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Brexit and transplantation research: EU funding and scientific collaborations

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INTRODUCTION

It has been extensively argued that the United Kingdom's impending departure from the European Union (EU), "Brexit", will have a major impact on the National Health Service and the scientific community in the UK. The consequences of such a scenario are expected to be severe. Without an agreement on future cooperation and collaborations, prospects are that the United Kingdom will lose access to EU research funding programs, which could significantly weaken the British scientific community.

An immediate result of a no-deal Brexit will be a lack of access to the Horizon 2020 funding, EU's major research funding scheme. Within the Horizon 2020 program, UK-based researchers have access to around €1.3 billion per year. Furthermore, the United Kingdom will probably not have access to the next EU research and innovation program "Horizon Europe", for which a budget of €94.1 – 120 billion for the years 2021-2027 has been proposed.^{1,2} In addition, UK-based foreign scientists, including post-doctoral researchers and graduate students, especially those from the EU, face uncertainty with regard to their legal status in the United Kingdom, threatening research productivity. Moreover, a large group of researchers with an EU-background may consider returning to the European mainland, together with their personal funding and networks.³

With the above in mind, the consequences for the United Kingdom's involvement in transplantation research, in both Europe and globally, remain uncertain. The current literature does not provide an analysis of the United Kingdom's involvement in (transplantation) research projects and scientific publications, or on the consequences of global research collaborations. Considering these major changes in the scientific landscape, and the fact that organ transplantation crosses many borders, we provide an overview of the allocation of EU-funding in the EU and the potential loss of international research collaborations in case of the Brexit.

METHODS

Information on EU-funding was collected utilizing the Publications Office of the European Union (CORDIS) database (1988 – 2019). To assess international collaborations, a bibliometric analysis of scientific publications from transplantation journals was performed, using the Web of Science database (1999 – 2019). An elaborate description of the methodology is provided as a Supplement.

EU-FUNDING

The data on EU-funding for transplantation research clearly shows the dependence of the UK transplant community on EU-funding: From 1988 to 2019, 135 projects focusing on transplantation research received EU-funding, with a total budget of €292 million. The 4 largest EU countries, based on population size, received the largest part of the funding budget, with 26.8% (€78.3 million) going to Germany, 17.1% (€49.8 million) to France, 12.0% (€35.0 million) to Italy and 10.7% (€31.4 million) supporting United Kingdom research. Stratifying projects based on coordinating countries show that the United Kingdom is one of the five leading coordinators of EU funded projects on transplantation research (Figure 1) (France 17.8%, Germany 14.8%, United Kingdom 14.1%, Spain 10.4% and Italy 9.6%).

These numbers indicate the strong link among EU-member states, with the involvement of UK-based researchers in 47.4% of the EU-funded projects (14.1% as coordinating country and 33.3% as participating country). Participation of UK-based researchers was mostly seen in projects coordinated by Germany (28.9%), France (22.2%) and The Netherlands (13.3%) (Figure 2).

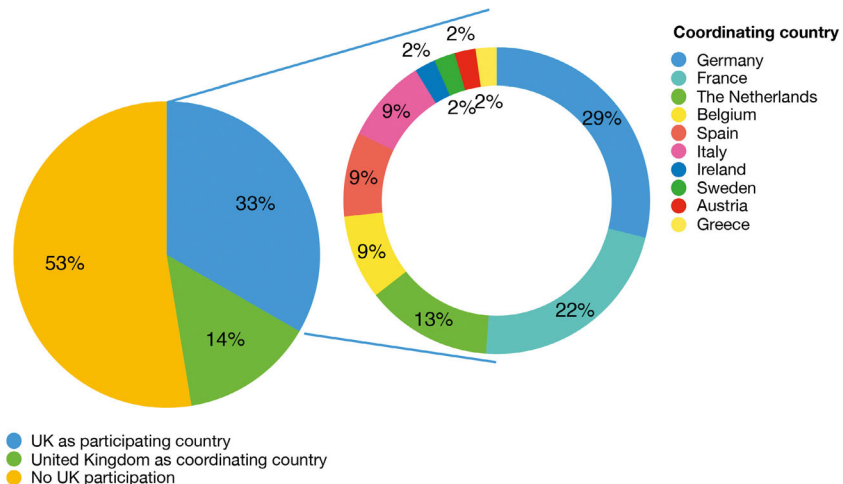


Figure 1. EU-funded projects and coordination/participation by UK-based researchers. EU, European Union

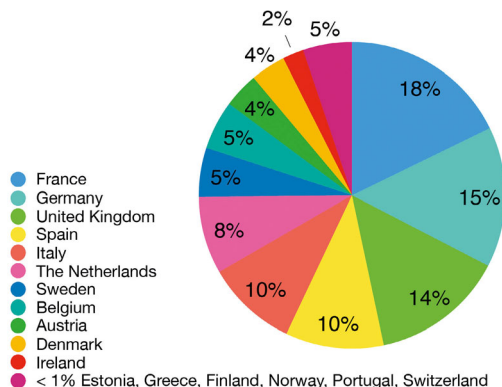


Figure 2. Percentage of EU-funded projects by coordinating country. EU, European Union

INTERNATIONAL COLLABORATIONS

When assessing the scientific output in the transplantation community, the United States has been the largest contributor (17277 publications) followed by Germany (3179 publications) with the United Kingdom ranked third (2.766 publications).

Approximately 20% of scientific publications by UK primary authors are the result of an international collaboration, with a multiple/single country ratio of 0.19 (the number of publications by authors based in different countries as a proportion of the total number of publications). The worldwide median (interquartile range) multiple/single country ratio that characterizes the number of publications by authors from different countries as a proportion of the total number of publications, was 0.20 (0.15 – 0.30), with the highest ratio for Norway (0.35), the lowest ratio for Pakistan (0.00) and a ratio of 0.19 for the United Kingdom (Figure 3). When reviewing these international collaborations, the United States (n=306, 7.6%), Denmark (n=139, 3.4%), Germany (n=121, 3.0%), the Netherlands (n=113, 2.8%) and France (n=102, 2.5%) were identified as the most relevant scientific allies of UK-based authors, 4 of which are part of the EU (Figure 4). Including scientific publications as participating authors, UK-based authors contributed to 4017 (4017/42628, 9.4%) publications.

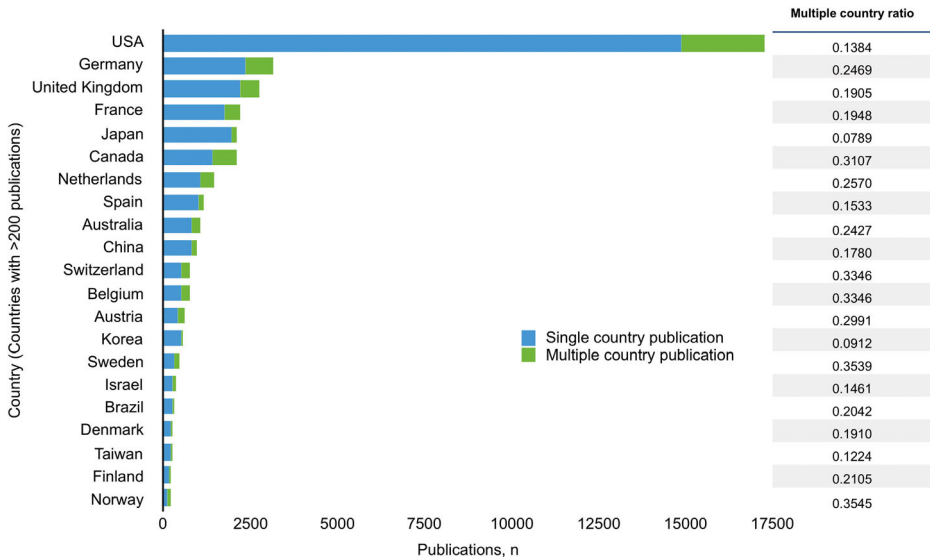


Figure 3. Number of single country and multiple country publications (1999-2019).

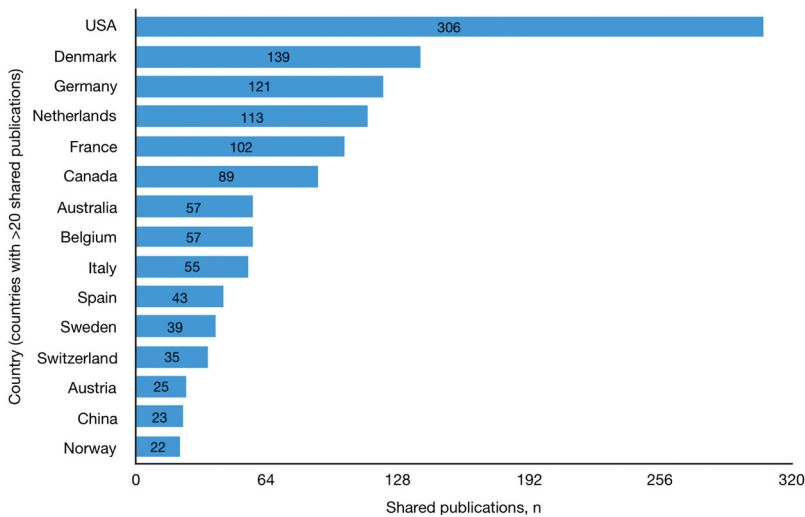


Figure 4. Numbers of publications shared with UK-based authors

THE IMPACT OF BREXIT

Earlier publications on the effect of the dawning Brexit on international scientific collaborations and research output point to the high probability of a negative impact in the first years after Brexit.⁴⁻⁶ In 2017 and 2019, Fahy et al^{5,6} provided an extensive analysis of 4 possible Brexit scenarios, with (1) a no-deal Brexit; (2) a withdrawal agreement; (3) the Northern Ireland Protocol's backstop, an option assuring that the border between the United Kingdom (Northern

Ireland) and Ireland remains open; and (4) a political declaration on the future relationship between the United Kingdom and EU.

Currently, we see 3 possible options: (1) a withdrawal agreement (deal); (2) no deal; or (3) a revoke of #50 (no Brexit), albeit the latter seems to be improbable. With the first scenario, EU funding and collaborations, including a legal framework, will stay in place until December 2020. Both sides will aim for continued UK and EU research collaborations, however, terms are expected to get more challenging for the UK. The second scenario will end EU funding and stall EU collaborations. Considering the most current political climate, the no-deal scenario seems far more likely than a revoke of #50. However, The British Medical Association, British Medical Journal and the Royal College of Nursing continue to insist on a second Brexit referendum.⁷ A second referendum or a revoke has, however, been thus far declined by the Government. Current evaluations show that all variations of Brexit will have negative consequences for the United Kingdom's position in healthcare and health-related research, with the most detrimental effect in case of a no-deal Brexit.

As the United Kingdom is a significant beneficiary of EU-funding, the United Kingdom government announced their efforts to guarantee EU-funding beyond the official Brexit date, at least up to the end of Horizon 2020.⁸ The United Kingdom government also announced to explore the possibility of creating an international research fund to fill the gap when EU-funding opportunities are lost after Brexit.⁹ From a scientific perspective, allowing Britain to participate in the Horizon 2020's successor "Horizon Europe" as an "associated" country is expected to significantly limit Brexit's impact. The status of "associated" country would enable UK-based researchers to be part of European Research Council projects, a status currently held by non-EU countries such as Norway and Switzerland. However, a series of side-deals and compromises will be essential to soften the blow on research and innovation for both the United Kingdom and the EU.

From a clinical perspective, Brexit could have a forceful impact on organ donation and transplantation in the United Kingdom. While international donation and transplantation societies are thriving, UK-based researchers could face difficulties when pursuing international collaborations.¹⁰ Shapey and co-workers detailed the areas of potential impact on clinical transplantation in case of a Brexit extending to (1) existing EU-wide legislation; (2) regulation and governance, with requirements and standards of quality and safety for organs; (3) existing organ-sharing networks; (4) pan-European initiatives, including EU-funding for research and cross border initiatives to increase donation rates; (5) EU efforts to combat organ trafficking and transplant tourism; and (6) legal status for EU-citizens working as clinicians and/or researchers in United Kingdom transplant centers.¹¹

CONCLUSION

With nearly 11% of transplantation research-related EU-funding and the involvement of UK-based researchers in almost half of all EU-funded projects, the United Kingdom plays an important role in transplantation research and UK-based researchers have an important position within the EU research community.

Brexit, the United Kingdom's impending departure from the European Union, is expected to have a detrimental impact not only the scientific community in the United Kingdom but also on the continental European countries.

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SUPPLEMENT: METHODS

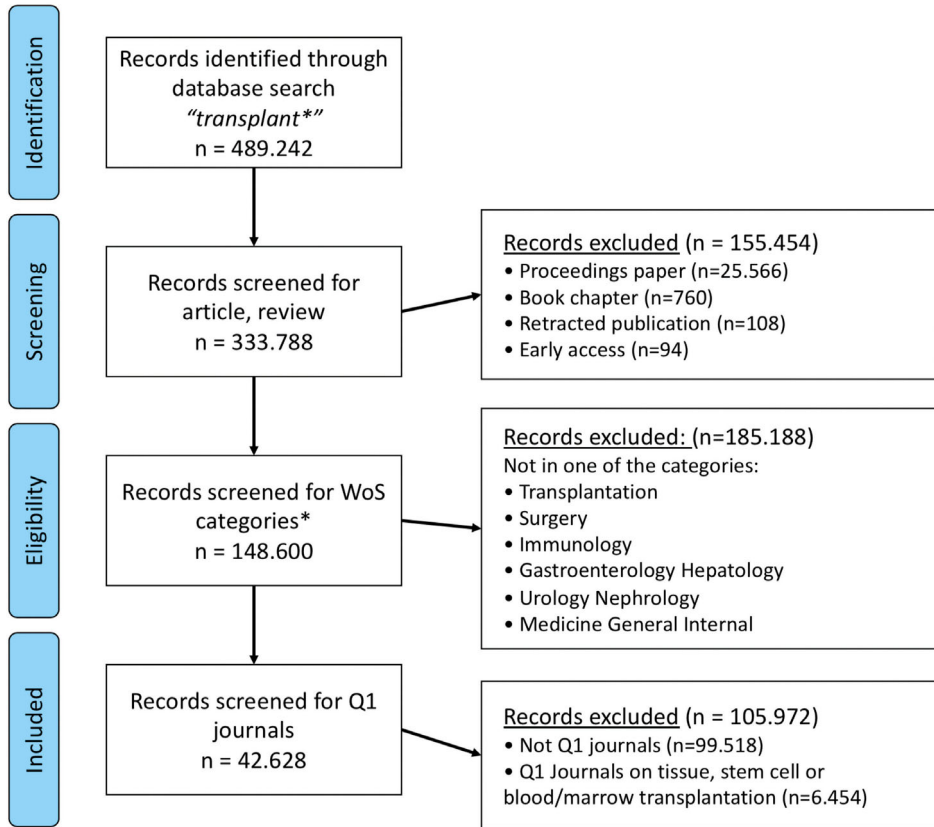
To evaluate the distribution of EU funding between EU countries, we used funding information from the Publications Office of the European Union (CORDIS).¹ The CORDIS database contains information from 1988, the year in which EU-wide scientific funding started, up to now. A CORDIS search was performed using the query “contenttype=‘project’ AND (‘transplantation’) AND period=01-01-1988 to 25-03-2019” at March 25, 2019. Data of 877 projects was extracted and screened for the sole inclusion criterion “projects focusing on solid organ transplantation”. To study international collaborations, we performed a bibliometric analysis of scientific publications from transplantation journals. We used the Web of Science database with the term “*transplant**” to include all relevant publications between 01-01-1999 and 17-06-2019.² We focused on original publications (article, review), and excluded editorials, letters to the editor and conference abstracts. We selected 1st quartile (Q1) journals from the Web of Science categories “*Transplantation*”, “*Surgery*”, “*Immunology*”, “*Urology Nephrology*”, “*Gastroenterology Hepatology*” and “*Medicine General Internal*”. Journals specifically focusing on tissue, stem cell or blood/marrow transplantation were excluded. This resulted in publications from 32 Q1 journals, as listed below (source Q1 journals from search categories). A total of 42.628 first-quartile scientific publications focusing on transplantation were identified between 1999 – 2019. The initial search resulted in 489.242 publications, after which 155.454 publications were excluded for not being either article or review. Screening for the Web of Science categories resulted in exclusion of 185.188 publications. After selection of Q1 journals, a final selection yielded 42.628 publications. A PRISMA flowchart of the publications through the search process is shown below.

All data was analyzed using *R: A Language and Environment for Statistical Computing*, version 3.5.2 (R Foundation for Statistical Computing, Vienna, Austria), with the software R-Package *bibliometrix* (Aria & Cuccurullo, 2017) and *Numbers* (version 6.0 apple inc.). Results are presented with descriptive statistics. The multiple – single country ratio, as provided by the *bibliometrix* package, describes the number of publications by authors based in different countries, as a proportion of the total number of publications.

Source Q1 journals from search categories

Q1 journal	Number of transplant* publications
Transplantation	9486
American Journal of Transplantation	5297
Journal of Heart and Lung Transplantation	3571
Liver Transplantation	3404
Transplant International	2424
Nephrology Dialysis Transplantation	1917
Journal of Immunology	1567
Annals of Thoracic Surgery	1229
Kidney International	1100
American Journal of Kidney Diseases	982
Pediatric Nephrology	935
Journal of Surgical Research	900
Journal of Thoracic and Cardiovascular Surgery	888
Journal of the American Society of Nephrology	852
Frontiers in Immunology	768
European Journal of Cardio Thoracic Surgery	707
Xenotransplantation	684
Clinical Journal of the American Society of Nephrology	632
Annals of Surgery	558
Journal of Urology	489
New England Journal of Medicine	438
Journal of Nephrology	425
World Journal of Surgery	410
Lancet	381
European Journal of Immunology	326
Journal of the American College of Surgeons	320
Journal of Gastrointestinal Surgery	307
American Journal of Nephrology	303
HPB	244
Urology	220
American Journal of Surgery	212
British Journal of Surgery	206

PRISMA flow diagram showing the flow of studies through the search process



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