How will Brexit affect health and health services in the UK? Evaluating three possible scenarios

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The process of leaving the European Union (EU) will have profound consequences for health and the National Health Service (NHS) in the UK. In this paper, we use the WHO health system building blocks framework to assess the likely effects of three scenarios we term soft Brexit, hard Brexit, and failed Brexit. We conclude that each scenario poses substantial threats. The workforce of the NHS is heavily reliant on EU staff. Financing of health care for UK citizens in the EU and vice versa is threatened, as is access to some capital funds, while Brexit threatens overall economic performance. Access to pharmaceuticals, technology, blood, and organs for transplant is jeopardised. Information used for international comparisons is threatened, as is service delivery, especially in Northern Ireland. Governance concerns relate to public health, competition and trade law, and research. However, we identified a few potential opportunities for improvement in areas such as competition law and flexibility of training, should the UK Government take them. Overall, a soft version of Brexit would minimise health threats whereas failed Brexit would be the riskiest outcome. Effective parliamentary scrutiny of policy and legal changes will be essential, but the scale of the task risks overwhelming parliament and the civil service.

Published **Online**
September 28, 2017
http://dx.doi.org/10.1016/S0140-6736(17)31926-8

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Introduction

Leaving the European Union (EU) is arguably the greatest peacetime challenge that the UK has ever faced. The future is especially uncertain following the 2017 general election, which left the government with a minority in Parliament.

The potential impact on heath and health care will be substantial,[1] affecting how medical products are licensed, the employment of EU staff in universities and the National Health Service (NHS), the rights to health care of EU citizens in the UK and vice versa, regulation of research, and much more. However, the British Government has not addressed these crucial issues, while the civil service appears to be struggling to cope, especially within the Department of Health, which has experienced large scale redundancies.[2] The Department for Exiting the EU had not initially considered reciprocal health-care arrangements[3] and the Department of Health was excluded from the formal negotiating process.[4] There are deep divisions within the cabinet and we have no confidence that central government is yet in a position to address the consequences for health.

In this paper, we use the WHO's health systems building blocks (figure 1)[5] to evaluate the effects of Brexit on health and the NHS. Given the present uncertainty, we assess three possible scenarios: a quasi-European Economic Area (with access to the single market but restrictions on free movement of people, which we refer to as soft Brexit; a free trade agreement, such as that between the EU and Canada, referred to as hard Brexit; and falling back on World Trade Organization (WTO) rules, referred to as failed Brexit (panel).

Health impact assessment

We identified several topics within each building block and scored each as broadly unchanged, positive, moderate negative, and major negative in terms of health risk.

Figure 2 summarises the probable consequences of the soft Brexit, hard Brexit, and failed Brexit scenarios.

Health workforce

The health workforce is especially vulnerable to the effects of Brexit, with major effects on recruitment and retention of EU nationals within the NHS and social care.

Recruitment and retention of EU nationals to the NHS workforce

It will be very difficult for the UK to be self-sufficient in the NHS or social care workforce in the foreseeable future. As of 2017, over 60 000 people from non-UK EU countries work in the NHS and 90 000 work in adult social care.[2] One in ten doctors in the UK is a European Economic Area (EEA) graduate (the EEA comprises the EU countries plus Iceland, Liechtenstein, and Norway).[2] The Association of UK University Hospitals notes that EU membership greatly enhances the attractiveness of the UK as a place to build a career in research and clinical

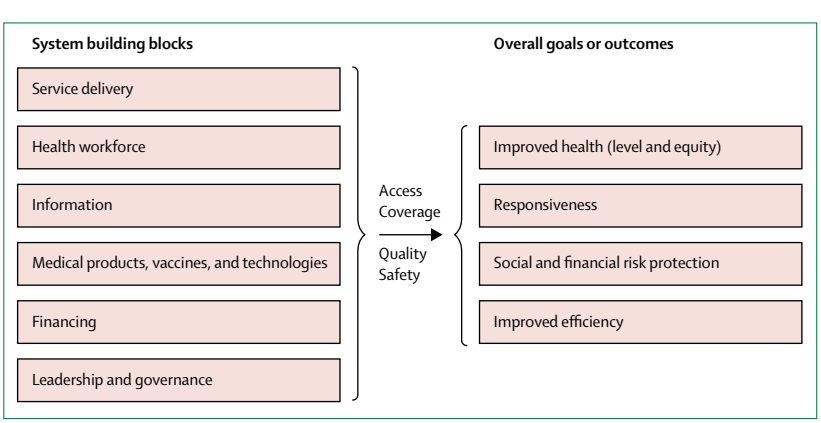

Figure 1: **The WHO Health System Framework.**
Reproduced from WHO's framework for action,[5] by permission of World Health Organization.

Panel: Three possible scenarios for Brexit

Soft Brexit: continued integration with the single market

This scenario represents the closest continuing relationship with the EU, with a high degree of integration with the single market, although, as restrictions on free movement of people seem inevitable,[6,7] there would have to be limits on this integration. This scenario could be based on the European Economic Area model, used by Norway, Iceland, and Liechtenstein. Given the importance of avoiding tariffs and quotas on goods with the EU, one obvious counterbalance for the UK would be to offset limits in free movement with limits on trade in services, although this would have a substantial impact on the City of London in particular, and thus on tax revenues. Some rights of people from the rest of the EU who are already in the UK could be settled in the UK's withdrawal agreement, although major questions would remain about how these rights would operate, be enforced and, in the case of disputes, adjudicated.

The legal implications of soft Brexit include that much of EU law would continue to apply in the UK, albeit without the UK participating in making that law, and without access to the European Court of Justice (ECJ) to interpret and enforce that law. Formally, EU law would no longer be a source of UK law, but in reality much of it would continue to be so, through compliance with EU regulatory standards necessary for UK firms to secure access to EU markets, and through the interpretation and application of law originating from the EU, as proposed under the EU Withdrawal Bill, which would transpose all existing EU legislation into domestic UK law (although many practical questions remain unanswered about this process).[8] In practice, much would depend on what dispute resolution mechanism replaces the ECJ, as a tribunal system is unlikely to maintain the transparency and commitment to a high standard of health enshrined in the European treaties and upheld repeatedly by the ECJ.[9]

Hard Brexit: free trade agreement

This scenario involves a wide-ranging EU-UK free trade deal, perhaps similar to the free trade agreement (FTA) signed in 2016 between the EU and Canada. The position set out in the Government's White Paper on Brexit[6] is not compatible with remaining within the single market in any way, particularly in view of the government's insistence on avoiding any judicial oversight of an agreement. An FTA would be the closest probable future relationship with the EU that is consistent with the White Paper's negotiating approach. By creating an entirely new agreement, though, this approach would also probably be the most time-consuming and could take up to a decade to reach agreement.[10]

One of the legal implications of this agreement would be that the EU-UK FTA is not in any way part of UK law. At present, individuals have recourse to EU law if their rights are violated, but under an EU-UK FTA they would lose this entitlement. This was a central issue in the government's attempt to avoid seeking Parliamentary approval for triggering Article 50, signifying its intention to withdraw from the EU. Instead of the mechanisms currently in place, an investor-state dispute resolution system might be included in the FTA.

Failed Brexit: falling back on World Trade Organization (WTO) rules

This scenario is possible if the UK and the EU cannot reach agreement, and the UK falls back on WTO rules for its trade with the EU. From a trade point of view, this poses technical and substantive challenges. From a technical point, the process of updating the UK's terms of trade under the WTO is likely to be far from straightforward. The challenges involved have been illustrated by a case study that examined the superficially simple rules on trade in lamb and mutton[11] that, in practice, were so complex that they had not been updated since before the EU's 2004 enlargement. From a substantive point, the UK will abruptly face additional tariffs and, arguably more importantly, quotas on goods of all kinds with the EU and countries with whom we trade under FTA through the EU. There are also many aspects of trade which are governed within the EU legal framework but which do not have corresponding frameworks within the WTO, meaning that further individual agreements would need to be found under this scenario.

roles.[2] These overall figures do not take into account professional-specific, regional-specific, and sector-specific reliance on EU and EEA nationals, where London and the South East appear particularly vulnerable to a loss of labour, while Northern Ireland effectively shares a health and social care workforce with an EU country.

Brexit might make the UK less attractive to health workers from the rest of the EU because it could undermine their legal entitlements and those of their families (whether their families are EU citizens or not). These entitlements include not only residency rights but also the right to not be discriminated against on nationality grounds when entering the UK; access to employment, housing, and other benefits, including access for their children to primary, secondary, and higher education; accumulation and transfer of pensions, social security, and welfare; the right to health care anywhere in the EU on retirement and when visiting their home country (eg, for childbirth); some democratic rights, such as voting rights in local elections; and mutual recognition of qualifications from any EU country (subject to linguistic competencies). Where competence to practise is a concern, an EU-wide alert mechanism is in operation, bolstering trust in qualifications obtained elsewhere in the EU; there is no similar system covering the rest of the world.

These entitlements derive from EU law and are subject to minimal administrative formality. If rights are breached, enforcement is done through UK courts.

 Published online September 28, 2017 http://dx.doi.org/10.1016/S0140-6736(17)31926-8

	Soft Brexit	Hard Brexit	Failed Brexit
Workforce			
Recruitment and retention of EU nationals in the NHS	Likely to include some restrictions on migration	Likely to include restrictions on migration and legal status of EU nationals	Absence of legal framework for mobility likely to have a severe impact on migration
Mutual recognition of professional qualifications	May remain unchanged	Potential for regulators to improve system	Potential for regulators to improve system
		Likely to make mutual recognition more difficult	Likely to make mutual recognition much more difficult
Employment rights for health workers	Existing rights likely to remain	Existing rights likely to be diminished	No protection of existing rights
Financing			
Reciprocal health-care arrangements	Arrangements likely to continue	Replacement arrangements unlikely to provide equivalent protections	No rights in place due to absence of legal framework
Capital financing for the NHS	Likely to continue through European Investment Bank	EU funds through European Investment Bank likely to be stopped	Likely to undermine capital financing more generally
Indirect impact on NHS financing	Likely to affect wider economy and thus NHS financing	Likely to affect wider economy and thus NHS financing	Likely to severely affect wider economy and thus NHS financing
Medical products, vaccines, and technology			
Pharmaceuticals	Likely to continue with current arrangements, but with loss of global influence	A new licensing regime needed, with impact on timely access Loss of global influence	Absence of legal framework likely to affect severely on the UK Loss of global influence
Other medical products	Arrangements likely to continue	A new licensing regime needed, with impact on timely access	Absence of legal framework likely to affect severely on the UK
Information	Arrangements likely to continue	External position likely to undermine information collaboration	Absence of agreements likely to mean end of information collaboration
Service delivery			
Working time legislation	Arrangements likely to continue	Potential to improve on current rules	Potential to improve on current rules
		Existing protections likely to be diminished	Existing protections removed
European Reference Networks	Arrangements likely to continue	External position likely to undermine collaboration	Collaborations stopped without a legal framework
Cross-border care	Arrangements likely to continue	Likely to cause severe problems with current collaborations, unless addressed by new arrangement	Absence of deal will cause severe problems with current collaborations
Leadership and governance			
Public health	Arrangements likely to continue	Potential to improve on current rules, if political will exists	Potential to improve on current rules, if political will exists
		Existing protections likely to be diminished	Existing protections likely to be diminished
Competition and trade	Trade likely to be affected	Potential to adapt competition rules, if political will exists	Potential to improve on current rules, if political will exists
		Trade likely to be affected	Trade likely to be severely affected
Research	Arrangements likely to continue	Funding likely to be diminished Loss of global influence	Collaborations and funding from EU ended Loss of global influence
Scrutiny and stakeholder engagment	Volume of new legistlation likely to limit scrutiny and engagement	Volume of new legislation likely to severely limit scrutiny and engagement	Volume of new legislation likely to severely limit scrutiny and engagment

Broadly unchanged · Positive · Moderate negative · Major negative

***Figure 2*: Risks posed to health-related issues (organised by WHO health system building blocks) of three scenarios for Brexit**

Apart from symbols on their passports, these staff are treated as UK nationals. In March, 2017, *The Guardian* reported a 92% drop in EU nationals registering as nurses in England, which the Royal College of Nursing blamed "on the failure of the government to provide EU nationals in the UK with any security about their future."[12]

Mutual recognition of professional qualification

One area in which some see potential for improvement after Brexit is professional regulation, with regulators in the UK[4] uncomfortable with how mutual recognition of qualifications works. Specific skills, such as language, are assessed by employers, as they are most familiar with specific needs of the job and are best qualified to make

that assessment. However, UK professional regulators (who have expanded their responsibilities more than regulators in other EU countries in recent years[13]) believe that they should have this role, and see potential for improvement by strengthening their requirements for recognising professionals' fitness to practise in the UK. Given the reciprocity principle in negotiations by the EU, this is likely to cause corresponding increased difficulties for mobility by health professionals from the UK to the EU.

Employment rights arising from EU law

Health and social care staff are protected by numerous employment rights under EU law. These include EU equality law (which protects against discrimination on sex, race, disability, and other grounds); EU health and safety at work law (including maternity leave rights, working time); and EU employment law on restructuring (such as security of rights when another employer takes over a contract to provide services). Although these will initially be incorporated into UK law by the EU Withdrawal Bill, the protection that comes from interpretation of disputes by the European Court of Justice (ECJ) will cease.

Financing

The main effects of Brexit on financing will affect individuals, who will lose coverage when abroad if reciprocal health-care arrangements end. There are also effects on capital financing for the NHS and on the overall NHS budget.

Reciprocal health-care arrangements

Free movement within the EU depends crucially on support from social protection systems of the Member States. In turn, access to these systems depends on the mutual recognition of rights acquired in each country, and a mechanism by which the country where the person is covered reimburses the countries where the person receives care or support.

Although details are complex, the basic principles are simple: rights are built up and passed on as a person lives and works in different countries. Anyone requiring health care in a different EU country is treated as if they live there, with their home country reimbursing the country where care was provided. The EU-UK post-Brexit deal could continue this system and the UK Government appears to want to do so,[2] although how this system can be reconciled with its wider Brexit objectives (in particular, leaving the future jurisdiction of the European Court of Justice)[6] is unclear. It is clearly a high priority for the EU and was reportedly invoked explicitly by the president of the European Commission, Jean-Claude Juncker, when he met UK Prime Minister Theresa May, but the summary of the EU and UK negotiating positions on citizen's rights shows no agreement on this crucial issue.[3]

Leaving this system will jeopardise access for people covered by the NHS who are travelling to the EU for work, study, or leisure. Around 27 million people hold European Health Insurance Cards (used to show home country coverage) issued by the UK.[2] This system has several important advantages over the alternative, voluntary private insurance, which would transfer the costs to the individual. First, the European Health Insurance Card does not exclude pre-existing conditions; second, all existing private insurance schemes are priced according to individual risk, which would make coverage prohibitively expensive for older people, or those with chronic conditions; third, it would not replace some specific EU arrangements, such as provision for people requiring dialysis.[14]

The most profound impact is likely to be on UK nationals who live elsewhere in the EU. There are around 190 000 people receiving British pensions who live in other EU countries (in particular Spain, France, Ireland, and Cyprus), and depend on these arrangements for health care.[2,15] Many are UK nationals who worked their whole lives in the UK, but who retired to warmer climates where their pension would go further.[16] Others are not British, but have worked in the UK for much of their lives before retiring to their countries of birth.

The costs of EU-insured people receiving care in the UK are also covered by this system. Although they are fewer than UK nationals living abroad, the mechanism remains crucial.

The UK pays about £650 million per year for care provided to British people in EU countries (of which about £500 million is for pensioners), and receives about £50 million for the care provided to EU-insured nationals in the UK (although because there is no easy or routine method to check a patient's eligibility for NHS care, the UK could in theory claim perhaps as much as £200 million).[2] Financially, the amount paid by the UK is marginal in comparison to the total NHS budget (<0·5%),[17] and it also represents good value for money, because the average cost of treating pensioners elsewhere in the EU under these arrangements is about half the cost of similar treatment within the UK.[2]

Capital financing for the NHS

The EU is the primary source of capital investment in health-care infrastructure in poorer Member States through European Structural and Investment Funds, although this is not the case for the UK as one of the richer Member States. However, the European Investment Bank has provided over €3·5 billion in low-cost capital to the NHS since 2001,[18] a major contributor to the funding of public-private partnerships.

Indirect impact on NHS financing

The NHS is the largest discretionary part of UK public expenditure,[19] so events that affect the UK economy are likely to have a substantial impact on NHS financing.

 Published online September 28, 2017 http://dx.doi.org/10.1016/S0140-6736(17)31926-8

With extra costs of recruitment due to scarcity of staff and higher prices of imported medicines, the Economist Intelligence Unit has estimated an increase in NHS costs of £7·5 billion a year, out of a total expenditure of £177 billion.[20]

While some have drawn reassurance from the short-term performance of the UK economy since the referendum, this performance is unsurprising as no change in EU-UK relations has taken place yet. However, the overwhelming consensus of economic forecasts, including that of the Office for Budget Responsibility, is that Brexit will have a substantial long-term negative impact on the UK economy, and thus can be expected to put additional pressure on NHS financing.

Medical products, vaccines, and technology

A key concern relates to the impact of Brexit on pharmaceuticals, where EU law governs nearly every aspect of medicine licensing. Less visible, but equally important, is the impact on other medical products, including medical devices and radioisotopes.

Pharmaceuticals

The UK has benefited from hosting the European Medicines Agency (EMA), which has helped to consolidate its position as a leading location for the pharmaceutical industry in Europe. It might be possible for the UK to continue to pay to participate in the work of the EMA following a soft Brexit, or even after a hard Brexit. However, the UK would become an observer at best at the International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use, where the global standards are set for pharmaceuticals.[21]

If the UK leaves the European system of medicine licensing, it will be excluded from the sole process for authorising medicines across the EU, which offers substantial benefits in terms of the cost and speed of bringing new products to the market. The Association of the British Pharmaceutical Industry notes how this process has "not only greatly simplified the…situation but also resulted in a system where medicines information such as the patient information leaflet are consistent across all EU member states, which is good for public health protection."[22] In Switzerland and Canada, which have separate approval systems, medicines typically reach the market six months later than in the EU. It will therefore be necessary for the UK to develop its own regulatory system, unless it is willing simply to accept the decisions of other regulatory agencies, such as the US Food and Drugs Administration or EMA.

Counterfeit medicines pose a major threat worldwide, both in terms of ineffective treatment and the emergence of antimicrobial resistance.[23] The EU is at the forefront of measures to address this problem, having created systems to monitor global supply chains and to share safety information on emerging problems. The UK might be able to opt into this scheme, but with little or no input into policy.

The UK will need to strengthen the domestic Medicines and Healthcare Products Regulatory Agency. However, this process will be challenging, as the agency derives a substantial proportion of its income from the EU, either as a contractor to the EMA or from EU research funding and, as with universities and the NHS, it is likely to face difficulties in attracting specialised staff from other parts of Europe.

Other medical products, substances of human origin, and radiotherapy

Similar issues arise with medical devices (also licensed through an EU system, though in a more decentralised form than for pharmaceuticals) and substances of human origin, such as blood and organs. Again, the UK has the choice of either passively accepting EU regulatory standards, deregulating the sector substantially, with all that entails for patient safety, or developing a new framework, which risks making the UK unattractive for companies because of extra costs.

A failed Brexit would cause immediate disruptions to importing health products whose trade is not governed by WTO rules. There is a major threat to the availability of radioisotopes for diagnosis and for cancer therapy, which the UK imports mostly from the Netherlands.[24] The generation, movement, and handling of these radioisotopes within Europe are governed by the Euratom treaty, one of the core European treaties agreed when the European Economic Community was created in 1957. Exiting this treaty means that a new legal structure will be needed if supplies of radioactive medical isotopes for cancer treatments are to continue.

Because so much of the UK's trade depends on EU regulatory structures and networks that make it friction free, it is difficult to assess how pharmaceuticals, medical equipment, and medical devices would continue to be traded when these frictions return. More complex issues, such as securing human blood, organs, or tissue supplies are also subject of specific provisions in EU law and are likely to face difficulties and short-term disruptions.

Information

Comparable information at EU level has been a substantial force for improvement in health care. For example, European comparative data on cancer outcomes, generated by the EU-funded EUROCARE studies, have had a profound impact on cancer care in the UK, highlighting variations in outcomes and scope so that the UK can rise to the level of better performing systems elsewhere in Europe. Yet producing this comparable data is an enormous and technically complex endeavour, and it has taken decades to generate even the limited datasets that are currently available. Similarly, in the area of communicable diseases, the European Centre

for Disease Prevention and Control in Stockholm has over 200 staff working simply to ensure effective monitoring of this one relatively small domain.[25]

There is little reason in theory for cooperation on information sharing not to continue, provided that a regulatory framework for transfer of personal data is in place, and that the UK gains adequacy status as a non-EU country under the General Data Protection Regulation 2016/679. However, in practice this kind of work depends heavily on sustained financing and investment in collaboration, as shown by the fact that EU's collaboration on health data is well in advance of comparable international efforts elsewhere in the world.

Service delivery

Though the EU treaties leave the primary responsibility for the organisation and delivery of health services and medical care to Member States, there are some areas where Brexit will impact on service delivery, where perhaps the highest profile example is the working time directive. Alongside it, though, are less well-known networks for accessing specialist care for rare diseases throughout the EU, and the specific cases of cross-border care provisions in Northern Ireland and Gibraltar.

Working time legislation

EU legislation on working time and its application to doctors in training has been a long-standing controversy in the UK. Indeed, it was one of the areas identified as a problem by the former UK prime minister, David Cameron, in 2013, as he launched the process that led to the Brexit referendum.[26] Even now, views on the legislation are mixed. On one hand, professional regulators see scope to improve flexibility by relaxing existing rules on working time. On the other, junior doctors have insisted that the provisions of the Working Time Directive are included explicitly in their new national employment contract.[4]

European Reference Networks

For rare diseases, it can be impractical or impossible to access care in every individual country, since there might only be a handful of centres of expertise in the whole EU. The EU has set up European Reference Networks to bring together these highly specialised centres into networks dedicated to particular treatment areas, to enable patients to be diagnosed and treated by the best available expertise, even when in another EU country. These networks also facilitate research and clinical trials by drawing on a larger pool of patients than would otherwise be possible, the sharing of knowledge, and the development of guidelines. The UK has 33 hospitals participating in 22 of the 24 existing European Reference Networks.

Cross-border care

Two regions are likely to experience substantial disruption of service delivery because of Brexit: Northern Ireland and Gibraltar. In Northern Ireland, efforts to promote cross-border collaboration in health as part of the peace process have existed for decades, creating projects with active support from the EU and the administrations in the UK and Ireland. These projects deliver care for many patients with specific medical needs including diabetes, sexual health, eating disorders, and autism, and serve communities on both sides of the Irish border, thereby reaching sufficient patients to secure the economies of scale necessary to justify provision. The matter of the UK-EU post-Brexit land borders is high in the EU's negotiation priorities, but attention to the health aspects of the negotiation, not solely to the security and trade aspects, will be crucial.

Leadership and governance

This building block covers a wide range of system-level issues, such as regulation, where EU rules on the environment and public health, as well as competition and trade rules, are particularly relevant; supporting functions such as research, where again the impact of Brexit is substantial; and also the processes of scrutiny and stakeholder engagement.

Public health

A series of EU directives designed to improve air quality have had a major impact on health. Following restrictions on the sulphur content of fuel, there has been an 80% decline in sulphur dioxide emissions, practically eliminating the problem of acid rain. However, the UK has often lagged behind its neighbours in the implementation and enforcement of these directives. In 2015, only two London boroughs met EU standards for nitrogen dioxide concentrations, leading the European Commission to initiate infringement proceedings.[27] EU directives on water quality have also been effective, although again the UK has some way to go, with only 77% of British beaches rated as excellent, a figure well below that in many other Member States. This trend suggests that, in the absence of EU legislation, UK environmental standards could slip further.

The EU has been active in policies designed to tackle threats to health posed by products that cross borders, especially tobacco, an area in which the UK has been ahead of many other Member States. Currently, UK courts look to EU law in interpreting these rules. There is, however, a risk that the UK could become a prime target for the tobacco industry post Brexit, as is the case in Switzerland.[28]

The UK benefits greatly from its participation in EU specialised agencies, such as the European Food Standards Agency and the European Centre for Disease Prevention and Control. These agencies perform essential roles and, if the UK is unable or unwilling to continue participating in them, it will have to find alternative arrangements. Working through and with the WHO or the UN *Codex Alimentarius* system as the UK,

rather than as part of an entity the size of the EU, will inevitably entail a loss of influence. However, given the persistent threat of infectious diseases crossing borders, any lesser engagement poses a potentially serious threat to human and animal health.

Competition and trade

Competition law is one of the areas where the UK could have an opportunity to improve the policy environment for the NHS post-Brexit, should it choose to do so. The EU has a strong regulatory structure designed to prevent states from implementing industrial policies that might impede competition within the internal market. This includes anti-trust legislation that gives the Commission great authority to find and punish cartels, so-called state aid laws that block corrupt or unfair public subsidies to businesses, public procurement laws that keep governments from promoting businesses at the expense of the public purse, and competition laws intended to create level playing fields for companies established in different Member States. These bodies of law all create inconveniences and even some threats to the NHS.

The risk with state aid laws, and competition laws in general, is that sensible health policy might be interpreted as a subsidy to a particular provider (such as the NHS) in a competitive market. If a private firm bids to provide NHS services and does not get the contract, it can challenge the decision in court, arguing that the process unfairly advantaged one set of competitors (NHS organisations) over another. These challenges have not been especially successful under EU law, with the ECJ consistently recognising the particular nature of health care, but the risk of expensive litigation drives behaviour within the NHS. Public procurement law creates administrative inconvenience since it demands that procurements be made in accordance with EU administrative requirements (or that contracts be split into smaller contracts that have a lower administrative burden). There is almost certainly scope to reduce the administrative overhead of these actions. However, this presupposes that the government wishes to do so. Whereas many European governments have insulated their health systems from these processes, the UK has explicitly decided not to, with the 2012 Health and Social Care Act opening up the NHS in England (but not in Scotland) to further competition, invoking EU law as a justification for its own pro-competitive agenda. Consequently, it is far from clear that the UK will take this opportunity to structure its domestic competition and procurement laws in ways that will strenghthen the NHS.

A related issue is the ability of future trade deals to subject the NHS to investor-state dispute settlement mechanisms. These mechanisms could allow corporations to contest domestic policies on health, the environment, and working conditions by arguing, for example, that such policies are non-tariff barriers to trade or investment. This scenario has been one reason for controversy over the proposed Trans-Atlantic Trade and Investment Partnership. Although the EU's negotiating position incorporated many safeguards, including for health systems, it seems probable that any arrangements outside the EU would not do so.

Research

The scientific community was one of the most vocal against Brexit in the referendum campaign, reflecting the enormous importance of EU membership for British research, and the leading role of British universities within the EU.

Although direct EU funding accounts for only 17% of research contracts held by British universities, it accounted for almost three-quarters of the growth in funding in the past decade. However, the consequences go far beyond funding. British researchers and institutions benefit from access to EU networks and infrastructure, and from the free movement of personnel within the EU. An estimated 16% of the academic workforce in the UK comes from other parts of the EU. Additional benefits flow from the common legal frameworks and standards that underpin research, in areas such as data protection and clinical trials regulation. The UK Government has attempted to assuage these concerns, offering to underwrite continued funding for existing EU projects, but without any commitment for long-term support. However, it has provided no reassurance about the remaining benefits in question. There are at least six issues of direct relevance to health, including research funding, mobility of researchers, harmonisation of regulations, intellectual property, research collaborations, and science policy.[29]

The UK already lags behind comparable economies in investing national funds in research and development. It is a net beneficiary of EU research funding, attracting substantially more funds than it contributes to the common pool, and the loss of this funding would have severe consequences. It is thus crucial that the UK finds a mechanism to continue to participate in the EU Horizon 2020 programme, as other countries (such as Israel) do, by paying into the scheme. Other sources of funding have also been important, such as the European Fund for Strategic Investment in support of exports, and loss of these sources will also need to be addressed.

However, there is more to continued research success than funding. Freedom of movement is also central, with the UK attracting almost a quarter of the researchers moving within the Marie Curie scheme, which supports mobility of researchers within the EU and some associated countries.[30] Additionally, health research in particular operates within an EU regulatory framework. For example, clinical trial legislation, although initially overly burdensome, has been revised to strike a good balance between safety and administrative burden.[31] Any divergence in standards would add greatly to the

administrative burden of undertaking collaborative research and, potentially, to obtaining approval for new products that emerge from that research. Likewise, with the developing EU intellectual property regime, departure from the EU risks increased difficulty in the protection of intellectual property generated by UK research.

Scrutiny and stakeholder engagement

Whatever the form of Brexit, vast areas of EU legislation will need to be adopted and adapted into national law and then potentially revised; the harder the Brexit, the greater the volume of legislation needed. Given the sheer volume of legislation to be dealt with, this represents a challenge in itself, with the UK Government likely to make substantial use of provisions that allow primary legislation to be amended directly by the government through secondary legislation.[32] Lord Judge, a former Lord Chief Justice, has argued that what he described as a "legislative tsunami" will prevent parliament from applying adequate legislative scrutiny,[33] and thus also limiting the potential for stakeholder engagement in the legislative process.

Conclusion

We offer three key messages on the potential effects of Brexit on health. First, the effects of Brexit are wide-ranging, touching every building block of a health system as described in the WHO Health System Framework. Second, these effects on health range from somewhat negative to very negative, with few opportunities. Third, the effects depend on what type of Brexit is pursued; the harder the Brexit, the worse the effects, with no deal being the worst of all. They present a challenge for the Brexit negotiations, as their scale could vary widely according to how the UK leaves the EU and could influence the basis of future EU-UK relations. Brexit is also a fundamental challenge for health policy within the UK. Intentionally or not, Brexit will reshape the health system in the UK in a variety of ways, and much momentum in the coming years will be stalled, as existing arrangements are reworked and adapted for the new situation. The impacts on the workforce of the NHS and on people depending on reciprocal health-care arrangements will be substantial, and potentially devastating for the individuals involved. However, the largest impact on the health system is likely to come from Brexit's impact on the wider economy, on the ability of the state to function, and thus on the ability of the UK to finance the health service.

How effectively the UK deals with these challenges will be a governance challenge for the entire health policy system of the UK. Given the apparent lack of capacity of the government to rise to this challenge, we argue that the wider health community within the UK must work together to address these issues.

Contributors

MM designed the initial structure of the paper and prepared the first draft. All authors then contributed drafts on different themes (public health, MM and DS; research, MG; health services and pharmaceuticals, NF and TH; competition, SG; trade, HJ), which MM assembled before revision by all authors. The paper was then extensively revised by NF and TH, who prepared the table, before final revisions by all authors. The scorecard was discussed at a conference on Brexit hosted by the UK Society for Social Medicine.

Declaration of interests

NF and TH have acted as advisers to the House of Commons Health Committee, to which MM gave evidence. NF is a former employee of the European Commission and is supported by the National Institute for Health Research, Biomedical Research Centre, Oxford, UK. TH is a Jean Monnet professor, formerly partly funded by the EU, is acting as adviser to the House of Lords EU Home Affairs Sub-Committee, and is co-investigator in an ESRC Brexit Priority Grant ES/R002053/1. DS is funded by a Wellcome Trust Investigator Award. MG is the Programme Director of Scientists for EU, an NGO which campaigned to remain in the EU. MM is the immediate past president of the European Public Health Association and a member of the European Commission's Expert Panel on Investing in Health. MM and TH were members of the advisory board of Healthier In the EU, an NGO which campaigned to remain in the EU. SG and HJ have no competing interests to declare.

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