

ORIGINAL ARTICLE

Diversity in medical PhD curricula: a call for harmonisation

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Abstract

Background: Globalisation has increased human movements around the world, spurring greater connectiveness and opportunities to collaborate. In an increasingly connected world, quality assurance among professionals is paramount, particularly in medical research where PhD (Doctor of Philosophy) degree holders are expected to be at the peak of their field and play advanced-level research, education and leadership roles. While some regional efforts have been made to ensure comparability in the standards of advanced degree training, no previous study has compared these standards for a PhD in medicine across the globe.

Aims: To explore the structural diversity of medical PhD degrees and identify which aspects benefit from greater harmonisation.

Methods: In 2021, the 10 best-ranked universities from each of the top five Western countries, and the top Asian country, were identified based on Quacquarelli Symonds World University Ranking. Data were collected for each university based on individual website information regarding the level of degree required to gain entry into a PhD programme in medicine and requirements for completion of coursework, journal publication and oral defence.

Results: Significant variations exist in the requirements for medical PhDs across the world in terms of prerequisite degree and inclusion of coursework. Oral defence is near universal, but a mandatory requirement for publication is largely absent.

Conclusions: Harmonisation of medical PhD degrees through international standards should be considered to encourage quality improvement and benchmarking between institutions, as well as to facilitate greater ease of movement within the medical research community, improving international collaboration and individual career opportunities accordingly.

Introduction

In a world where medical research is rapidly expanding and competition for jobs is fierce,^{1,2} a PhD (Doctor of Philosophy) degree provides a platform for opportunity and advantage. It is postulated that the PhD originated from Islamic centres of learning in the Middle East in the ninth century,³ later evolving under the Humboldtian model of higher education which emphasises the interconnectedness between teaching and research.⁴ Today, a PhD is often viewed as a prerequisite for an academic career. A PhD is the highest academic degree, and it is expected that students perform

original research which produces new knowledge in their field, as well as being able to defend their work against experts from that discipline. Compared to other domains, medical doctors are more likely to obtain a PhD,⁵ and this has been magnified in recent years as demand spreads for innovative clinicians proficient in conducting the research needed to address the health challenges facing a growing population.^{6,7} Furthermore, junior doctors seeking specialist careers face an ever-increasing pool of peers from which to differentiate themselves from, and the award of a PhD offers evidence of experience in independent research design, grant application, critical thinking and collaboration, which are all skills highly sought after by hospitals and healthcare employers.^{8–10}

Conflict of interest: None.

The production of meaningful, novel knowledge from research is one of the key aspects of the PhD degree that differentiates it from other qualifications, and a prerequisite level of research experience is expected from candidates. Formal research qualifications of a lower level than PhD include the master's degree and the honours degree, which represent less substantial bodies of research work that are completed in less time and with greater supervision.^{11–13} Coursework is less prominent within PhD programmes than these lesser degrees but is still commonly incorporated to help provide students with a robust underpinning in foundational research skills like research methodology, statistics, ethics and research integrity. Given that research competencies are seen as valuable not only to academia but also to a broad range of employment sectors, an important aim is to better prepare PhD students to work outside of academia by emphasising the acquisition of 'generic competencies' during doctoral education. Coursework may also be more discipline-specific depending on the area of study. More prominent within PhD degrees is an oral defence of the dissertation before a jury, where students discuss and are questioned on their body of work by a group of experts with the expectation of demonstrating specialist understanding.

In many countries, the tuition and resource costs needed to earn the PhD are comprehensively subsidised by the government in an attempt to encourage engagement with this advanced level of study.¹⁴ This subsidisation is remarkable when one considers that the estimated cost of these degrees can range anywhere from USD10 000 to USD60 000 per year depending on the university.^{15,16} PhD students are typically paid a small stipend but produce research, teach other students and contribute to the educational reputation of their respective universities and nations. Because the PhD is the peak tertiary qualification,^{11–13} admission into a PhD programme is understandably selective, but differences between international education systems are suspected to contribute to variation in their outcomes.

PhD recipients earn the right to use a post-nominal indicating their degree award, but these letters fail to

provide any differentiation between recipients with regard to the structure or content of their degree programme. While some regional efforts have been made to produce comparability in the standards of advanced degrees,¹⁷ few studies have sought to explore and compare the standards for PhD degrees in medicine across the globe.^{18,19}

We aimed to identify the similarities, differences and diversities for PhDs in medicine for selected countries with an established track record of high-quality tertiary education.

Methods

We identified the top five Western countries for number of universities ranked within the best 200 of the world, based on Quacquarelli Symonds (QS) World University Ranking,²⁰ in the USA, UK, Germany, the Netherlands and Australia. The QS World University Ranking is the most widely read university ranking in the world, comparing institutions across multiple metrics including academic reputation, staff-student ratios and research output.²⁰ Japan was also selected for analysis as the top Asian country for number of universities ranked within the best 200 of the world.²⁰ The 10 best-ranked universities in each of these 6 countries were identified and their websites searched for information on their PhD programmes. If a university did not offer a PhD degree in medicine, it was excluded from further analysis, and the next best-ranked university in that country that did offer a PhD in medicine was included. Information was only obtained for stand-alone PhD degrees and not conjoint programmes, for example Doctor of Medicine/Doctor of Philosophy (MD/PhD) (Table 1).

Data were collected for each university including the minimum degree required to gain entry to a PhD degree in medicine, requirement for completion of coursework, requirement for journal publication as part of the degree award, requirement for an oral defence and mean typical duration. These data were corroborated with each country's national qualifications framework or equivalent.^{11–13,21–23}

Table 1 Comparison of PhD degree prerequisites and content between countries

Country	Prerequisite degree	Coursework	Oral defence	Publication requirement	Mean duration (years)
United States	Bachelor	Yes	Yes	No	5
United Kingdom	Honours	University dependent	Yes	No	4
Germany	Master's	No	Yes	No	4
Netherlands	Master's	Yes	Yes	No	4
Australia	Honours	University dependent	University dependent	No	4
Japan	Master's	No	Yes	University dependent	4

'University dependent' indicates a PhD feature that applies to no less than 20%, and no more than 80%, of the degrees analysed for that country.

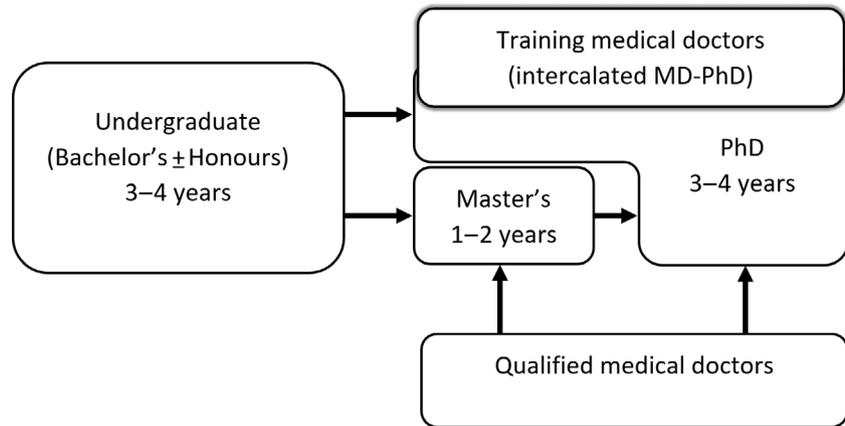


Figure 1 General schema of main pathways to obtaining a medical PhD degree.

Statistical analysis

Differences in these parameters were analysed between the separate countries with Microsoft Excel 2010 (Microsoft Corporation, WA, USA). Two-proportion z-tests were performed to establish significance in trends of $P < 0.05$.

Results

The minimum level of degree required to gain entry to a PhD is higher for the European countries and Japan compared to the rest of the world. In the USA, a bachelor's degree is often all that is required for initial enrolment in a PhD programme, while in Australia and the UK, an honours degree is the typical prerequisite. A master's degree is required in Germany, the Netherlands and Japan. A general schema of the main pathways to a PhD is depicted in Figure 1.

Coursework is an essential requirement of the PhD in the USA but varies elsewhere. The European countries diverge, with coursework being incorporated consistently across the Netherlands while absent in Germany. Coursework is also absent in Japan. In contrast, there are mixed results in Australia and the UK with no significant difference in the number of PhDs with and without coursework.

Although the results of PhD dissertations are known to frequently undergo peer review followed by publication, journal publication as a stipulated requirement for PhD completion is rare. This was found to be true for all countries except Japan, where there was no significant difference in the number of PhDs that do/do not maintain this as a condition of award.

An oral defence of the PhD dissertation is almost universally required around the world, except in Australia, where it is notably absent and required by only 2 of the 10 universities analysed.

The average PhD duration is estimated typically at 4 years around the world, except in the USA, where 5 years is the norm.

Discussion

Our results show that significant variation exists in requirements for medical PhDs across the world in terms of prerequisite degree and inclusion of coursework, while oral defence was near universal, and a mandatory requirement for publication is largely absent at the universities analysed. While the completion of a clinical medical degree would often meet the minimum standard required to enrol in a PhD programme, many of those enrolling in medical PhDs are not clinicians. For this reason, the identified prerequisite degree requirements for PhD enrolment may be more relevant to aspiring non-clinical research scientists than medical doctors. The lower entry requirement for the USA must be considered in association with their longer PhD duration, which typically enables would-be content of a master's degree to be incorporated into the 5-year PhD programme.¹⁶ Indeed, in other countries a research-oriented master's degree is often used as a steppingstone to more advanced PhD studies, providing a foundation of research experience as well as an opportunity to network and explore potential dissertation topics.²⁴ An additional benefit of the US arrangement is that candidates who decide to exit their PhD programme early may still have sufficient academic credit to warrant the award of a master's degree.²⁴

The reasons for the variation between countries in their general pathways to higher research degrees are multifactorial and beyond the scope of this article. However, the requirement for an additional master's degree in Europe/Japan, supplementary to an initial undergraduate degree, is worthy of acknowledgement because it presents a considerably more substantial obstacle than

exists in Australia/UK. Limiting entry requirement to an undergraduate degree provides a financial benefit to Australian/UK students who avoid the need to pay for the more expensive master's degree and expedites their pathway towards PhD completion by reducing the amount of time spent studying prior to enrolment. It is plausible that this variation may reflect a difference in values/priorities between UK/Australian and European/Japanese institutions. The UK and Australia may be more interested in encouraging a larger number of students to enrol and complete PhDs while Europe/Japan may be more interested in maintaining a very high calibre of graduates with extensive research experience. Being employed by the university or affiliated hospital for teaching/research as a PhD student appears to be very much the expectation in Europe, though not necessarily in the UK/Australia.^{25–27} The additional responsibilities and expectations of adequate experience that lead to formal employment may further explain the lower threshold for entry in Australia/UK in comparison to Europe.

Coursework is required in most US-based PhDs given the low initial entry requirement and understanding that candidates may not be very experienced academically when commencing their programme. In contrast, the absence of coursework in Japan and Germany was in keeping with those countries maintaining a higher entry requirement and thus higher expectations of previous knowledge. Conducting a comprehensive research project such as that required by a PhD student would benefit from relevant knowledge in key competencies of research, so it is not difficult to appreciate the rationale behind tertiary institutions prescribing coursework. In this way, coursework can serve as a quality standardisation tool for PhD students. Additional benefits may include allowing students to become more informed within a field they are not yet entirely familiar with, allowing for exploration of different aspects of the field to help shape dissertation planning and lessening the culture shock for those transitioning from didactic classroom study to a research degree.

Much of the success of medical research and its translation into clinical practice is predicated on the dissemination of results within the public forum.²⁸ As such, research publication plays an integral role in shaping the future direction of medicine. While journal publication may, in practice, be expected from a PhD, this analysis indicates it has not been formally established in the Western world as a mandatory requirement for PhD award. To demand publishable content from a PhD student is to demand content that has the potential to alter practice, through bettering patient outcomes, creating new diagnostic and therapeutic tools, or improving services, and this should ultimately be a goal of all medical

research. It also forces the student to organise their research findings in a restrictive format that is a prerequisite of any future research career. In an increasingly competitive job market, PhDs can serve as a tool for clinicians to differentiate themselves, so emphasis on impactful translational research must be maintained to avoid potentially trivial contributions to the field. Stipulating eventual publication would also help focus PhD candidates' topic selection when initially planning projects, encouraging impactful research purposively attuned to current trends. Undergoing peer review and publication makes dissertations more valuable, objectively demonstrating that independent reviewers and journal editors have considered the research to be of noteworthy value and interest to their field.

Students who complete a PhD are recognised as experts, possessing in-depth knowledge of how to perform advanced research and having demonstrated an intellectual capacity to add something useful to their discipline. Award of a PhD is an affirmation by the community that the individual is ready to complete high-quality research independently and help guide the next generation of candidates. Harnessing this experience to drive change is dependent on effective communication, and the oral defence provides an ideal platform to demonstrate this ability. While this concept appears to have been recognised by most of the lead scientific institutions of the Western world, reinforcing this as a standard for all medical PhDs would further promote an expectation of significant impact by completing the degree, by clearly establishing a value of communication. This could be implemented by standardising many of the dissertation defence elements that are already practised by certain universities such as periodic oral presentations over the course of the degree, a requirement for external third-party expert feedback and the public accessibility for engagement during the PhD defence. These aspects better reflect the conditions in which career scientists operate: emulating the need to regularly update stakeholders, advocate for ongoing financial support and convey their results to the lay public.

As the world becomes progressively more interconnected with the advent of globalisation, the call for internationally accepted standards of advanced degrees becomes louder. With international migration reaching an all-time high,²⁹ the need for quality assurance from employers, industries and other institutions regarding prospective employees who have been trained elsewhere is critical. This is emphasised even more so in the field of medical research, where PhD holders are expected to be at the peak of their field and perform advanced level research, education and leadership roles. Internationally accepted standards for medical PhD degrees could be

Table 2 Summary of basic best practices for PhD degrees in medicine proposed by ORPHEUS³¹ (abridged)

A. Research environment
1. Strong research environment must be maintained (funded, staffed, active)
2. Facilities must be compatible with requirements of project
3. Research must be consistent with international ethical standards
B. Outcomes
1. Produces researchers competent in responsible, independent research
2. Provides benefit for those who end in careers outside of academia/research
3. Produces transferable skills (complex problem analysis, leadership, teaching ability)
C. Admission policy
1. Competitive and transparent
2. Minimum prerequisite of Master's/medical degree
3. Research proposals must be of high scientific quality, achievable, innovative
D. PhD training programme
1. 3–4 years' time limit full time, with extensions possible but only exceptionally
2. 6 months of coursework is essential, transferable skill training to be included
3. Performing part of the degree elsewhere should be allowed where possible
E. Supervision
1. Number of PhD students must be compatible with supervisors' workload
2. Supervisors must be active scholars in the field concerned
3. Training in supervision must be available
F. Dissertation
1. Dissertation must be the basis for evaluating if required skills have been obtained
2. Dissertation benchmark is equal to three peer-reviewed international journal papers
3. Dissertation in clinical medicine must meet same standards of other PhD theses
G. Assessment
1. Must include both written dissertation and oral defence
2. Must be assessed by external expert committee without conflict of interest
3. Continuous assessment should be performed throughout programme

used as a tool for quality improvement, academic auditing, benchmarking between institutions and strengthening the reputation of the PhD degree. This would bolster confidence in PhD degree holders across the globe, providing greater ease of movement within the medical research community and improving international collaboration and individual career opportunities as a result. Harmonisation in this way would help facilitate the success of pre-existing policy movements such as the European University Initiative,³⁰ working to strengthen partnerships between

Table 3 Potential benefits of medical PhD degrees

A. Individual
1. Learning of new skills
2. Professional network development
3. Optimisation of career opportunities
B. Clinical
1. Development of new therapies, diagnostics or technologies
2. Development of new guidelines/procedures
3. Improved patient care and outcomes
C. Organisational
1. Expert researchers able to provide high-quality education to others
2. Improves overall organisational reputation
3. Attracts further students and investment
D. Public Health
1. Improved quality of healthcare delivery
2. Improved disease prevention/reduction
3. Improved life expectancy
E. Political/economic
1. New knowledge/technology encourages new jobs
2. New knowledge/technology can be exported for trade
3. Expert opinion able to guide policymaking
4. Encourages foreign interest and collaboration

universities and increase competitiveness of higher education as a whole.

Potential criteria for medical PhD standardisation have been floated before. The Organisation for PhD Education in Biomedicine and Health Sciences in the European System (ORPHEUS) has suggested best practices for PhD training under broad themes of research environment, graduate outcomes, admission policy, programme structural aspects and final assessment.^{31,32} Our findings suggest that similar criteria could be extended to the entire global research community. Specific aspects of individual medical PhD degrees such as their scientific merit, or capacity to be translated into clinical practice for better patient outcomes in terms of clinical impact, quality, safety or service enhancement, could be used as part of a grading system to compare PhDs within and in between institutions. The extent to which an institution meets these standards and its tendency to produce high-grade theses could then be used as an objective measure for international comparison, providing institutional accountability and encouraging quality improvement as a result (Table 2).

Further rationale for the development of international standards in medical PhD degrees has been provided from the COVID-19 pandemic. This phenomenon has transformed how the world uses technology to conduct our activities remotely, and this applies no less to education where the prospect of completing a PhD degree with limited in-person contact is no longer a far-fetched fantasy. Soon, PhD candidates in remote or under-resourced areas may be able to access expert supervision

from international experts on the other side of the world via the Internet. As this type of collaboration becomes more and more commonplace, international harmonisation becomes more important for safeguarding the meaning and function of a medical PhD degree within the broader global research space.

As a brief analysis of only the top 10 universities for 6 of the top countries in tertiary education, the sample size for this study is obviously limited and was used to provide only a general picture of the major differences in medical PhDs across the globe. Analysing more universities from more countries and investigating additional variables would allow greater generalisability. An inherent limitation of the data collection process was the reliance on university website information, which was sometimes general rather than specific to a PhD in medicine, resulting in potential inaccuracy. Pertinent variables that were not explored in this study include equity, diversity and inclusion, sustainable development and secondary research methodologies in PhDs.³³

Conclusion

The results obtained suggest that not all PhDs are equal, and considerable diversity exists between countries and

within countries. A medical PhD is a powerful experience that can be used to shape both the life of the individual and the lives of others through the impact of their research, with multiple flow-on benefits as outlined in Table 3. As medical research becomes progressively more advanced, the expectation upon medical researchers advances too, so optimising the formative education content and structures which govern researchers' career trajectories is essential for maximising the influence of their work on health outcomes. With our emergence from the COVID-19 pandemic, the powerbrokers of medical research and academia are now presented with a golden opportunity to come together and harmonise PhD degrees for the good of individuals, institutions, governments and the broader global community.

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References

- 1 Scott A. *The Future of the Medical Workforce*. ANZ-Melbourne Institute; 2019 [cited 2022 Jul 17]. Available from URL: https://melbourneinstitute.unimelb.edu.au/__data/assets/pdf_file/0008/3069548/ANZ-MI-Health-Sector-Report-Future.pdf
- 2 United States Bureau of Labor Statistics. *Occupational Outlook Handbook, Physicians and Surgeons*. United States Government; 2021 [cited 2022 Jul 17]. Available from URL: <https://www.bls.gov/ooh/healthcare/physicians-and-surgeons.htm>
- 3 Stewart DJ, Meri JW. *Degrees, or Ijazah. Medieval Islamic Civilization: An Encyclopedia*. New York, NY: Routledge; 2006.
- 4 Anderson RD. *European Universities from the Enlightenment to 1914*. Oxford: Oxford University Press; 2004.
- 5 Organisation for Economic Co-operation and Development (OECD). *Online Education Database: Graduates by Field of Education*. OECD; 2014 [cited 2022 Jul 17]. Available from URL: <http://stats.oecd.org/Index.aspx?DatasetCode=RGRADSTY>
- 6 Noble K, Owens J, André F, Bakhoun SF, Loi S, Reinhardt HC *et al.* Securing the future of the clinician-scientist. *Nat Cancer* 2020; **1**: 139–41.
- 7 Harding C, Akabas M, Andersen O. History and outcomes of 50 years of physician-scientist training in medical scientist training programs. *Acad Med* 2017; **92**: 1390–8.
- 8 Bonham A. MD–PhD training. *Acad Med* 2014; **89**: 21–3.
- 9 Eley DS, Benham H. From medical student to clinician-scientist: where is the pathway in Australia? *Intern Med J* 2016; **46**: 1449–52.
- 10 Ng E, Jones A, Sivapragasam M, Nath S, Mak L, Rosenblum N. The integration of clinical and research training: how and why MD–PhD programs work. *Acad Med* 2019; **94**: 664–70.
- 11 Australian Qualifications Framework Council. *Higher Education Standards Framework (Threshold Standards) 2021*. Australian Government Department of Education, Skills and Employment [cited 2022 Jul 17]. Available from URL: <https://www.legislation.gov.au/Details/F2022C00105>
- 12 Quality Assurance Agency for Higher Education. *The Frameworks for Higher Education Qualifications of UK Degree-Awarding Bodies*. Quality Assurance Agency for Higher Education [updated 2014 Oct; cited 2022 Jul 17]. Available from URL: <https://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf>
- 13 United States Department of Education. *Structure of the U.S. Education System: Research Doctorate Degrees*. United States Department of Education [updated 2022 Feb 22; cited 2022 Jul 17]. Available from URL: <https://www2.ed.gov/about/offices/list/ous/international/usnei/us/edlite-structure-us.html>
- 14 Barnacle R, Cuthbert D. *The PhD at the End of the World: Provocations for the Doctorate and a Future Contested*. Melbourne: Springer Nature; 2021.
- 15 The University of Melbourne. *The University of Melbourne Tuition Fees – 2022*. The University of Melbourne [cited 2022 Jul 17]. Available from URL: https://study.unimelb.edu.au/__data/assets/pdf_file/0017/291140/2022-tuition-fees-tuition-fee-tables-for-australian-fee-paying-students.pdf
- 16 University of Chicago. *Tuition and Fees 2020–2021: Biological Sciences Division* [cited 2022 Jul 17]. Available from URL: <https://bursar.uchicago.edu/biological-sciences-division-2-3-2/>
- 17 Organisation for PhD Education in Biomedicine. *ORPHEUS 2009 position*

- paper: *Towards Standards for PhD Education in Biomedicine and Health Sciences*. ORPHEUS [cited 2022 Jul 17]. Available from URL: <https://orpheus-med.org>
- 18 Barnett JV, Harris RA, Mulvany MJ. A comparison of best practices for doctoral training in Europe and North America. *FEBS Open Bio* 2017; **7**: 1444–52.
 - 19 Williams A, Jones MG, Jonsson R, Harris RA, Mulvany MJ. A comparison of doctoral training in biomedicine and medicine for some UK and Scandinavian graduate programmes: learning from each other. *FEBS Open Bio* 2019; **9**: 830–9.
 - 20 Quacquarelli Symonds. *QS World University Rankings*. Quacquarelli Symonds [updated 2021 Jun 10; cited 2022 Jul 17]. Available from URL: <https://www.topuniversities.com/university-rankings>
 - 21 German Ministry of Education and Research. *German Qualifications Framework for Lifelong Learning*. German Ministry of Education and Research [updated 2011 Mar 22; cited 2022 Jul 17]. Available from URL: https://www.dqr.de/dqr/shareddocs/downloads/media/content/the_german_qualifications_framework_for_lifelong_learning.pdf?__blob=publicationFile&v=1
 - 22 Netherlands Ministry of Education Culture and Sciences. *Netherlands Qualifications Framework*. Netherlands National Contact Point [updated 2019 Sep; cited 2022 Jul 17]. Available from URL: <https://europa.eu/europass/system/files/2020-06/The%20Netherlands%20Referencing%20Report.pdf>
 - 23 Japanese Ministry of Education, Culture, Sports, Science and Technology. *Ministry of Education Ordinance Number 28: Graduate School Establishment Standards* [updated 2007; cited 2022 Jul 17]. Available from URL: <https://www.japaneselawtranslation.go.jp/en/laws/view/3793/en>
 - 24 Nerad M, Heggelund M. *Toward a Global PhD*. Washington, DC: University of Washington Press; 2018.
 - 25 Schiermeier Q. Europe is a top destination for many researchers. *Nature* 2019; **569**: 589–91.
 - 26 Zhou N. *Almost Half of Australian PhD Students Considering Disengaging From Studies Due to Pandemic*. The Guardian [updated 2020 Jul 10; cited 2022 Jul 17]. Available from URL: <https://www.theguardian.com/australia-news/2020/jul/10/almost-half-of-australian-phd-students-considering-disengaging-from-studies-due-to-pandemic>
 - 27 Livermore T, Gallagher J. *Should PhD students be classed as employees?* The Guardian [updated 2015 Jul 16; cited 2022 Jul 17]. Available from URL: <https://www.theguardian.com/higher-education-network/2015/jul/16/should-phd-students-be-classed-as-employees>
 - 28 United States National Research Council Committee on Responsibilities of Authorship in the Biological Sciences. *Sharing Publication-Related Data and Materials: Responsibilities of Authorship in the Life Sciences*. Washington, DC: National Academies Press; 2013.
 - 29 The World Bank. *International Migration at All-Time High*. The World Bank [updated 2015; cited 2022 Jul 17]. Available from URL: <https://www.worldbank.org/en/news/press-release/2015/12/18/international-migrants-and-remittances-continue-to-grow-as-people-search-for-better-opportunities-new-report-finds>
 - 30 European Commission. *Council Conclusions on the European Universities initiative – Bridging Higher Education, Research, Innovation and Society: Paving the Way for a New Dimension in European Higher Education*. Brussels: European Union; 2021.
 - 31 Organisation for PhD Education in Biomedicine. *Best Practices for PhD Training*. [cited 2022 Jul 17]. Available from URL: <https://www.orpheus-med.org/best-practices-recommendations/>
 - 32 Harris B, Mulvany M, Creemer J. *A Framework for Collaborative Doctoral Education Within Europe*. EUA Council for Doctoral Education Organisation [updated 2021 Jun 21; cited 2022 Jul 17]. Available from URL: <https://eua-cde.org/the-doctoral-debate/229:a-framework-for-collaborative-doctoral-education-within-europe.html>
 - 33 Puljak L, Sapunar D. Acceptance of a systematic review as a thesis: survey of biomedical doctoral programs in Europe. *Syst Rev* 2017; **6**: 1–8.