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Ten years later: a review of the US 2009 institute of medicine report on conflicts of interest and solutions for further reform

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Abstract

Conflicts of interest (COIs) in healthcare are increasingly discussed in the literature, yet these relationships continue to influence healthcare. Research has consistently shown that financial COIs shape prescribing practices, medical education and guideline recommendations. In 2009, the Institute of Medicine (IOM, now the National Academy of Medicine) published Conflicts of Interest in Medical Research, Practice, and Education—one of the most comprehensive reviews of empirical research on COIs in medicine. Ten years after publication of theIOM's report, we review the current state of COIs within medicine. We also provide specific recommendations for enhancing scientific integrity in medical research, practice, education and editorial practices.

Summary box

What is already known about this subject?

- In 2009, amid growing concern about undue industry influence on the medical establishment in the USA, the Institute of Medicine (IOM), now the National Academy of Medicine, published its landmark report, *Conflicts of Interest in Medical Research, Practice, and Education*.
- The IOM report used one of the most comprehensive reviews of empirical research on conflicts of interest (COIs) in medicine to lay out a wide-ranging set of recommendations for strengthening COI policies.
- The creation of the US Open Payments database in 2013 and similar transparency laws and industry self-regulation in other countries have ushered in a new era of COI research and brought transparency on industry payments to physicians and teaching hospitals.

Introduction

In 2009, amid growing concern about undue industry influence on the medical establishment in the USA, the Institute of Medicine (IOM), now the National Academy of Medicine, published its landmark report, *Conflicts of Interest in Medical Research, Practice, and Education*.[1] This report used one of the most comprehensive reviews of empirical research on conflicts of interest (COIs) in medicine to lay out a wide-ranging set of recommendations for strengthening COI policies.

Although the IOM report remains an invaluable resource, research on COIs has expanded dramatically in the 10+ years since its publication. In particular, the creation of the Centres for Medicare and Medicaid Services' online Open Payments (CMS-OP) database (https://openpaymentsdata.cms.gov/) in 2013 has been instrumental to the growth of COI research. This database brought unprecedented transparency on industry payments to physicians and teaching hospitals in the USA. Since the Open Payments database launched, researchers have used it to shed new light not only on the prevalence, distribution and under-reporting of industry payments to physicians, but also on their association with physician behaviour. While Open Payments provides insight into the financial relations of only US-based physicians, similar transparency laws and industry self-regulation have been implemented or contemplated in several other countries, including Australia, France, Japan, Latvia, Portugal, Slovenia and Turkey.[2 3] This growth in transparency laws indicates that the 'sunshine' from Open Payments legislation may be spanning the globe.[3]

In recent years, researchers have also expanded COI research into medical publishing, the drug review process, social media, patient advocacy and non-financial domains. In this article, we focus on financial COI (FCOI). Certainly, non-FCOI (eg, intellectual) can unduly influence medical practice and research. However, there is abundant evidence that FCOIs produce unidirectional bias and are of greater ethical priority (see, eg, Goldberg, 2020; Bero and Grundy 2016). Thus, we asked experts who have studied FCOI in various domains of

Summary box

What are the new findings?

- COIs are still prevalent within today's healthcare system and have the potential to negatively affect patient care through individual physician–patient encounters and more globally through practice-influencing documents such as clinical practice guidelines.
- In recent years, researchers have expanded COI research into medical publishing, the drug review process, social media, patient advocacy and non-financial domains.
- Although recent developments (such as the Open Payments database) have provided insight into physician–industry relationships, further efforts are needed to prevent COIs from affecting medical education, research and practice.

How might it impact clinical practice in the foreseeable future?

- We highlight how future initiatives can inform current efforts to address conflicts of interest (COIs) in medicine and make specific recommendations for enhancing scientific integrity in medical training, research and practice. Ultimately, addressing COIs in medicine improves the physician–patient relationship and elevates overall patient care.

medicine to provide a narrative review of the FCOI literature and to identify any remaining gaps. We first discuss recent legislation regarding industry payments, followed by COIs related to clinical research, medical education, medical practice, clinical practice guidelines (CPGs), editorial boards and emerging topics in COIs. We then assess the progress made and the challenges that remain in carrying out the IOM's mandate to address COIs, prevent bias, and restore trust in medicine. Finally, we highlight how future initiatives can inform current efforts to address COIs in medicine and make specific recommendations for enhancing scientific integrity in medical training, research and practice (table 1).

Legislation on COIs

Several countries have enacted legislation in recent years for increased transparency of relationships between industry and healthcare providers. In the USA, the Physician Payments Sunshine Act mandates public disclosure of payments from pharmaceutical, medical device and medical supply companies to healthcare providers and academic hospitals.[4 5] These payments are catalogued in the Open Payments database and include speaker's and consulting fees, travel and accommodation reimbursements, gifts, honoraria, meals, research grants and ownership or investment interests by physicians and their immediate family members.[6] Similar regulations have been enacted in several European Union (EU) countries such as Denmark, France, Greece, Latvia, Portugal and Romania.[7] In 2013, the European Federation of Pharmaceutical Industries and Associations (EFPIA) adopted a Code on disclosures of payments to healthcare professionals and organisations.[8] This code is already implemented in other EU member states such as: Germany, Italy, Netherlands, Spain, Sweden and the UK.[9] Notably in the EU, public disclosure of financial relationships includes all healthcare professionals, while in the USA only physicians are included. Other countries that have implemented industry self-regulation initiatives include Japan[10 11] and Australia.[3 12]

Numerous studies used these databases to identify and report payments on specific topics and to certain groups of physicians,[13–20] epidemiological analyses of the impact of industry payments on clinical practice,[21–23] and broad summaries of the entire database.[24–30] While the use of such large, comprehensive and well-regulated databases may allow for more robust analyses, critics highlight issues such as potentially incomplete and under-reported payments[31 32] along with limited vetting of payment data by physicians.[33] These concerns, however, are largely unsubstantiated. First, these laws, compared with voluntary disclosure by individual physicians, mandate disclosures by pharmaceutical and medical device companies. This mandate ensures that disclosure accuracy is not affected by a physician's perception of which payments constitute COIs. Second, the quality of the data is enhanced through internal audits, corroboration of the data with other sources, and retraction of data found to be inaccurate.[34]. Third, individual healthcare providers are able to correct inaccuracies. For example, US-based physicians are able to review and submit corrections to their profiles on CMS-OP.[35]

COIs in clinical research

Recent research has identified a high prevalence of COIs among authors of clinical trials published in high-impact medical journals. [36 37]Additionally, COIs are frequently under-reported or undisclosed.[36]Clinical trials are critical to the advancement of clinical practice and patient care. Therefore, the high prevalence of COIs among clinical investigators presents risks of bias that must be carefully considered.

Recent studies using the Open Payments database[36–38] as well as those not using the database [39–47]have evaluated whether the likelihood of a positive outcome (generally defined as either the statistical results or a favourable discussion of the results by the author) differs within trials that have conflicted authors. Some studies have suggested that trials with conflicted authors report positive outcomes more frequently than studies without conflicted authors. This observation has been recorded in fields such as oncology,[36] cardiology,[37] rheumatology,[38] and others. For example, a study by Yank *et al*[48] found that industry-sponsored meta-analyses of antihypertensive drugs were not associated with favourable results, yet they were associated with favourable conclusions. Conversely, some studies did not find an association between COIs and proindustry outcomes,[38 49–52] underpinning the importance of continued investigation of COIs and factors that may ameliorate financial bias. Of additional concern, under-reporting of COIs was common in the trials described above. For example, among oncology trials, nearly one-third of authors did not accurately or fully disclose their COIs with the trial sponsor.[36] In neuro-oncology,[53] failure to disclose a trial's funding source was significantly associated with a trial's positive conclusion. Overall, these studies highlight the potential biasing effect that COIs can have on clinical trials and demonstrate an urgent need for the regulation of disclosure of COIs in clinical trials.

Of note, COIs in clinical trials can result from both the trial itself being industry funded and the investigators having personal COIs. With far more research regarding clinical trials and industry funding, future research should be directed both at funding sources and at investigators' COIs. Additionally, peer reviewers are gatekeepers, rendering judgements to editors about the novelty, rigour and influence of a submitted manuscript. Despite increasing attention on primary author COI disclosures, similar attention has not been rendered to peer reviewer COIs.[54–56]

Table 1 New evidence and further reform

Domain	New evidence since the 2009 IOM report	Suggestions for further reform
Legislation	Several countries have enacted legislation in recent years for increased transparency of relationships between industry and healthcare providers. In the USA, the Physician Payments Sunshine Act mandates public disclosure of payments from pharmaceutical, medical device and medical supply companies to healthcare providers and academic hospitals.[4 5] Similar regulations have been enacted in several EU countries such as Denmark, France, Greece, Latvia, Portugal and Romania.[7] In 2013, the European Federation of Pharmaceutical Industries and Associations adopted a Code on disclosures of payments to healthcare professionals and organisations.[8] This code is already implemented in other EU member states such as: Germany, Italy, Netherlands, Spain, Sweden and the UK.[9] Other countries that have implemented industry self-regulation initiatives include Japan[10 11] and Australia.[3 12]	To maximise the benefit of such legislation, provisions are needed that require all industry payments to healthcare providers be publicly disclosed in a single database in each country.
Clinical Research	Recent studies using the Open Payments database[36–38] as well as those not using the database[39–47] have suggested that trials with conflicted authors report positive outcomes more frequently than studies without conflicted authors and conversely, some studies did not find an association between COIs and proindustry outcomes,[38 49–52] underpinning the importance of continued investigation of COIs and factors that may ameliorate financial bias. Of additional concern, under-reporting of COIs is also common. For example, among oncology trials, nearly one-third of authors did not accurately or fully disclose their COIs with the trial sponsor.[36] In neuro-oncology,[53] failure to disclose a trial's funding source was significantly associated with a trial's positive conclusion.	Organisations requiring disclosures of COIs need to devise and implement valid processes for the verification of those disclosures. One potential solution already being implemented by the *American Journal of Sports Medicine* is to cross-reference author disclosures against Open Payments data.
CME	CME organisations have been slow to implement and enforce COI policies outlined in the 2009 IOM report. The Accreditation Council for CME currently allows industry to fund medical communication companies[57] and industry-funded CME may spend more time discussing low value, costly interventions made by sponsors and ignore higher value, inexpensive therapies that are not produced by the company.[58] Bias applies not only to how a product is discussed but also to the unspoken choices of what is discussed and what is not discussed. However, one promising study concluded that from 2003 to 2012, US medical students were less frequently exposed to industry interactions, felt less entitled to gifts, and were more aware that gifts from industry may influence them.[59]	To enhance the implementation and enforcement of COI policies, all medical schools to adopt the National Academy of Sciences recommended COI policies. Also, in order to fully mitigate the potential for bias, all industry funding from CME should be eliminated, including funding of medical communication companies. Medical education must be permitted to fulfil its ideal—to disseminate evidence based, impartial information proportionate to the merit of products.
Medical practice	Physicians who receive industry money demonstrate greater use of the paying companies' drugs, use of brand-name drugs instead of generic drugs, and higher overall prescribing costs.[60] Physicians who receive industry payments are also more likely to use brand-name drugs rather than generic alternatives.[23 71] Additionally, physicians educated at medical schools with policies preventing industry payments had lower prescribing of brand-name psychiatric medications later in their careers.[72] Consistent with greater use of brand-name drugs, physicians who receive industry money also have greater prescribing costs (ie, total cost of drugs prescribed).[73]	We recommend that physicians not engage in personal financial relationships with pharmaceutical companies that manufacture products relevant to their clinical practice. Pharmaceutical detailing should also cease to be a source of clinical practice information for physicians, and this role can and should be filled by medical professional societies.
Clinical practice guidelines	The IOM published standards for guideline development in 2009 and 2011.[90] Among other standards, the IOM recommended that all guideline developers be free of COIs, but at a minimum, the chair and majority of authors should be free of commercial ties. However, these standards are voluntary and there is currently no vetting system or penalty for failing to meet these standards. One recent review found that a guideline featured on Medscape and published in a peer-reviewed journal did not meet any of the IOM standards. The authors of this guideline recommended expensive on-patent medications when generics were available.[92] Additionally, many studies have identified a high prevalence of financial COIs among guideline creators.[82–89]	COIs among guideline authors and development groups should be prohibited. Guideline developers should adhere to IOM standards and thus when no independent individuals with the requisite expertise are available, individuals with COIs should not have decision-making authority or voting rights regarding the diagnostic or clinical practice recommendations formulated.
Editorial boards	The International Committee of Medical Journal Editors (ICMJE) recommends that journal editors publicly disclose their 'potential' COIs, recuse themselves from assessing articles related to their COIs, and hold other journal staff to equal standards[94] Despite this clear guidance, even the ICMJE member journals do not follow their own policy: only 5 out of 14 member journals have a publicly available policy for editorial COIs, and only 2 of them publicly posted declarations of individual COIs for their editors in 2018.[93] Eighty-two per cent of journals following the ICMJE policies had COI declaration policies for authors and 34% had such policies for reviewers. In contrast, 18% had a publicly available policy on editorial COIs, and less than 1% journals had individual editors' COI declarations posted online.[95]	COIs from each journal should be published and updated regularly on the journal website and journals should be required to disclose their financial income, particularly when they publish industry-funded research.

CME, continuing medical education; COI, conflicts of interest; EU, European Union; IOM, Institute of Medicine.

COIs in medical education

There is reason to believe that one of the most troubling forms of industry influence in medicine is in the education system. For students, the lessons learnt in medical school will shape how they practice as physicians. For clinicians, continuing medical education (CME) courses,seminars and medical conferences provide opportunities to learn about new drugs and procedures and are likely to influence the adoption of novel treatments. For example, there is some evidence that medical conference FCOI policies are ineffectual, and even those speakers that choose to disclose FCOI may do so faster than humans can comprehend.[57 58] The goal of medical education, regardless of the learner's stage and experience, is to disseminate evidence based, impartial information to those in the medical field to improve patient care. The presence of for-profit industry influence in this setting may introduce bias and thereby threaten the principles of medical education.

The 2009 IOM report extensively reviewed the effects of industry in medical education and determined that the benefits of the financial relationships between medical institutions and the industry do not outweigh the associated risks.[1]. The IOM recommended implementing policies that prohibit faculty, students, residents and fellows in all associated training sites from establishing relationships with industry (except in specified situations). Those prohibited relationships include gifts, industry-run educational presentations and publications (including works written by medical writers), consulting arrangements not based on written

contracts for expert services for appropriate market price, access by drug and medical device sales representatives and the use of drug samples. The IOM also recommended that training sites provide formal education about avoiding and managing COIs. Furthermore, the IOM recommended a new system of funding for CME programmes devoid of industry influence.

Unfortunately, CME organisations have been slow to implement and enforce COI policies. The Accreditation Council for CME, which accredits many CME providers in the USA, currently allows industry to fund medical communication companies as long as the industry supporters are not involved in the creation of the educational activity, the presentations are unbiased and evidence based, and all industry ties are disclosed.[59] Yet, even the application of this standard may still allow for significant industry bias in CME. Industry-funded CME may spend more time discussing low value, costly interventions made by sponsors and ignore higher value, inexpensive therapies that are not produced by the company.[60] Bias applies not only to how a product is discussed but also to the unspoken choices of what is discussed and what is not discussed.

One promising aspect of COI policy is education on industry influence. From 2003 to 2012, US medical students were less frequently exposed to industry interactions, felt less entitled to gifts, and were more aware that gifts from industry may influence them.[61] Formal education on the effects of industry involvement can bring awareness to trainees and practising physicians alike.

COIs and medical practice

Research has identified a consistent relationship between receipt of money from drug and device companies and changes in physician practice patterns.[62] Physicians who receive industry money demonstrate greater use of the paying companies' drugs, use of brand-name drugs instead of generic drugs, and higher overall prescribing costs.[62] The temporal association between receipt of industry money and subsequent prescribing changes strongly suggests that industry money has a causative impact on physician behaviour.[63 64]

Several studies have examined drug classes with several substitutable agents to assess whether receipt of industry money shifts physicians' prescribing preferences. These studies have consistently found that physicians who receive money from one company (compared with those who do not) use that company's drug more often than competitors' drugs. This association has been observed for drug classes including alpha blockers, overactive bladder medications, cholesterol-lowering drugs, diabetes medications, tumour necrosis factor-alpha blockers, proton pump inhibitors, non-steroidal anti-inflammatory drugs and targeted drugs used to treat lung cancer, kidney cancer and chronic myeloid leukaemia.[22 65–70] The same association was observed in device selection among orthopaedic surgeons.[71] Without comparing use against other drugs in the same class, industry payments were associated with increased use of the drugs degarelix, denosumab and corticotropin.[72 73] Of the drug classes studied, to our knowledge, the only case in which studies did not show an association between industry payments and increased prescribing was targeted drugs for prostate cancer.[70 74]

Physicians who receive industry payments are also more likely to use brand-name drugs rather than generic alternatives. Specifically, physicians receiving payments prescribe more brand-name cholesterol-lowering drugs, beta-blockers, ACE-inhibitors and angiotensin receptor blockers and selective serotonin reuptake inhibitors.[23 75] Additionally, physicians educated at medical schools with policies preventing industry payments had lower prescribing of brand-name psychiatric medications later in their careers.[76]

Consistent with greater use of brand-name drugs, which are more expensive than equally effective generic drugs, physicians who receive industry money also have greater prescribing costs (ie, total cost of drugs prescribed). Receipt of industry payments is associated with increased prescribing costs across multiple medical specialties[77] and with increased cost per daily dose within the opioid class of medications.[78] These prescribing patterns have direct implications for patient out-of-pocket costs and the 'financial toxicity' of healthcare.

To date, there has been little research on efforts to mitigate the impact of industry payments on prescribing.[79] However, when academic medical centres implemented policies restricting pharmaceutical sales representative visits (or detailing), prescribing of 'detailed' drugs decreased significantly across most drug classes.[80] Other studies examining state-level disclosure laws and stricter COI policies at academic medical centres have found minimal to no change in prescribing practices or in the receipt of industry money.[70 81 82] The effectiveness of COI policies on prescribing practices remains a significant research need.

COIs and development of CPGs

CPGs aim to improve and standardise evidence-based practice and shared decision making. To achieve these goals, CPGs should be based on the best available evidence and informed unbiased judgements by experts.[83] Unfortunately, as CPGs have proliferated, so have concerns about their trustworthiness. More than two decades ago, when guideline production was relatively new, researchers looked at a broad array of guidelines in multiple fields and found that fewer than half of the reviewed guidelines met methodological standards for the development of CPGs.[84] The hope was that with time, more developers would adhere to scientific standards for rigour and the quality and trustworthiness of the CPGs would increase.[85] Unfortunately, many studies have identified a high prevalence of FCOIs among guideline creators,[86–93] leading one guideline development expert to declare 'in guidelines we can not trust'.[85]

Because of concerns about the trustworthiness and integrity of CPGs and the risk to public health if they are not reliable, the IOM published standards for guideline development in 2009 and 2011.[94] Among other standards, the IOM recommended that all guideline developers be free of COIs and be multidisciplinary (including methodologists). The recommendation that the committee is multidisciplinary is critically important in order to avoid undue guild influence. Also, at a minimum, the chair and the majority of authors should be free of commercial ties. However, much like the principles developed by the Guideline International Network in 2015,[95] these standards are voluntary and there is currently no vetting system or penalty for failing to meet these standards. One recent review found that a guideline featured on Medscape and published in a peer-reviewed journal did not meet any of the IOM standards. The authors of this guideline recommended expensive on-patent medications when generics were available and did not provide support for that recommendation or for the new clinical condition—'mixed depression'—that these drugs were supposed to treat.[96]

COIs and editorial boards

While authors' and reviewers' COIs are a challenging and timely issue in clinical research, little is known about COIs among journal editors and thus this issue remains largely unaddressed.[97] The International Committee of Medical Journal Editors (ICMJE) recommends that journal editors publicly disclose their 'potential' COIs, recuse

themselves from assessing articles related to their COIs, and hold other journal staff to equal standards.[98]

Despite this clear guidance, there is evidence that journal editors do not follow the COI policies imposed on authors and reviewers. Even the ICMJE member journals do not follow their own policy: only 5 out of 14 member journals have a publicly available policy for editorial COIs, and only two of them publicly posted declarations of individual COIs for their editors in 2018.[97] Eighty-two per cent of journals following the ICMJE policies had COI declaration policies for authors and 34% had such policies for reviewers. In contrast, 18% had a publicly available policy on editorial COIs, and only less than 1% journals had individual editors' COI declarations posted online.[99]

Editorial COIs in non-ICMJE medical journals also lack transparency. Studies using Open Payment data have demonstrated no improvements in editorial COI disclosure for high-ranked or low-ranked medical journals.[54 56 100–112] For example, among editors of journals with the highest number of citations in 2015, 10% in internal medicine, 44% in cardiology, and 2% in surgery received more than US$10 000 as general payments (eg, non-research, personal payments) from industry.[110] Such findings demonstrate the need for improved editorial COI regulation. Likewise, while the majority of journals have well-defined FCOI disclosure policies, many do not have policies on disclosure of FCOIs of authors' family members or institutions.[113–115] An additional example of FCOI within editorial boards includes the potential profits from the sale of reprints. Given the findings of Handel *et al*[116] —published articles with high reprint orders are more likely to be industry funded studies—further research is needed to determine the extent to which editorial boards accept articles which may prove profitable to their journal.

Emerging COIs topics

As we move forward in addressing COIs within the medical field at large, new topics of interest have emerged that were not addressed within the 2009 IOM report. As new technologies and means of spreading medical information arise, new methods to manage COIs must be developed. Here, we highlight areas in which COIs may result in bias and our thoughts for preventing these pitfalls in the future.

First, small panels of experts (eg, advisory boards) are trusted to make evidence-based, unbiased recommendations about the safety and efficacy of new, potentially costly drugs. These advisory boards take into account public sentiment about novel drugs during open public hearings. These open public hearings commonly include speakers that have industry-related COIs for novel drugs.[117–119] These COIs are associated with overwhelmingly positive statements about novel drugs.[117–119] Additionally, among hematology-oncology reviewers at the US Food and Drug Administration (FDA) who leave the FDA, a majority subsequently found jobs with a pharmaceutical company.[120] The *New York Times* referred to this revolving door between the FDA and industry as 'appointing a fox to guard the hen house'.[121] Therefore, there is a need for regulation of both COIs and this revolving door because, similar to other federal employees, FDA advisory board members and reviewers maintain a fiduciary responsibility to the public.

Second, public discourse on new published papers or drug development increasingly takes place on Twitter and other social media platforms. The Altmetric attention score is becoming increasingly popular as a metric for article influence because it is able to capture social media discussions. Patients are likely to benefit from open discourse on social media and may be influenced by expert testimony online. Thus, it is alarming to find that COIs affect how one tweets, blogs or posts.[122 123] Recognising the potential for bias on social media from COIs, some professional organisations have published policies on physician COIs and social media.[124] In an increasingly digital age, social media engagement by physicians with COIs is likely to play a major role in the public's attitude toward medical therapies.

Third, patient advocacy groups are important lobbying organisations that aim to magnify the voice of their constituents. Multiple studies have found that among US patient advocacy organisations, industry financial support is common and often poorly disclosed.[125–130] However, a recent review found significant industry COIs among patient advocacy organisations contributing to UK National Institute for Health and Care Excellence (NICE) health technology assessments.[131] Moreover, NICE decision-makers were not aware of these conflicts 80% of the time. The implication is that patient advocacy groups risk magnifying the voice of industry rather than the voice of patients. One promising initiative to monitor industry involvement with patient advocacy groups is the Prescription for Power database,[132] which tracks patient advocacy group funding disclosures. Additionally federal lawmakers have proposed extending Sunshine Act Reporting requirements to cover industry payments to patient advocacy organisations, an idea that was originally suggested in the 2009 IOM report.[133]

Recommendations for COIs moving forward

Recommendations for legislation

The enactment of sunshine legislation in many countries affirms the global importance of transparency. However, legislation varies widely by country and is lacking in many countries, notably EU countries with high drug expenditures. To maximise the benefit of such legislation, provisions are needed that require all industry payments to healthcare providers be publicly disclosed in a single database in each country. As databases resulting from this legislation become available, standards for these databases must be established. Such standards could include the minimum set of information that each record should include (eg, source, amount, date), a standardised categorisation of COIs (eg, following ICMJE typology) and standards for appeals.

Recommendations for clinical research

The current COI disclosure system within journals and conferences is based on the honour system. However, the recently widely publicised cases of undisclosed financial ties between researchers and industry show that this system may not be sufficient.[134] In parallel, there is accumulating evidence of under-reporting of financial relationships by researchers.[13 15] Organisations requiring disclosures of COIs need to devise and implement valid processes for the verification of those disclosures. One potential solution already being implemented by the *American Journal of Sports Medicine* is to cross-reference author disclosures against Open Payments data. If disclosures are inaccurate, journals (or conferences and other venues) may consider penalties at their own discretion. This recommendation would be a critical step away from the honour system toward a more transparent method of managing COIs in the USA. However, advocating for such change does not solve the issue of self-disclosure around the world. For example, the EFPIA requires all members to have disclosure policies, but, in many cases, compliance with these policies is not regulated.[135] Internationally, we recommend that governing bodies create a regulated, mandatory, and verifiable database to shed light on COIs around the world. It is important to note that disclosure does not not eliminate the risk of bias. Therefore, we believe that disclosure should be paired with strategies for limiting COIs to the extent possible.

Recommendations for medical education

Guidelines to ensure unbiased, evidence-based education in the medical field are available. These guidelines need to be enforced to ensure quality education for trainees and practitioners. Some may argue that financial separation of physicians from industry stifles innovation and collaboration, and others may claim that it is impossible to fund education without industry. Yet, the sizeable role industry plays in the delivery of education threatens the core independence of the field. Our first recommendation for medical education reform is for all medical schools to adopt the National Academy of Sciences recommended COI policies. Our second recommendation is to remove all industry funding from CME, including funding of medical communication companies. Medical education must be permitted to fulfil its ideal—to disseminate evidence based, impartial information proportionate to the merit of products.

Recommendations for medical practice

Research has consistently shown that physicians with such financial relationships engage in practice patterns more favourable to industry, potentially contributing to increased treatment costs and patient out-of-pocket financial burden. Many financial relationships arise from pharmaceutical detailing, on which many physicians rely to attain information on new drugs and treatment practices. Pharmaceutical detailing should cease to be a source of clinical practice information for physicians, and this role would ideally be filled by medical professional societies that are free from bias. However, currently medical professional societies do not maintain such freedom. We, therefore, recommend that medical professional societies, like individual physicians, divest from industry funding in the interest of unbiased, patient-oriented medical recommendations.

Recommendations for the development of CPGs

Because COIs have been found to be prevalent among CPG committees, effort must be taken to reduce the potential influence of COIs on documents that guide medical practice and billing. COIs among guideline authors and development groups should be prohibited; however, at a minimum, guideline developers should adhere to IOM standards. In the rare event that no independent individuals with the requisite expertise are available, individuals who have ties to industry could serve as consultants for the guideline development group. However, individuals with relevant COIs should not have decision-making authority or voting rights regarding the diagnostic or clinical practice recommendations formulated.

Recommendations for editorial boards

We recommend that journal editors be required to provide the same level of COI disclosure as they expect from their authors and reviewers. COIs from each journal should be published and updated regularly on the journal website. Additionally, editorial COIs should be published in the journals alongside the authors' COIs in the case of mega-journals, and could also be considered in other types of journals. Finally, journals should be required to disclose their financial income, particularly when they publish industry-funded research.

Conclusion

COIs are widespread within today's healthcare system and have the potential to negatively affect patient care through individual physician–patient encounters and more globally through practice-influencing documents such as CPGs. Although recent developments (such as the Open Payments database) have provided insight into physician–industry relationships, further efforts are needed to prevent COIs from affecting medical education, research and practice.

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