendable job in responding to reviewers' concerns. The elaboration of methods and reanalysis of data in this version satisfy the points I brought up in my initial review. This work is an important contribution to our understanding of the use of IDPs.

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Referee Report 10 July 2018

doi:10.5256/f1000research.16898.r35802

✔

Zeba Wunderlich
Department of Developmental and Cell Biology, University of California, Irvine, Irvine, CA, USA

Thank you for the response to my comments. I have two minor suggestions:

1. I'm still a little confused by the percentages of IDP use. In the abstract 53% are reported to be required to complete the IDP, and the same number is reported as a usage rate in the first sentence of the results section. Does that mean that 100% of respondents required to complete an IDP did so? And 0% of non-required respondents? Also, 37.4% completed an IDP with their advisor and 26.1% didn't -- that adds up to 63.5%, not 53%. Can you explain this discrepancy?

2. At the start of the IDP effectiveness section, can you state what fraction of those that complete an IDP find it effective? It may be useful to put this in the abstract as well, as a point of comparison to the 33% of all respondents that find it useful.

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Referee Report 27 June 2018

doi:10.5256/f1000research.16508.r35352

Zeba Wunderlich
Department of Developmental and Cell Biology, University of California, Irvine, Irvine, CA, USA

In this article, Vanderford, et al. examine the patterns of Individual Development Plans (IDP) usage and perceptions among biology and physics graduate students at U.S. universities. Given the increasing numbers of institutions that require IDPs for graduate students, the research questions posed in this article are timely and of potentially high impact. I recommend the following changes to the article:

1. I strongly agree with the other reviewers that a key modification is to re-do the analysis, only considering those students who have experience completing an IDP, or to clarify if the study already followed this protocol.

2. How do the demographic data (gender, race, ethnicity) compare with the eligible survey population? If the data differ from the eligible population, do you expect this to affect the results? It might be appropriate to add a brief section to the beginning of the results section describing the demographics of the data and a comment to the discussion about the caveats of an opt-in survey. (I believe this is what you are hinting at in the paragraph starting "We recognize that there are limitations..." but it could be stated more explicitly.)

3. As the first reviewer, I did not always understand the denominators of the stated percentages. For example, do 37.4% of all respondents fill out an IDP with their advisor? Or 37.4% of those that are required to complete an IDP do so with their advisor? Please review the results section to clarify

this and similar statements. Also, what fraction of students required to complete an IDP actually do it? And what fraction of students not required to complete an IDP do it?

4. (Minor) The word "only" is used many times throughout the results section, which colors the interpretation of the results. I'd suggest keeping the results section more neutral, while saving the "only" statements for the discussion.

5. (Minor) It might be worth noting that there is a two year gap in the 2014 postdoctoral study and the current study, so some of the increase in IDP usage may be due to an increase in usage over time.

6. (Minor) What are the p-values of the reported differences in IDP effectiveness between males/females, physics/biology students? I found these in the Supplement, but they are worth mentioning in the main text or depicting on the figures/figure legends.

7. (Minor) I appreciate the paragraph in the discussion about the changes to IDP structure. It may be worth commenting on the differences of IDP structure between institutions or individuals. My own experience with IDPs (Vincent, et al. 2015 Molecular Cell) didn't use the myIDP platform and may have influenced my perception of IDPs. I suspect I'm not alone.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 05 Jul 2018

Nathan Vanderford, University of Kentucky, USA

Dear Dr. Wunderlich,

We greatly appreciate your review, which has aided in shaping our revised article. We have responded to your major critiques/comments below.

In response to your critique and that of the other reviewers, we have reanalyzed the IDP effectiveness data to include only those respondents that completed an IDP. We have revised the text and figures accordingly. Of note, upon this reanalysis, the differences in IDP effectiveness between fields of study and gender were no longer significant.

Given that our study was based on an online survey that was conducted, in part, through an open call on social media, we have no way of knowing the demographic makeup of the all the potential respondents. That said, we have characterized the demographic makeup of all the actual respondents (see Supplementary File 1 and 2). We agree that there are caveats to our methods and thus we have added an extensive description of the limitations to this work within the methods section of the article.

We apologize that there was confusion regarding the denominator used in our analysis. We have now clarified which respondents were used in the analysis. Namely, in the analysis of IDP use, one-way frequencies were calculated based on the responses from all the respondents. In the analysis of IDP effectiveness, again, we have reanalyzed our data and now present univariate associations that were calculated based on the responses from only the subset of respondents that completed an IDP. This has been more clearly stated in the revised version of the article.

We have revised the article such that it is now written in a neural tone; we have removed such words as “only” and “minimal” in relation to describing our own findings. Future work should address what is a reasonable/acceptable level of IDP use and effectiveness.

We appreciate your comments regarding the comparison of our data to the 2014 postdoctoral study. We have revised the text such that we now point out the study, but we do not specifically comment on how the prior data may relate to our findings. Future work should address the current use and effectiveness of the IDP in postdoctoral researchers.

We have now included p-values in the text and in the figure legends were applicable.

We have added comments in our limitations section regarding how differences in IDP structures could influence our data.

In summary, we have revised our article according to your critique/comments and that of the other reviewers, and we feel that the collective reviews have significantly strengthened our work. Thank you for your time and we look forward to reading your next review.

Sincerely,

Nathan L. Vanderford

Competing Interests: No competing interests were disclosed.

Referee Report 25 June 2018

doi:10.5256/f1000research.16508.r34887

Jessica K. Polka
Whitehead Institute, Cambridge, MA, USA

In "A cross-sectional study of the use and effectiveness of the Individual Development Plan among doctoral students," the authors present a survey of graduate students conducted with the intention of determining experience with, and attitudes toward, Individual Development Plans. Given the widespread use of IDPs in the biomedical sciences, this study has the potential to provide insights that could improve the career planning process for many PhD students.

Like reviewer 1, I am concerned that the overly-negative conclusions in this paper are influenced by the inclusion of irrelevant respondent populations. Therefore, in addition to the revisions suggested by reviewer 1, I recommend the following modifications:

1. It is perhaps unsurprising that overall usage of the IDP is low given that only 76.5% of respondents were in the life/biological/medical sciences programs. While it's possible that the 23.5% of respondents in physical/applied sciences are in programs that require or encourage IDP completion, these students are likely unaffected by the NIH mandate mentioned in the introduction. As such, the author should not use this sample to imply that low IDP usage indicates a failure in NIH policy, as suggested by the first two sentences of the discussion.

2. Given the valid concerns that reviewer 1 has expressed, the authors should reanalyze their data to exclude respondents who have no experience with IDPs (assuming that the survey instrument did not do this already). While survey instrument did not address this question directly, the authors could at least take a subset of respondents who answered affirmatively to Q2 or Q3. If my calculations are correct, >50% of this subset finds the IDP process helpful for career development. Therefore, when the analysis is confined to students with confirmed IDP experience, the outlook for the IDP is less bleak than the tone of the paper makes it out to be.

3. The assessment of the value of the IDP should be placed into the context of overall cost of its implementation (which I suspect is extremely low). Assuming that 50% of students that complete it annual benefit from it, this is (in my opinion) a good payoff for a very small number of hours of work for mentors and students. I would be interested to read the author's comments on cost/benefit ratio of this intervention.

4. In the discussion, the authors express concern that the IDP has been implemented without an attending study of the benefits. Later in the same section, they call for widespread career development infrastructure and "extensive" expansion of "Train-the-Trainer" events; to abide by their own logic, they should provide evidence that this change is supported by data. Again, the benefits of these interventions should be placed into the context of their cost.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Not applicable

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 05 Jul 2018

Nathan Vanderford, University of Kentucky, USA

Dear Dr. Polka,

Thank you for your review of our work. Your comments and critique have been critical in guiding our revisions. We respond to your major points below.

We appreciate your thoughtful comments regarding the tone of the first version of this article. We have now revised the article in a way that neutrally presents and describes the data; our use of words such as “only” and “minimal” within the context of our findings have been removed. Additional work will need to be done to understand an appropriate and acceptable level of IDP use and effectiveness in the PhD trainee population.

We have added a limitations subsection (within the methods section) that speaks to several points raised by all the reviewers. Within this section, we provide cautions regarding the generalizability of the data and differences between disciplines.

We have reanalyzed the IDP effectiveness data to focus only on those respondents that completed an IDP. Of note, in relation to the previous comments about generalizability, upon reanalysis of the IDP effectiveness data, the differences between fields and gender are no longer significant and the text and figures have been revised accordingly.

Regarding the cost/benefit ration of the IDP, this is a very interesting and important consideration, but ultimately we feel that our thoughts on this are too speculative to include in the article itself. That said, as stated at the end of the article, we do feel that the IDP can be an effective career planning tool when used “correctly.” However, we believe that more work needs to be done to assess the “correct” way to use the IDP, especially in a way that causes no harm to trainees. We believe that it is unacceptable for any trainee to be intimidated by and/or harmed through the use of the IDP, as has been suggested to occur. Ultimately, there is not enough information available on the use of the IDP to fully understand the costs, consequences, and/or benefits of its use.

We have revised the discussion to clarify that our recommendations are based primarily on our own findings and we call for the evaluation of any new interventions that are put into place.

In closing, we look forward to your second review in light of our revisions that are in response to your critiques and that of the other reviewers. We feel that your comments have been critical to the improvement of this work. Thank you again for your time and expertise.

Sincerely,

Nathan L. Vanderford

Competing Interests: No competing interests were disclosed.

Referee Report 21 June 2018

doi:10.5256/f1000research.16508.r34890

Christopher L. Pickett
Rescuing Biomedical Research, Washington, DC, USA

The article "A cross-sectional study of the use and effectiveness of the Individual Development Plan among doctoral students" by Vanderford et al. examines the use of Individual Development Plans among biology and physics graduate students at U.S. universities. Through the use of an opt-in survey advertised on social media, the authors received over 650 responses about the usefulness of IDPs. The goal of the study was to provide information on how widespread the use of IDPs is and how effective they are in helping students explore careers.

Understanding the efficacy of IDPs is important as this is an increasingly important piece of the career and skills development portfolio for grad students. However, I have serious reservations regarding the survey instrument and the interpretation of the resulting data.

- It is not clear from the survey instrument or the methods section that all survey respondents completed an IDP. If respondents have never completed an IDP, their responses to questions about the efficacy of the IDP in Fig. 1 would likely skew the data in an unfavorable direction. The authors should describe whether they ensured that only those who have completed an IDP took the survey.
    - If they did not use this screen, the authors should describe how data from those who haven't completed an IDP might affect their data on IDP efficacy and take this into account when drawing conclusions.
    - If the authors did ensure that all respondents completed an IDP, this information should be clearly stated.
    - In addition, the authors should better define the denominators of the percentages reported. For example, if 33.7% respondents find the IDP helpful, is this 33.7% of those completing the survey or 33.7% of those that completed an IDP?
    - If a student completes multiple IDPs, isn't it possible the student could agree with questions 2 and 3 (complete IDP annually with advisor and complete IDP annually but don't talk to advisor)? Overlap in these populations, as is apparent in the supplemental data spreadsheet provided, could complicate the analysis of the data in Figs. 2 and 3 as it is not clear which experiences respondents may be referencing in their answers to the questions.

    - How are we to think of the values presented here in light of the study referenced that analyzed the use of IDPs among postdocs? If the data here show that more grad students fill out IDPs than postdocs, this may provide insight into how and why different populations use IDPs.

- The negative tone of the article is surprising. The authors rightly point out that the IDP is poorly studied and this survey is one of the first analyzing use by graduate students. Therefore, this study establishes the baseline for IDP use among grad students. If the authors wish to characterize the use of IDPs as low or ineffective, the authors should take time to discuss their expectations and what previous data/experiences were used to set those expectations.
    - For example, the overuse of "only" in the first paragraph of the results communicates these values fall below the authors' expectations. Recognizing that these values will likely never reach 100%, what constitutes broad, acceptable use of an IDP?
    - Furthermore, an IDP is supposed to help students set a path for developing skills relevant for their career. The authors should discuss what "minimal effectiveness" of IDPs means in the context of the respondents being students who do not have experience understanding how their IDP relates to securing subsequent jobs.

- The interpretation of the data from the first question of the survey "My institution/college/department/PI/advisor requires me to compete a formal IDP" should be more guarded. This question asks respondents to comment on institutional or departmental policy. Respondents may disagree with the statement either because the institution does not require an IDP or because the student does not know institutional policies around IDPs. Additionally, some institutions had dozens of respondents. How consistent are responses to this and other questions when looking at respondents from the same institution?

- The authors should provide figure legends beyond the figure titles to help the reader understand the data.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

I have read this submission. I believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 05 Jul 2018

Nathan Vanderford, University of Kentucky, USA

Dear Dr. Pickett,

Thank you for your review. Your critique has been helpful as we have revised the article. Below we address the major issues you raised.

Within the text, we have clarified which respondents were analyzed in the article, thus addressing the confusion regarding the denominators used in the analysis. In the analysis of IDP use, one-way frequencies were calculated based on the responses from all the respondents. In the analysis of IDP effectiveness, we have reanalyzed our data and now present univariate associations that were calculated based on the responses from only the subset of respondents that completed an IDP. As such, our interpretation and reporting of the data has been adjusted accordingly. Of note, upon this reanalysis, the differences in IDP effectiveness between fields of study and gender were no longer significant.

We apologize for the confusion regarding the reporting of the 33.7% of respondents that found the IDP helpful to their career development in the top section of the univariate analysis table (Supplementary File 3). We have now removed this data from the top section of Supplementary File 3, although this data can still be found in Supplementary File 2.

We have neutralized the tone of the article in general and specifically we have removed words such as “only” and “minimal” within the context of our findings. We agree that our assessment of the expected level of IDP use and effectiveness was speculative. We also agree that as a baseline study, more work should be done to characterize an acceptable level of IDP use and effectiveness within the PhD trainee population.

We have added an extensive limitations subsection (within the methods section) to the new version of the paper that speaks to several issues raised by the reviewers including your points about how respondents may or may not understand or be aware of their institution’s policies regarding IDP use. We also added cautions regarding variability in responses from subjects within the same institution. There are such variabilities within our dataset and it is difficult to assess the exact reasons for this, as it could be caused by, for example, general variability between respondents based on one’s individual perception of the IDP, different interpretations of the policies and procedures around IDP use, and/or the use of different IDP formats. Future work should help clarify this issue.

We have added additional descriptions to our figure legends to help readers understand the data and our analysis.

In closing, we hope that you will favorably review the revised version of the article in light of our changes based on your critique as well as that of the other reviewers. We thank you again for your comments and we strongly believe that your review has been critical in strengthening this work.

Sincerely,

Nathan L. Vanderford

Competing Interests: No competing interests were disclosed.

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