Scottish Universities Life Sciences Alliance evidence submission on the Life Sciences and the Industrial Strategy for the House of Lords Select Committee on Science and Technology

1) The Scottish Universities Life Sciences Alliance (SULSA; http://www.sulsa.ac.uk/), supported by the Scottish Funding Council (SFC), aims to promote and connect the Scottish Life Sciences academic sector. We welcome the opportunity to comment on the Life Sciences Industrial Strategy on behalf of the life sciences researcher community in Scotland.

Q1. How can investors be encouraged to invest in turning basic life science research into new innovations in treatment? Why has investment been lacking in this sector? Does the research base have the necessary infrastructure to be world-leading?

2) SULSA welcomes the new UK industrial strategy, and particularly the commitment to a £4.6 billion investment by the end of this Parliament. This is the largest increase in government investment in research in a long time[1]. However, even taking this increase into account, the UK Government spends well below the OECD average on research – currently 1.68 %[2]. SULSA gives the strongest possible recommendation that this is increased to at least the OECD top quartile of 2.63 % of GDP[3], but ideally at 3 % of GDP if the UK wishes to remain internationally competitive in research. This should be distributed across the whole innovation pipeline, from fundamental to applied research.

3) The green paper places a strong emphasis on the translation and commercialisation of research. Whilst the SULSA community agrees that producing tangible outcomes from our research is important in driving improvements in quality of life for example, there is a concern amongst SULSA academics that commercialisation of research is being favoured at the expense of 'blue sky' research. Whilst this type of research frequently does not produce immediately obvious translational outcomes, supporting risky and innovative research has led to some of the most important discoveries in life sciences research (for example the invention of monoclonal antibodies by Cesar Milstein in Cambridge, who invented the technique to address a specific fundamental question in immunology, but with an outcome of a technique that now underpins a worldwide industry with sales running into hundreds of billions of dollars each year). Basic research is absolutely required for the innovation pipeline, and there is concern that by removing the focus from basic research may lead to the pipeline drying up. Research policy should not be driven by immediate requirements, but should look at longer-term time frames as well.

4) We believe there needs to be improved routes for translational research and commercialisation, and better linkage between academic research and industry. Whether the formation of UKRI helps with this remains to be seen. The injection of funds into R&D via the Industrial Strategy Challenge Fund is a welcome advance. Whilst many SULSA academics would love to have industry connections, many researchers believe they are unable to access the Industrial Strategy Challenge Fund either because their research is "basic" (and they can't see a translational aspect, or it is not ready to translate), or they don't have the industrial contacts required to apply for the funding. In Scotland, Interface, and the Innovation Centres are going some way to address this issue, but more could be done. However, we observe that the Innovation Centres (and particularly the Industrial Biotechnology Innovation centre, has made great strides in bringing productive collaborations between Industry and academia, and looking carefully at the ways by which this has been achieved is recommended. In addition, the focus on challenge-led funding minimises the possibilities of step-change research outcomes because

funding is focused on a defined need. Moreover, the challenges laid out may not have identified key issues that may yet come to light in the future.

5) It is vital that the Government supports innovative, risky basic research in as wide a variety of research areas as possible, as no one can predict when the next breakthrough will occur. This should occur alongside support for translational research and commercialisation of the outputs. A specific mechanism to assist researchers to spot opportunities arising from their research (and assisting industry to seek translational potential in research) may catalyse increased translation.

Q3. What can be done to ensure the UK has the necessary skills and manpower to build a world class life sciences sector, both within the research base and the NHS?

6) This conversation is ongoing in Scotland, where Skills Development Scotland is currently updating their Skills Investment Plan for Scotland's Life Sciences Sector[4]. Increasingly, life sciences are based on quantitative biology, and a grounding in maths, statistics and computer sciences is now seen as a standard requirement, rather than a luxury. Much of the research in life sciences now requires large-scale experiments that result in huge data sets that need specialist analysis – from drug screening, to microscopy to metabolomics and genomics. Bioinformaticians, who process experimental data from organism-scale projects (for example, the whole sequence of an organism), are in short supply. Bioinformatics is a shortage occupation[5] and many researchers requiring staff with these skills are struggling to hire – as there are not enough trained bioinformaticians (there are only three Masters courses in Bioinformatics in Scotland – at Glasgow, Edinburgh and Heriot Watt Universities), and many of them are tempted away by large companies (e.g. in the financial sector) for much greater salaries. In academia, salaries are not negotiable in the way they are in the private sector, and Universities are usually not able to offer a salary that is competitive.

7) In addition, the collaborative nature by which most bioinformatics work means they are often not leading grant applications or publishing as lead or senior authors, and so the traditional career trajectories that other academics follow are generally not suitable for these staff. Glasgow University is in the process of adding a new job family, Research Scientist, as part of their Research and Teaching job family, for these type of staff that are performing key, important research contributions but are not leading research[6]. It remains to be seen if this approach is effective in rewarding bioinformaticians/ statisticians/ data analysts. We would recommend the sector follows this closely, and if shown to be effective in improving the career paths of these types of researchers, looks at widespread adoption.

8) The UK has a significant skills shortage in the life sciences[7], which we believe stems from school years. With maths now underpinning the majority of life sciences disciplines, we believe maths should be a requirement for entry into University life sciences courses. It has recently been published that in England, 24.6 % students fail GCSE maths[8]. In Scotland at Higher level there were 18,861 mathematics candidates this year compared to 18,868 in 2016, with an A-C attainment rate of 74 % compared to 73.5 % in 2016[9]. Students from an early age need data training as well as being taught the latest advances in the life sciences – this may help alleviate the stigma associated with STEM subjects. In addition, it is imperative that teachers are trained properly in these new advances so they feel comfortable and capable of delivering this updated information to students.

9) From conversations with our industry colleagues, we are being told that basic lab skills are missing from University graduates and they are struggling to hire good candidates. In fact, anecdotal evidence suggests that graduates with training in forensic sciences are preferred over life sciences graduates due to their meticulous record-keeping skills and adherence to standard operating procedures in basic lab techniques. We assume this is because of the expense and staff time required to run lab-based courses in an era of unprecedented funding squeeze, combined with the huge amount of information life sciences courses are expected to cover. We propose a way to rectify this, which could be for Universities to design a compulsory subject based around laboratory management and techniques, that is designed in conjunction to industry to ensure it is fit-for-purpose. We would recommend an explicit funding mechanism whereby Universities wishing to implement such courses (which could be accredited by the relevant agency) are supported in doing so.

10) A key issue to address with the skills shortage will be that of migration. 16 % of academic staff at UK higher education providers are from EU countries, while 12 % are from non-EU countries[10], and if the ability of these skilled workers, and their families, to live and work in Britain is threatened, the skills shortage will amplify. This is addressed further in our response to Q16.

Q6. (If published) Does the strategy contain the right recommendations? What should it contain/what is missing? How will the life sciences strategy interact with the wider industrial strategy, including regional and devolved administration strategies? How will the strategies be coordinated so that they don't operate in 'silos'?

11) Sir John Bell's Life Sciences Strategy[3] has balanced each of the sub-sectors within the life sciences (chiefly academia, industry and the NHS) well, in what is a complicated and crowded landscape. We give our full support to the strategy's plan to reinforce the UK's science offer, and agree that the UK Government needs to continue increasing its support for R&D, particularly in basic research including 'risky' projects, and enhancing the Charity Research Support Fund. In addition, the creation of a programme to attract international talent would be very welcome particularly in light of the UK's departure from the EU, and the perceptions (real or perceived) that this has generated in the international research community (discussed further in our response to Q16).

12) Regarding the skills recommendation, we agree with the proposals and this has already been discussed in our response to Q3.

Q9. How do the devolved administrations and city regions fit into the strategy? Scotland has its own life sciences strategy, how will the two interact?

13) In the research sector, the large majority of funding comes from UK, not Scottish sources, so Scotland's strategy needs to align well with the UK strategy, otherwise Scottish researchers will be less successful in winning funding if their research does not fit with UK strategic priorities. From an academic point of view, it will be very important for the SFC to be closely connected to UKRI, as it will not be a part of it, and there is the potential for the Scottish point of view to be excluded somewhat if communication lines are not open and functioning.

Q12. How can collaboration between researchers and the NHS be improved, particularly in light of increased fiscal pressures in the NHS? Will the NHS England research plan help in this regard? How

can the ability of the NHS to contribute to the development of and adopting new technology be improved? Responsibility and accountability?

14) Clinician scientists are vital for our translational research agenda. Clinicians with research experience will be better able to engage with academics and have fruitful collaborations. Recent findings show that major barriers to career progression are lack of funding and support and greater guidance about their career options[11]. The English National Institute for Health Research in Practice (HRIP) Fellowships, which provide two years' funding prior to application for a research training fellowship (and PhD), does not extend to Scotland. Scottish clinicians therefore have less opportunity to experience laboratory training, which we consider very important to bridge the gap between research and clinical practice. Expanding this HRIP scheme to Scotland would go some way in addressing this problem. Going further with additional funding schemes that link NHS and academia should be considered too. One good example has been the MRC-EPSRC Molecular Pathology Nodes, where groups consisting of researchers, the NHS and industry partners, are working on novel routes to diagnosing disease (not just biomarker discovery through genomics etc. but also designing new engineered devices e.g. microchip based immunoassay, application of machine learning algorithms to pattern search micrographs of diseased tissue etc.).

Q16. What impact will Brexit have on the Life Sciences sector? Will the strategy help the sector to mitigate the risks and take advantage of the opportunities of Brexit?

15) Brexit has the potential to strongly impact on the Life sciences sector, particularly via the issues of research funding and immigration. It appears that Scottish Life Sciences research is already suffering following the Brexit referendum. Whilst we welcome the Government's position on EU funding post-Brexit[12], there has been no formal agreement yet and no discussion on how costly a buy-in will be for the UK (and whether the Government will be willing to pay). The risks associated with removal of the UK from the European Research Area are very substantial with a potential loss of annual research income running into the hundreds of millions of pounds. Beyond that, a diminished pool of talented research workers to drive an active research agenda and potential loss of highly skilled non-UK citizens from key positions in the research community, risk diminishing Scotland's Internationally recognised reputation and exceptional outputs in the Life Sciences. Removal of Scotland's scientists from broad EC wide groupings will also present the risk of diminishing interdisciplinary research and lessen access to important large equipment that might be found only in a few European laboratories. 15 months on from the referendum, many researchers believe it is too early to realise the full effects of Brexit on Life Sciences in Scotland. Much evidence remains anecdotal. We do have evidence that the referendum outcome has affected the sector in some ways.

16) *Eligibility for Funding*

UK HEI's had £725m in research grant income from EU government bodies in 2014/15, approximately 12 % of their total grant income[13]. As an EU member, UK academics are eligible to apply for Horizon2020 funding, including the prestigious European Research Council grants and Marie Skłodowska-Curie fellowships. Eligibility to apply for EU funding is a major attractor globally and uncertainty around this reduces the UK's attractiveness substantially – traditionally the UK wins the greatest amount of this funding. Data from HESA shows that clinical medicine and biosciences have the highest research income by amount from the EU (£20M and £15M in 2015-16 respectively). Although a huge sum, this is a relatively small percentage of total research income (9 % and 11 % respectively[13]),

but if these funding avenues were not available, would still leave a sizeable hole in the funding landscape which researchers would expect the UK government to fill.

17) All UK academics (and Scottish ones are no exception) are extremely concerned that they will not have access to EU funding programmes after the UK leaves the EU. We welcome that the Government has agreed to continue pay UK contributions to EU H2020 projects after Brexit, provided that the projects were bid for before the day that the UK leaves the EU[14]. Whilst the Government recently published their Collaboration on Science and Innovation: A Future Partnership Paper[12], which demonstrates they are willing and enthusiastic to continue working with the EU by seeking "an ambitious science and innovation agreement with the EU that will support and promote science and innovation across Europe both now and in the future", there has been no formal agreement to date.

18) *Staff Recruitment and Retention*

With a hard Brexit seemingly more likely, all SULSA member institutions are concerned about the diminished pool of researcher talent that changes in freedom of movement will bring about. We strongly support free movement, if not then fast-track, light-touch visa applications/work permits for those in the life sciences sector. There is now the perception that the UK is a less welcoming country to foreigners. Decreases in the value of the pound impact negatively on salary comparisons, particularly with the USA and Australia, for EU candidates. Some researchers have benefitted; those with EU funding that are paid in instalments (for example the prestigious European Research Council grants) have profited from the weak pound and have had large increases in their effective grant payments.

19) There have been instances of job offer rejections, and this has been noted at least at the Universities of Strathclyde and Glasgow. Of concern was the rejection of a Chair in Neuroscience at Glasgow University (a very senior post), who explicitly stated that their decline of their offer was purely due to Brexit.

20) In addition, we have email evidence that some of the high-profile European universities are now aggressively recruiting strong European researchers working in the UK, using Brexit as an explicit argument, and inviting them to reconsider their commitment to the UK. All SULSA member institutions are concerned that non-UK citizens among their staff will be of increased likelihood to leave their institutions.

21) *Student Applications*

Although correlation is not causation, PhD application numbers at various Universities have been affected since the referendum. For example, at Glasgow University the School of Psychology PhD student applications are as follows: 2012: n-17, 2013: n=16, 2014: n=22, 2015: n=21, 2016: n=24, 2017: n=9. Numbers had remained constant until the Brexit outcome after which application rates have dropped dramatically. Strathclyde University has had at least one student reject their offer and another withdraw their application, due to their concerns surrounding Brexit. In contrast, Aberdeen University has had an increase in the number of student applications, however they believe this is associated with a lot people making use of the opportunity while the UK is still a member state of the EU.

22) *Willingness of European Partners to Collaborate*

There are many reports of changes in willingness of European partners to work with Scottish life sciences researchers, although much of these are anecdotal. We are however are starting to collect specific examples from our partner Universities. Generally these where when EU partners have voiced concerns and would be unwilling to add UK partners in future. In many cases researchers believe they have been excluded from discussions about EU applications, but don't have evidence.

23) In one instance at Aberdeen University, a researcher who was a beneficiary on an Innovative Training Network last year, was downgraded to a partner on resubmission this year, as there were concerns in the consortia about a UK partner being a beneficiary. Another researcher in Aberdeen was invited to join a consortium but then they decided against adding him because he was from the UK. There are several reports from Glasgow University that EU partners don't want Glasgow researchers to coordinate submissions for fear of harming their chances of success. Strathclyde University has three reports of a decline in willingness of EU partners

24) In addition, researchers are focusing much of their time cementing EU partnerships before the UK leaves the EU. For example, Prof. Andrew Millar from Edinburgh University is founding a software association (www.fair-dom.org) in Germany to cement the ties with key European partners working on biological data management systems.

25) SULSA recently ran a funding call (as stipulated by the Scottish Funding Council) for SULSA life sciences researchers pursuing involvement in EU projects (e.g. through establishing network connections, showcasing skills and capabilities, and participating in specific networking activities both for policy influencing and project preparation; http://www.sulsa.ac.uk/eu-partnership-building/). We had only three applications (all strong), and many researchers commented to us that they felt this was not a useful call to them considering the uncertain nature of EU funding going forward.

26) Industry links have also suffered – global companies looking to expand into Europe will no longer consider basing their expansion in the UK. Scotland has an excellent example of this – the US-based metabolomics company Metabolon was considering Glasgow as a European base. Following the Brexit vote negotiations halted and Metabolon have recently announced establishing a European base in Germany.

27) *Change in Success Rates of EU Research Grants*

Any changes in success rates will not be seen until evaluation results are released 5 months after call deadlines. Because of this it is too early to tell what impact the referendum result has had on general grant income. Results from specific calls e.g. the ERC Starting Grant 2016 call show that the UK share of awards increased from 16 % in 2015 to 18 % in 2016; and the results from the ERC Consolidator Grant 2016 call shows the UK has the most grants across all three domains. Life Sciences usually attract the greatest EU funding (by income not percentage), and thus lack of access to these funding sources would impact heavily. For example at Aberdeen University, the EU income for the School of Biological Sciences, although the largest within the University, represents 13 % of their total income; for Medicine it is 6%. However this 13 % amounts to almost £3 million pounds.

28) *Change in Application Rates of EU Research Grants*

Currently most SULSA Universities, bar Glasgow, have seen comparable numbers in applications to previous years. Strathclyde has two reports of staff members not submitting EU grant applications, and it is the belief of Glasgow University that their decrease in fellowship applications is due to the perception that UK applicants would be penalised.

29) *Procurement Price Increase*

The drop in the value of sterling in the wake of the Brexit vote, has seen many companies increasing prices of imported goods. For example, Illumina (a company which provides sequencing equipment and reagents and has almost a total monopoly) recently increased their prices by 10 %. These price rises increase the cost of research. They also make costings on grants out-of-date, and may mean there are now not enough funds to complete work.

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