General Review Article

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Research integrity and academic medicine: the pressure to publish and research misconduct

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Abstract

Context: This narrative review article explores research integrity and the implications of scholarly work in medical education. The paper describes how the current landscape of medical education emphasizes research and scholarly activity for medical students, resident physicians, and faculty physician educators. There is a gap in the existing literature that fully explores research integrity, the challenges surrounding the significant pressure to perform scholarly activity, and the potential for ethical lapses by those involved in medical education.

Objectives: The objectives of this review article are to provide a background on authorship and publication safeguards, outline common types of research misconduct, describe the implications of publication in medical education, discuss the consequences of ethical breaches, and outline possible solutions to promote research integrity in academic medicine.

Methods: To complete this narrative review, the authors explored the current literature utilizing multiple databases beginning in June of 2021, and they completed the literature review in January of 2023. To capture the wide scope of the review, numerous searches were performed. A number of Medical Subject Headings (MeSH) terms were utilized to identify relevant articles. The MeSH terms included "scientific misconduct," "research misconduct," "authorship," "plagiarism," "biomedical research/ethics," "faculty, medical," "fellowships and scholarships," and "internship and residency." Additional references were accessed to include medical school and residency accreditation standards, residency match statistics, regulatory guidelines, and standard definitions.

Results: Within the realm of academic medicine, research misconduct and misrepresentation continue to occur without clear solutions. There is a wide range of severity in breaches of research integrity, ranging from minor infractions to fraud. Throughout the medical education system in the United States, there is pressure to publish research and scholarly work. Higher rates of publications are associated with a successful residency match for students and academic promotion for faculty physicians. For those who participate in research misconduct, there is a multitude of potential adverse consequences. Potential solutions to ensure research integrity exist but are not without barriers to implementation.

Conclusions: Pressure in the world of academic medicine to publish contributes to the potential for research misconduct and authorship misrepresentation. Lapses in research integrity can result in a wide range of potentially adverse consequences for the offender, their institution, the scientific community, and the public. If adopted, universal research integrity policies and procedures could make major strides in eliminating research misconduct in the realm of academic medicine.

Keywords: authorship; research integrity; plagiarism; internship; residency; medical education

The landscape of academic medicine in the United States places a strong emphasis on scholarly work and publications in peer-reviewed journals. Publications are often required for career advancement, to procure grant funding, and to maintain accreditation with regulatory bodies [1–4]. The pressure to publish can be felt at all levels of academic medicine, from medical students to resident physicians to faculty physicians [5–8]. The longstanding culture of the scientific world, including medical education, has been described as a "publish or perish" [3] mentality, which

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highlights the highly intertwined relationship between prolific publication and career advancement in academic medicine [1, 2, 4, 9]. Unfortunately, the pressure to publish can lead some participants to engage in research misconduct to bolster productivity [2, 3]. In this review, we explore existing guidelines for authorship, common types of research misconduct, the implications of scholarly work for medical learners and faculty, consequences of research misconduct, and finally, possible solutions to promote integrity in academic medicine.

Methods

The authors (MK, MD, EAG) identified a gap in the existing literature regarding the holistic examination of research integrity and its implications across the spectrum of medical education, from students to resident physicians to faculty physicians. To complete a narrative review, the authors explored the current literature utilizing PubMed, Scopus, and Google Scholar beginning in June of 2021 and completed the literature review in January of 2023. References included publications between 2001 and 2022 to ensure updated quality information that is applicable to the academic medicine population today. To capture the wide scope of the review, numerous searches were performed. A number of Medical Subject Headings (MeSH) terms were utilized to identify relevant articles. MeSH terms included: Authorship; Misconduct; Research Integrity; Plagiarism; Medical Education; Residency Applications; Faculty, Medical; Fellowships and Scholarships; and Internship and Residency. Papers were included if they were published between the set time frame, contained one or more of the previously mentioned MeSH terms, and were full-length articles. Additional references were accessed to include medical school and residency accreditation standards, residency match statistics, regulatory guidelines, and standard definitions. Articles were excluded if they were published outside of the specified time frame, if the majority of the paper did not relate to the attached MeSH term, or if the full-length article was inaccessible to the authors. Ultimately, the articles to be included were discussed between the authors (MK and MD), with the ultimate decision made by the primary author (MK). The faculty author (EAG) of this review has extensive experience as a physician educator, residency program director, and advisor to medical students applying to residency. Table 1 outlines the sources utilized for this narrative review.

Table 1: The sources utilized for this narrative review.

A PubMed search conducted between 6/2021 and 1/2023 utilizing the keywords: Authorship; Misconduct; Research Integrity; Plagiarism; Medical Education; Residency Applications; Faculty, Medical; Fellowships and Scholarships; and Internship and Residency
Targeted searches were conducted to review medical school and residency accreditation standards, residency match statistics, regulatory guidelines, and standard definitions
Discussions with experts in the field of academic medicine
Personal experience as a faculty physician, residency program director, and advisor to medical students applying to residency

Discussion

Authorship

The number of publications continues to increase, nearly doubling since 2010 [2]. Over the past 30 years, the average number of authors listed in an article has also increased, creating an opportunity for misrepresentation [3]. Being listed as an author comes with benefits such as prestige, increased funding, and career opportunities [3]. The International Committee of Medical Journal Editors (ICMJE) is a group that develops recommended protocols for conducting scholarly work [10]. ICMJE has suggested four criteria that should be met in order to be considered and named as an author on a scientific work:

(1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work
(2) Drafting the work or revising it critically for important intellectual content
(3) Final approval of the version to be published
(4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved [10].

The fourth criterion was added in 2013 to put an emphasis on accountability for all authors listed on the paper [7]. Adhering to these authorship criteria may prevent misrepresentations and hyper-authorship. Many well-known peer-reviewed journals follow the ICMJE suggestions; however, individual journals can set their own criteria for what constitutes an author [11].

There are multiple checkpoints that a project goes through to preserve scientific integrity and prevent research misconduct. Fostering a culture of academic honesty begins at the local institutional level with strict regulatory oversight by federal regulatory bodies, such as the US Office of Research Integrity (ORI) [12, 13]. The three major safeguards in place to maintain scientific integrity are: peer review for funding; the referee system of peer review for publication; and replication of results [13]. When these checkpoints fail, the possibility for misconduct to occur increases.

Research misconduct

Research misconduct is defined by the US ORI as “the fabrication, falsification, or plagiarism in proposing, performing,

Table 2: Definitions of common terms seen in relation to authorship misrepresentation and research misconduct.

Term	Definition
Honorary authorship	Adding an individual as an author, commonly because of their prestige or seniority, to a paper that does not meet the ICMJE criteria for authorship [2, 17]
Gift	Adding someone to a project as a token of appreciation for mentorship or in the hopes of being added to their future projects [2, 17]
Guest	Adding a well-known person to the author list to increase the likelihood of the paper being accepted by a journal [2, 17]
Coercion	A person not involved in the project forces the research team to add them as an author [2, 17]
Collaboration	A group of individuals add each other on multiple papers [17]
Ghost	A person who may fulfill the ICMJE criteria as an author that is not listed in the author list for publication [17]. This may occur for many reasons, such as: major conflict of interest, or financial support from commercial sponsor [7]
Salami publications	Also known as the "least publishable unit strategy" [2, 7]. Dividing aspects of the paper into smaller parts and presenting them as separate [2, 7]
Fabrication	"Making up data or results and recording or reporting them" [2, 12]
Falsification	"Manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record" [2, 12]
Plagiarism	"The appropriation of another person's ideas, processes, results, or words without giving appropriate credit" [2, 12]
Guarantor	Frequently the last author listed on an article. Typically, the principal investigator of the project as well as the individual with the most seniority [7]. They take full responsibility for the integrity of the paper [7]
Scienter	"Guilty state of mind, or necessary level of intent in carrying out a wrongful act" [46]
False investigator	An individual added to a grant proposal who is not expected to participate in the research [46]

ICMJE, International Committee of Medical Journal Editors.

or reviewing research, or in reporting results" [12, 14, 15]. There are numerous types of infractions in integrity with a range of seriousness. Plagiarism may present as superficial paraphrasing or the use of exact words without proper citation, or it may come in the form of utilizing others' ideas and misrepresenting them as one's own [2, 16]. During the process of data collection, research misconduct may take place in the form of data "trimming," which is the removal of irregular results to strengthen desired results, or data "cooking," which involves the deliberate manipulation of data to produce the desired results [2, 12]. The most egregious form of misconduct is the overt fabrication or falsification of data or results. Additional definitions related to misconduct are listed in Table 2.

Although not strictly covered by the ORI's definition of research misconduct, there are a number of improper research practices that should be noted. One of the most common improper practices is assigning "honorary authorship," which involves listing undeserving authors on a publication [2, 12, 17]. The motivations for this practice can be vast and variable. For example, honorary authorship may be offered by a junior researcher as reciprocity to a senior researcher who holds rank, influence, or funding in the department. Conversely, a senior, influential researcher may coerce a junior researcher to list them as an author without having met the criteria of authorship as defined by the ICMJE [2, 10, 17]. Alternatively, a junior researcher may list a highly influential honorary author as a tool to increase the likelihood of obtaining publication or funding from an entity that would otherwise be unattainable [2, 17]. With regard to misconduct during the peer review process, an influential author could generate bias, either positive or negative, from the reviewer [2].

Scholarly activity in medical education

For medical students, the motivation or pressure to engage in scholarly work may be multifactorial. To maintain accreditation, both allopathic and osteopathic medical schools in the United States must demonstrate support for faculty- and student-driven research. They must produce evidence of student participation in research and scholarly activity [18, 19]. Students may feel institutional pressure to participate in research as the medical school aims to maintain accreditation.

In addition to completing their academic work and clinical training, medical students must actively prepare to apply to postgraduate training programs, commonly known as "residency programs." Securing and successfully completing residency training is imperative to the unrestricted practice of medicine in the United States. Students apply for residency during their final year of medical school and must undergo a rigorous application and interview process to match into a program. Residency programs rank applicants based on numerous characteristics such as academic performance, including United States Medical Licensing Examination (USMLE) and Comprehensive Osteopathic Medical Licensing Examination (COMLEX) scores.

Furthermore, residency programs evaluate students based on participation in research and scholarly activity, service, leadership, and interpersonal skills. Prior to 2022, USMLE Step 1 and COMLEX Level 1 were graded numerically. Both USMLE Step 1 and COMLEX Level 1 transitioned to Pass/Fail scoring in 2022, which has potentially far-reaching implications for medical students and residency programs. It is speculated that the loss of numeric board scores will prompt programs to weigh other elements of the application more heavily, including research and scholarly activity. In fact, results from the 2022 residency match reveal that more research experience and publications are associated with higher residency match rates for medical students in all specialties for allopathic students and most specialties for osteopathic medical students [20, 21]. For students pursuing surgical specialties, such as general surgery [22], orthopedic surgery [23], or neurosurgery [6], research productivity plays a substantial role in matching into residency.

Facing pressures similar to medical students, resident physicians and those in fellowships frequently find themselves entrenched in a "publish or perish" culture [3]. In the United States, residency training programs are overseen by the Accreditation Council for Graduate Medical Education (ACGME). For the program to maintain accreditation and for individual residents to remain in good standing, participation in scholarly activity is required by the ACGME [24]. Furthermore, research and other scholarly activity encompass an important part of applications for resident physicians seeking fellowship programs. Unfortunately, evidence suggests that a substantial minority of students and resident physicians misrepresent their scholarly work [8, 25–27].

In addition to misconduct during the research and publication process, there exists potential for misconduct and misrepresentation in reporting one's work. It is not uncommon for job applications, residency or fellowship applications, and curricula vitae (CV) to include misrepresentations of varying severity [8, 25–27]. From egregious actions such as listing fake publications to lesser infractions such as embellishing the status of the listed work, misrepresentations are not rare [8, 25–27]. Yeh et al. [25] found that one in eight (12 %) student candidates interviewing for general surgery residency at their institution had serious inaccuracies in reported vs. actual publications. Oke and Mantagos [28] found that 4.7 % of applicants to a pediatric ophthalmology fellowship listed unverifiable publications on their applications. Cortez et al. [8] examined the accuracy of publications listed by applicants to an orthopedic sports medicine fellowship program. Within their cohort, 68 % of the articles were reported as "completed," with 5.7 % of those being found to be inaccurate, and 31.6 % of the articles were reported as "submitted," with 28.3 % being unpublished between 2 and 6 years later [8]. In order from most to least common, the types of misrepresentation found by Wiggins [26] was listing nonexistent articles, authorship order, and nonauthorship. This analysis also revealed that there was no consensus as to what constitutes misrepresentation [26]. None of these studies discuss if there were any consequences faced by the applicants, but they do reveal that misrepresentation has been a problem for many years.

Scholarly activity by faculty physicians

Physicians who pursue a career in academic medicine, commonly referred to as "faculty physicians," encounter numerous motivations to produce scholarly work and publications. As with medical students and resident physicians, faculty physicians face regulatory mandates from accrediting bodies to engage in research and scholarly activity [18, 19, 24]. Additionally, institutional pressure frequently exists surrounding the relationship between publications and reputation within the academic community. Higher rates of publication and publications with a higher impact factor are associated with more prestigious institutional reputations [2, 3].

Furthermore, publication output and the number of citations are primary factors when considering someone for promotions, job retention and mobility, and tenure [2–4, 29–31]. Within the world of academic medicine, the h-index is utilized as an objective measure to describe the impact that an individual's work has made. The h-index is calculated utilizing both the number of publications and the number of citations by other authors per publication [29]. Higher rates of publication, and high h-index results, are associated with higher academic rank, NIH funding procurement, and career advancement for faculty physicians [2–4, 29–31]. Rates of high-impact publications are impossible to untangle from career advancement. Career advancement opportunities frequently offer additional financial incentives, further incentivizing prolific publication.

With numerous incentives to publish, academic physicians may attempt to fast-track the path to success by engaging in research misconduct or misrepresentation. DuBois et al. [32] investigated the motivation that is driving researchers to participate in research misconduct. The study found that 33 % felt pressure to publish, and 48 % of cases could be attributed to a self-centered personality such as having confidence they would not be caught, arrogance, seeking prestige, and greed [32]. More serious cases of fabrication, falsification, or plagiarism were seen more often

with motivational factors of seniority, financial incentives, and oversight failures [32]. Although data for US physicians is lacking, a study conducted in 2000 in England showed that 59.8 % of physician survey respondents indicated that they felt pressured to publish to better their careers [1, 33]. It also revealed that 5.7 % of the physician respondents had participated in honorary authorship and 4.1 % would be willing to falsify data to improve a grant application [1, 33].

Consequences of research misconduct

There is not a universal process or consequence to research misconduct or misrepresentation in authorship. As a result, infractions such as research-related misconduct can result in a range of sanctions including article retraction, action by academic institutions or administrations, civil penalties, and criminal penalties [34]. Authorship disputes, including allegations of ghost authorship and others, are not viewed by the ORI as plagiarism, leaving journals and administrations to handle claims of misrepresentation as they see fit [34]. Journals have not yet enacted a universally accepted protocol for investigating and addressing research misrepresentation [11]. Many well-known journals, including *Cell*, *Nature*, and *The Lancet*, follow the guidelines proposed by the Committee on Publication Ethics (COPE) [35–37]. These guidelines encourage article retraction when necessary, along with publishing a notice of retraction outlining the reason [38]. A lack of government oversight and variability in journal response could be possible factors in the high and rising prevalence of authorship misrepresentation.

The ORI maintains lists of individuals that have committed research misconduct. Administrative actions imposed by the ORI are dependent upon the seriousness and impact of the misconduct, along with the individual's history of behavior [39]. Possible sanctions are listed below:

> … debarment from eligibility to receive Federal funds for grants and contracts; prohibition from service on PHS [Public Health Service] advisory committees, peer review committees, or as consultants; certification of information sources by respondent that is forwarded by institution; certification of data by institution; imposition of supervision on the respondent by the institution; submission of a correction of a published article by respondent; submission of a retraction of a published articles by respondent [39].

In the 1980s, a cardiology fellow was discovered to have fabricated data that led to false data being collected over a period of approximately 14 years. The author suffered a 10-year suspension from participating in federally funded research, along with the retraction of a total of 82 papers from two separate institutions [13]. This case is an example of a failure of the peer-review system and of oversight from the institution where the research was conducted. Reproducibility of data is incredibly important to avoid cases like this. In 2011, a study was conducted that reviewed articles retracted from PubMed between 2000 and 2010 [40]. Out of 742 articles, 73.5 % were retracted due to scientific error and 26.6 % due to fraud including falsification and fabrication of data [40]. A concerning finding of this study revealed that 31.8 % of the retracted articles did not have any indication that they had been retracted [40]. Both examples reveal the systemic gap that allows articles containing falsified and fraudulent material to remain available for continued citation by unsuspecting researchers. Utilizing information from retracted articles decreases the value of the work and the legitimacy of the author citing it.

Beyond the professional and legal consequences of research misconduct, ethical breaches in research can result in public harm and loss of confidence in the scientific community (Table 3). Perhaps the most socially impactful case of research misconduct is that of Andrew Wakefield, who published a paper in *The Lancet* in 1998 stating that the measles, mumps, and rubella (MMR) vaccine caused autism in children [41]. The author faced article retraction, banishment from practicing medicine, and worldwide attention from the media exposing him as a fraud. Despite proving that Wakefield falsified data and many studies affirming that there is no link between the MMR vaccine and autism, the social damage had already been done. Wakefield's fabricated work scared the public, and MMR vaccination rates decreased. Decreased vaccination rates resulted in a resurgence of measles, which had previously been eliminated by the vaccine [41]. Not only did this led to the death of children in Britain and the United States, but also it started a movement of antivaccinators putting more children at risk for many preventable diseases [41]. The implications of research misconduct are far-reaching for individuals, institutions, the scientific community, and the greater public.

Potential solutions

Scientific research and publications serve as a conduit for furthering knowledge and understanding of biology and medicine. Publications are a tool to communicate research and motivate one's peers [3]. Published works can initiate discussions regarding the interpretation of results, the application of the findings, and the generation of ideas for future works and advancement in knowledge. The development and execution of research studies require significant dedication and effort.

Table 3: Laws related to research misconduct.

Law name	Code	Definition
Research misconduct	42 CFR § 93.103	"*Research misconduct* means fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results (a) Fabrication is making up data or results and recording or reporting them (b) Falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record (c) Plagiarism is the appropriation of another person's ideas, processes, results, or words without giving appropriate credit (d) Research misconduct does not include honest error or differences of opinion" [14] "A finding of research misconduct made under this part requires that – (a) There be a significant departure from accepted practices of the relevant research community; and (b) The misconduct be committed intentionally, knowingly, or recklessly; and (c) The allegation be proven by a preponderance of the evidence" [42]
False, fictitious, or fraudulent claims	18 U.S.C. §287	"Whoever makes or presents to any person or officer in the civil, military, or naval service of the United States, or to any department or agency thereof, any claim upon or against the United States, or any department or agency thereof, knowing such claim to be false, fictitious, or fraudulent, shall be imprisoned not more than five years and shall be subject to a fine in the amount provided in this title" [43] Claims that fall under this law are considered criminal offenses [29, 46]
False Claims Act	31 U.S.C. §3729	"Imposing civil liability on people who present false claims to the government for the purpose of obtaining payment" [44, 46]. This allows the government to implement civil penalties and to recover money obtained by grant fraud [44, 46] "(A) knowingly presents, or causes to be presented, a false or fraudulent claim for payment or approval; (B) knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim …" [44, 46]
Physician Payments Sunshine Act		"… require applicable manufacturers of drugs, devices, biologicals, or medical supplies covered by Medicare, Medicaid, or the Children's Health Insurance Program (CHIP) to report annually to the Secretary certain payments or transfers of value provided to physicians or teaching hospitals ("covered recipients"). In addition, applicable manufacturers and applicable group purchasing organizations (GPOs) are required to report annually certain physician ownership or investment interests" [45]

CFR, Code of Federal Regulations; USC, Uniform System of Classification.

Within the realm of academic medicine, research misconduct and misrepresentation continue to occur without clear solutions. In the arena of clinical research, Bando et al. [4] propose a multifaceted approach to ensure research integrity. Although clinical research represents only one facet of academic medicine, their approach could be extrapolated to almost all areas of academic medical research and scholarly work. Their first recommendation involves the creation of a network of independent ORIs to work in tandem with local Institutional Review Boards (IRB). Although IRBs focus on ethics and the protection of human subjects, local ORIs would ensure the integrity of the scientific process [4]. Their second proposal involves creating and maintaining a local database to collect raw data related to clinical trials. This would allow for data review by a local ORI or journal editor, and data would be preserved and accessible to authorized parties for a minimum of 10 years [4]. The third element of the proposal calls for medical schools to implement the ORI's responsible conduct of research (RCR) program into their curriculum [4]. This would ensure universal knowledge of ethical research practices by all US-trained physicians. The fourth and final proposal is for clinical researchers to implement a "Checklist for Clinical Research" [4]. Their proposed checklist implements checkpoints at each step of the project, from inception to publication, to ensure integrity throughout the process [4]. It also calls for transparency and collaboration among all members of the research team.

Although this comprehensive approach, if adopted, offers much-needed solutions to the problem of research misconduct in academic medicine, there are barriers to implementation. The most likely barrier for academic institutions to implement a comprehensive research integrity program is funding. The funds required to establish an independent ORI and a central database would be cost prohibitive for most nonprofit organizations, including universities, osteopathic medical schools, and hospitals. Other interventions, such as the implementation of a research integrity curriculum and a research integrity checklist system, are much more feasible. Other barriers that may be encountered are regulatory fatigue, department culture that resists buy-in, and time constraints for those tasked with

implementation. Currently, osteopathic medical schools are required to include research methodology and research ethics in the curriculum but have no obligation to implement comprehensive research integrity systems [19]. Widespread and universal implementation of the changes proposed by Bando et al. into osteopathic education would likely require a mandate from Commission on Osteopathic College Accreditation (COCA), the accrediting body for osteopathic medical schools.

Limitations

This narrative review had limited access to full-length articles, which was a limitation. Additionally, only articles published after the year 2001 were included, limiting the historical context of this information. Narrative reviews are inherently limited by the completeness of a literature search. An inherent bias of the authors in their interpretation of content may also be present; however, this was attempted to be mitigated by including direct quotations from material and providing relevant information as complete as possible.

Conclusions

The world of academic medicine's pressure to publish is shared by the greater scientific community. Beginning early in medical school, young physicians learn that engaging in research and publishing manuscripts opens the door to opportunity. For physicians pursuing a career in academia, the pressure to publish continues. The potential for research misconduct and authorship misrepresentation exists and, if enacted, can result in a wide range of potentially adverse consequences for the offender, their institution, the scientific community, and the general public. If adopted, universal research integrity policies and procedures (like those suggested by Bando et al.), a universal process to investigate and address authorship misconduct, and adhering to the authorship criteria set forth by the ICJME, could make major strides in eliminating research misconduct in the realm of academic medicine.

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