

Becker, Michael; Merz, Kevin; Buchkremer, Rüdiger

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## RegTech—the application of modern information technology in regulatory affairs: areas of interest in research and practice

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## RESEARCH ARTICLE

# RegTech—the application of modern information technology in regulatory affairs: areas of interest in research and practice

Michael Becker<sup>1</sup>  | Kevin Merz<sup>2</sup> | Rüdiger Buchkremer<sup>3</sup>

<sup>1</sup>FOM University of Applied Sciences, Stuttgart, Germany

<sup>2</sup>IBM Deutschland GmbH, Ehningen, Germany

<sup>3</sup>FOM Institute for IT-Management and Digitalization, Düsseldorf, Germany

## Correspondence

Michael Becker, FOM University of Applied Sciences, Rotebühlstraße 121, 70178 Stuttgart, Germany.  
Email: michael.becker3@fom-net.de

## Summary

We provide a high-level view on topics addressed in scientific articles about regulatory technology (RegTech), with a particular focus on technologies used. For this purpose, we first explore different denominations for RegTech and derive search queries to search relevant literature portals. From the hits of that information retrieval process, we select 55 articles outlining the application of information technology in regulatory affairs with an emphasis on the financial sector. In comparison, we examine the technological scope of 347 RegTech companies and compare our findings with the scientific literature. Our research reveals that 'compliance management' is the most relevant topic in practice, and 'risk management' is the primary subject in research. The most significant technologies as of today are 'artificial intelligence' and distributed ledger technologies such as 'blockchain'.

## KEYWORDS

artificial intelligence, compliance management, distributed ledger technologies, regulatory technology, risk management

## 1 | INTRODUCTION

Owing to the increasing digitization in the financial industry, new technologies and technology companies have disrupted the financial sector. Financial technology (FinTech) firms and applications have started to change various aspects of the financial market. According to Gabor and Brooks (2017), payment systems, funding platforms, and financing procedures in particular have been impacted by new FinTech systems and companies. Concerning risk and compliance management activities of financial institutions (FIs), new technological solutions are referred to as regulatory technology, or RegTech (Institute of International Finance, 2015). According to Butler and O'Brien (2019), RegTech can be regarded

as a new and vital dimension of FinTech. Compared with other current innovations, RegTech is at an early stage of development (Institute of International Finance, 2016b).

According to a survey with 62 executive risk managers and compliance officers of FIs in Germany, 89% of the respondents are convinced that there is a significant need for new technological solutions in the risk and compliance management area to manage the increasing amount and complexity of regulations more efficiently in the future (Becker & Buchkremer, 2018). Therefore, our research objective is to provide an overview of the current state of RegTech in the financial industry. For this purpose, we extend the queries related to our literature search to identify various aspects related to regulatory affairs in combination with modern information technologies (ITs). In a subsequent step, we link the literature insights to various business areas of operating RegTech firms in order to compare relevant aspects in theory and practice.

This research was conducted without any sponsoring.

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## 2 | DEFINITION OF THE TERM REGTECH

RegTech is a comparatively young field of research. The Institute of International Finance (2015) defines this term as 'the use of new technologies to solve regulatory and compliance requirements more effectively and efficiently'. In addition, Arner et al., (2017) describe the term RegTech as 'the use of technology, particularly IT, in the context of regulatory monitoring, reporting, and compliance'. RegTech is used to describe both the technological solutions that aim to assist FIs in dealing with regulatory issues and the companies or organizations that have specialized in this business area. An essential condition for the implementation of RegTech solutions is that FIs not only apply IT and risk management infrastructures but are also able to integrate these new solutions (Arner et al., 2017). Both definitions do not name specific technologies that are used in RegTech applications. The definition of the Institute of International Finance is more general than the definition of Arner et al., which specifies RegTech in the context of regulatory monitoring, reporting, and compliance. Since this research aims to present a holistic overview of thematic fields, we are going to use the RegTech definition of the Institute of International Finance. A taxonomy of terms associated with RegTech is offered by RT Associates (2020).

## 3 | LITERATURE RESEARCH

In order to examine the research area more closely, we first search for the unambiguous terms 'regtech' and 'regulatory technology' and are not surprised to find many articles that are in line with the aforementioned definitions. However, the designation 'regulatory affairs' is not only used in the financial industry. The biomedical and pharmaceutical industries, for example, frequently use the term in combination with drug testing (Buchkremer & Thibaut, 2017; Chiodin, et al., 2019). It is also confirmed by a literature search with the query 'regulatory affairs' in the topic field of the Web of Science database, where 422 hits almost exclusively address biomedical topics. We extend our search to 'regulatory' (1,243) and 'compliance' (422) in combination with mentioning information technologies through proximity algorithms (i.e. TS = ((technology OR intelligence OR mining OR learning OR text OR "natural language")NEAR/2 regulatory)). We review the articles of the two data sets and check whether there are any other relevant articles that we cannot find through our simple search. Although the hits we reveal this way touch on the subject area, they do not influence the statements of our subsequent content analysis. Therefore, we refrain from an extensive literature research with methods of artificial intelligence or natural language processing (Buchkremer et al., 2019; Gampfer, et al., 2018). In combination with modern ITs, the application in regulatory affairs is currently almost exclusively depicted in the peer-reviewed scientific literature related to the financial and banking sector.

Thus, in the first part of our research, we investigate English-written scientific literature that covers the thematic field of

RegTech. To further enhance the appropriate quality of the literature analysed, we restrict the search for available resources to peer-reviewed scientific journal articles. One additional condition is that the journal has already published the article. Therefore, we exclude forthcoming and draft papers. In particular, we consider the following literature research online portals to retrieve relevant RegTech publications:

- Emerald Insight (Emerald Publishing, 2019);
- IDEAS RePEc database (IDEAS, 2019);
- Oxford Academic Journals (Oxford Academic, 2019);
- Sage Journals (Sage, 2019);
- Science Direct (Science Direct, 2019);
- Social Science Research Network (Social Science Research Network, 2019);
- Springer Link (Springer, 2019);
- Taylor & Francis (Taylor & Francis, 2019);
- Web of Science (Web of Science, 2019);
- Wiley Online Library (Wiley, 2019).

We select these portals because of their broad collection of high-impact journals in computer science, information technology, economics, and finance. In addition, we also checked the literature research portals IEEE Xplore and the ACM Digital Library. However, we did not find adequate hits for RegTech literature in these additional online portals. The next step was to set relevant search queries that are required to identify and select relevant journal articles. We selected the following two commands in each of the presented literature research online portals:

- "regulatory technology";
- "RegTech".

Based on these two search queries and the resulting hits, we double-checked additional, individual search commands within each research portal to find further highly related articles. The quotation marks around the term "regulatory technology" are required to find only articles that contain these two words adjacent to each other. Therefore, articles that randomly contain the two words, regulatory and technology, without dealing with the subject matter, are excluded from the results list. The term "RegTech" is also typed in quotation marks to limit the results on the exact word. This approach is required since some portals also include hits that contain word fragments if the search term is not written in quotation marks. The command search is restricted to titles, abstracts, and keywords of journal articles. The content of the articles is deliberately not part of the command search because it would have also included articles in which RegTech is only a marginal issue. Since title, abstract, and keywords contain a summary of the main content of an article, we ensure to find only articles in which RegTech is present as the main topic (based on Buchkremer et al., 2019). The literature research was carried out in December 2019.

We present an overview of the number of hits in titles, abstracts, and keywords in the investigated literature research online portals in Table 1.

If an article pops up in more than one literature portal, the article initially counts and is subsequently deducted as a duplicate. Table 1 shows that the command search leads to 55 relevant journal articles. Concerning the year of publication, it must be considered that the number of RegTech articles increased significantly from 2016 (three articles) to 2019 (17 articles). Concerning the individual research portals, the Social Science Research Network reveals the highest number of hits (19 articles), followed by Web of Science (10 articles). The remaining literature portals returned between one and eight hits. We investigate articles individually using the procedures that are presented in the following section.

#### 4 | AREAS OF INTEREST

The next step of our research is to analyse the retrieved journal articles concerning the main topics and, specifically, the ITs that

**TABLE 1** Number of hits in selected literature research online portals

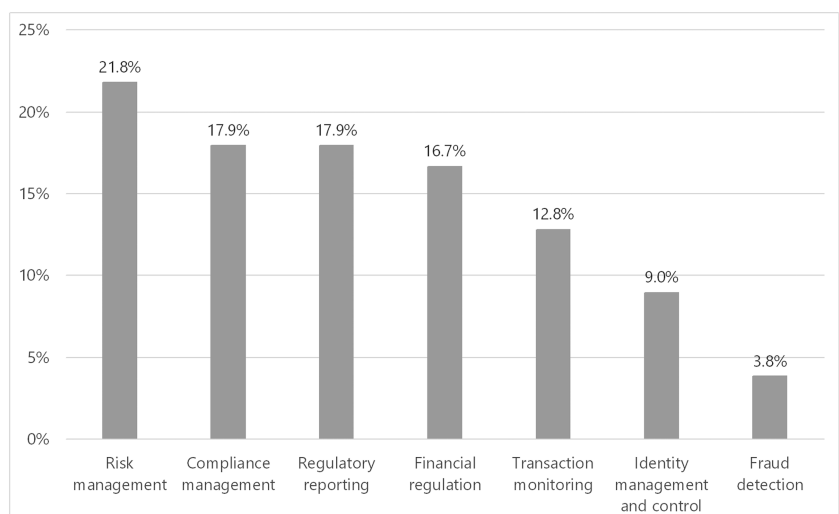
Literature research online portal	Number of hits
Emerald Insight	5
IDEAS RePEc database	8
Oxford Academic Journals	1
Sage	1
Science Direct	4
Social Science Research Network	19
Springer Link	7
Taylor & Francis	7
Web of Science	10
Wiley Online Library	3
Duplicates	-10
<b>Total</b>	<b>55</b>

they cover. For this purpose, each article is analysed individually through a manual reading process. Initially, the fields of application for RegTech solutions are examined. One article can cover either one or more thematic fields. As an initial result, we cover the following RegTech fields as they appeared in the journal articles investigated:

- risk management (17 articles);
- compliance management (14 articles);
- regulatory reporting (14 articles);
- financial regulation (13 articles);
- transaction monitoring (10 articles);
- identity management and control (seven articles);
- fraud detection (three articles).

Furthermore, the number of articles that are related to one specific topic is divided by the total number of articles in all thematic areas (78) to present an overview of the relative frequency of the topics covered. This investigation is visualized in Figure 1.

The bar chart in Figure 1 shows that 'risk management' (21.8%), 'compliance management' (17.9%), and 'regulatory reporting' (17.9%) are the most relevant topics. Some articles, like the one from Arner, Barberis, and Buckley (2016) and the articles written by Butler (2017) and Buckley, Arner, Zetsche, and Weber (2019), deal with these subjects. We notice six published articles that cover these topics in the *Journal of Financial Transformation* (Arner et al., 2016; Butler, 2017; Larsen & Gilani, 2017; Treleven & Batrinca, 2017; van Liebergen, 2017; Weber, 2017). Moreover, there is a wide range of topics that deal with compliance management that are discussed in the papers. For instance, Anagnostopoulos (2018) investigated the impact of RegTech on regulators and banks, whereas Sheridan (2017) presented the implications of MiFID II in the context of RegTech. In terms of risk management, several banks and other FIs have difficulties in aggregating their risk data efficiently on an automated basis. Several internal IT issues and legal restrictions make the aggregation process a manual and labour-intensive task for the risk management departments. Therefore, RegTech applications provide solutions for



**FIG 1** Thematic fields covered by the articles investigated

FIs to aggregate and manage their risk data more efficiently (Institute of International Finance, 2016b).

The topics that follow in the list of the most frequent hits are 'financial regulation' (16.7%) and 'transaction monitoring' (12.8%). Concerning financial regulation, Kavassalis, Stieber, Breyman, Saxton, and Gross (2018) presented a RegTech approach for regulation purposes through the application of distributed ledger technologies. Regarding conspicuous financial transactions, Salami (2017) investigated whether RegTech applications are capable of preventing the financing of terrorism. One further aspect that 9.0% of the articles investigated mention is 'identity management and control'. An example of a paper that discusses 'fraud detection' (3.8%) is the one by Williams (2013). This paper analyses how to govern fraud-related issues in financial markets.

We then evaluate the applied ITs in the articles. The following applications of the technology are discussed as major topics in our selected journal articles:

- distributed ledger technologies (16 articles);
- artificial intelligence (seven articles);
- cybersecurity (five articles);
- data mining (five articles);
- regulatory sandbox (five articles);
- machine learning (four articles);
- cloud computing (one article).

The number of articles that discuss the presented technologies is divided by the total number of articles of all categories (43) to present an overview of the relative frequency of specifically mentioned information technologies.

The evaluation of the chart in Figure 2 reveals that 'distributed ledger technology' is a prominent topic in 37.2% of the articles investigated. The most common term that is used in those articles is 'blockchain'. For instance, Yang and Li (2018) investigated distributed ledger technologies in the circumstance of technology-driven regulations. In addition, 'artificial intelligence' as a technological solution is in second position and covered in 16.3% of the articles. An article that

covers this thematic field is the one authored by Lui and Lamb (2018). Their research investigated how artificial intelligence technologies can help FIs to regain trust in the financial sector after the negative consequences of the financial crisis. The thematic fields 'cybersecurity', 'data mining', and 'regulatory sandbox' (each 11.6%) are also relevant technologies. For instance, the article by Becker and Buchkremer (2019) presented a practical use case for the implementation of 'process mining', a technology that is related to data mining, in the risk management environment of FIs. Moreover, 'machine learning' (9.3%) and 'cloud computing' (2.3%) technologies are also discussed in the context of RegTech.

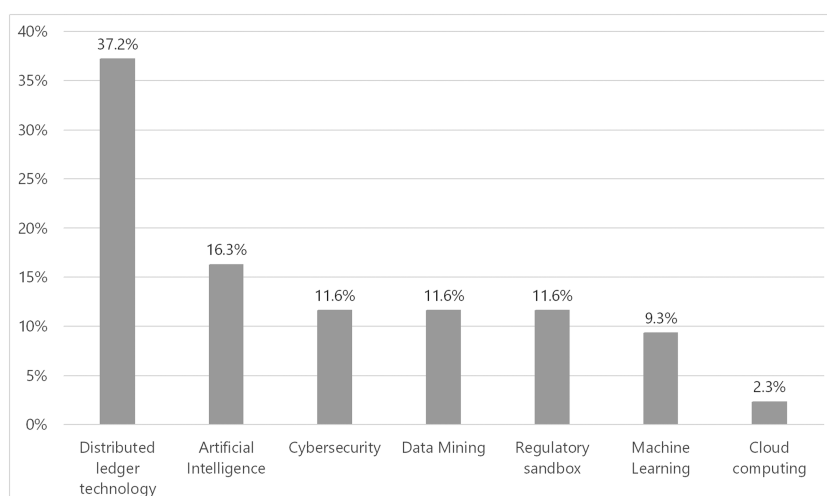
## 5 | ANALYSIS OF REGTECH COMPANIES

This section presents an analysis of the firms that offer practical RegTech solutions for banks and other FIs. The areas of practice of the individual RegTech companies are selected. Deloitte, an international consulting company, presents a real-time view of current RegTech firms. Please note that there are further platforms that give an overview of RegTech companies (e.g. CB Insights, Gartner, and RT Associates). For our research, we chose Deloitte as they offer the most convenient categorization of thematic fields. In this context, Deloitte assigns one company to only one most suitable thematic area. When the research was carried out in December 2019, we recognized the following thematic areas on the website of Deloitte (2019):

- compliance management (141 firms);
- identity management and control (83 firms);
- risk management (48 firms);
- regulatory reporting (47 firms);
- Transaction monitoring (28 firms).

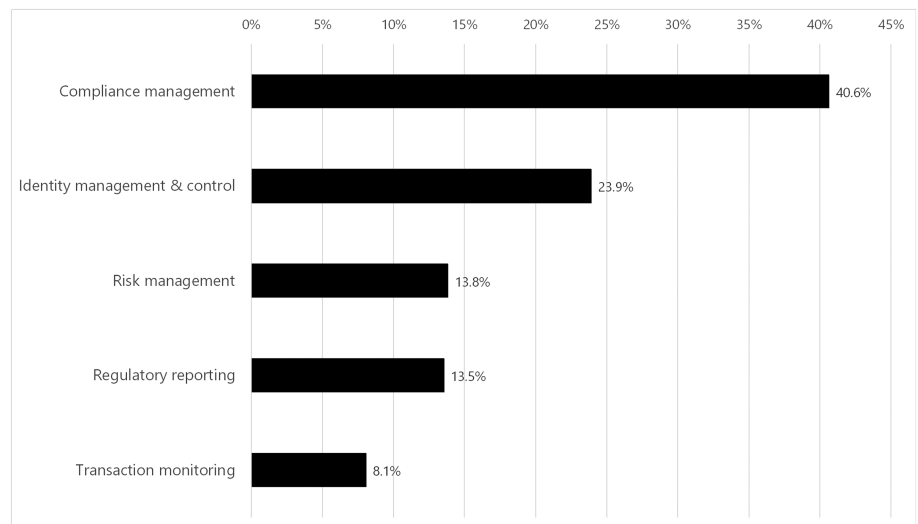
In total, Deloitte lists 347 RegTech companies. The percentage distribution of RegTech firms is presented in Figure 3.

A majority of the RegTech firms investigated (40.6%) deal with 'compliance management' issues. To name some of the companies in



**FIG 2** Technological solutions covered by the articles investigated

**FIG 3** Thematic fields covered by RegTech companies (own presentation, based on Deloitte, 2019)



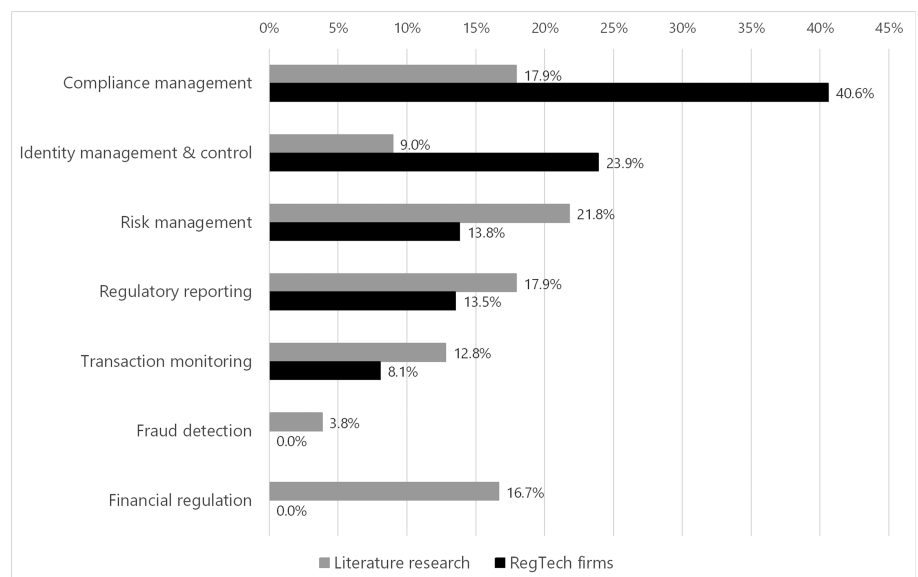
this field of action, the American company AxiomSL offers an integrated risk and regulatory compliance management platform for the financial industry (AxiomSL, 2019). MetricStream provides cloud-based applications for governance, risk, and compliance management purposes, and the Spanish company Abside RegTech offers a combination of a software solution and consulting services (Abside, 2019; MetricStream, 2019).

About one-quarter of the regarded RegTech companies present solutions for 'identity management and control' (23.9%) purposes. One simplified example that offers a financial crime compliance monitoring solution is the American company Accuity (2019). Furthermore, the American firm Jumio (2019) presents a real-time identity verification solution that assists FIs to comply with know-your-customer regulations. A further 13.8% of the companies investigated offer applications in the 'risk management' environment. For instance, the American company Provenir (2019) provides a risk modelling and analysis solution that supports FIs in the making of risk decisions

faster. The thematic fields 'regulatory reporting' (13.5%) and 'transaction monitoring' (8.1%) are also relevant fields of action. An enterprise that specializes in regulatory reporting purposes of FIs is BearingPoint (2019). In terms of transaction monitoring, the Dutch company Alto (2019) offers solutions to monitor cash flow activities in investment funds.

## 6 | COMPARISON OF RESEARCH AND PRACTICE

In comparison with the investigation of other technical topics we have undertaken—for example, on enterprise architecture (2018)—we find that RegTech is still a very young scientific field. Whereas we encounter thousands of articles on other technological topics, we currently only see a few dozen articles in this area. Also, the variety of technological topics addressed so far seems to be limited. For example, at



**FIG 4** Comparison of research and practice

present, significant topics such as natural language processing (2017) and robotic process automation (2020) are only marginally touched upon. Both subjects, process and text analysis, undoubtedly play an essential role in regulatory affairs. Therefore, we expect challenges for future research in these two areas. Though scientific articles predominantly address technologies (distributed ledger, artificial intelligence), companies tend to focus on the process view (compliance management). For this reason, it is not a trivial matter to compare these two areas. However, to obtain a comparative view, we assign insights from the literature research to practical aspects of RegTech companies in Figure 4. The chart shows that 'compliance management' is the most dominant thematic field for RegTech applications (40.6%), compared with the related scientific literature (17.9%). A potential reason for this could result from the fact that compliance management activities are both costly and time intensive for FIs. Internal and external experts require to ensure that business processes are designed in accordance with legal frameworks. Not being compliant can thus lead to the endurance of a financial penalty or, in the worst case, to the withdrawal of the banking license. Therefore, it is a high priority for banks and other FIs to ensure that compliance of activities and business processes is ensured at all times (Institute of International Finance, 2016a).

In addition, 'regulatory reporting' is covered by a high share of journal articles (17.9%). In contrast, a smaller portion of 13.5% of the investigated RegTech firms addresses this topic. One additional area that is handled by a higher share of scientific articles is 'risk management' (21.8%, compared with 13.8%). A significant reason for the difference appears to be that many RegTech companies are specializing in compliance management and present risk management and regulatory reporting applications as an integral part of their offerings.

Another aspect that provides a higher share in the literature is 'transaction monitoring' (12.8% and 8.1%). A possible reason for this difference could again be that the technological view is more present in science. We thus expect a future increase in the field of robotic process automation in connection with transaction monitoring.

One topic that is underrepresented in the scientific literature is 'identity management and control', with a total of 9.0% compared with a total of 23.9% from RegTech firms that deal with this field of action. Identity management and control activities are legally required in several frameworks. A highly relevant example is the know-your-customer requirements for FIs that intend to prevent money laundering, economic crime, and terrorism-financing activities (Arner et al., 2016). Owing to the digitization within society, an increasing number of persons and institutions prefer to carry out their banking activities online rather than referring to a bank counter. For this purpose, several RegTech companies offer customer identification solutions tailored to online customers (Jumio, 2019).

## 7 | CONCLUSION

Banks and other FIs are overwhelmed by new and constantly changing regulations that are published by supervisory authorities all over

the world. Not only do the total number of regulatory requirements increase steadily, but also the degree of complexity of regulations (Eggert, 2014: 7). Because of that, banks and other FIs are searching for new and innovative technical solutions that can assist in dealing with the regulatory burden in a more efficient manner (Becker & Buchkremer, 2018). These RegTech solutions are currently at an early stage of implementation compared with other innovations, like FinTech in the financial industry (Institute of International Finance, 2016b). However, the potential benefits of RegTech innovations are substantial. Therefore, this paper presents the most relevant thematic areas both in research and in practice. This research examines that there are several superior topics. In particular, the thematic field 'compliance management' is addressed by a majority of RegTech firms. In addition, 'risk management' activities and 'regulatory reporting' are regarded as further essential topics in the journal articles analysed. In practice, 'identity management and control' is the second most relevant business field for RegTech companies concerning current RegTech firms by Deloitte.

In conclusion, it must be considered that the last major step for banks and other FIs to enhance their risk and compliance management activities was to digitalize them, and the next major step is to make them more efficient using RegTech applications. Currently, RegTech seems to be discussed mainly in FIs, as our literature analysis reveals. The main focus areas currently seem to be the control of processes and the analysis and the alerting related to the content of the many guidelines that flood in on the enterprises and organizations. Here, researchers apply artificial intelligence technologies that are primarily related to natural language processing (Buchkremer et al., 2019). Since both topics (control and content alerts) are needed in other subject areas as well, we expect an extension of the terms RegTech to medicine and other industries in the future, both in practice and in the scientific literature.

## ORCID

Michael Becker  <https://orcid.org/0000-0002-7701-2398>

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