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# Global Expert Mission Israel Precision Medicine 2020

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# Welcome

Innovate UK's global missions programme is one of its most important tools to support the UK's Industrial Strategy's ambition for the UK to be the international partner of choice for science and innovation. Global collaborations are crucial in meeting the Industrial Strategy's Grand Challenges and will be further supported by the launch of a new International Research and Innovation Strategy.

Innovate UK's Global Expert Missions, led by Innovate UK's Knowledge Transfer Network (KTN)<sup>2</sup>, play an important role in building strategic partnerships, providing deep insight into the opportunities for UK innovation and shaping future programmes.

The Precision Medicine Expert Mission travelled to Israel in February 2020. During the mission, a delegation of government representatives and precision medicine experts visited academic organisations, hospitals, government agencies and businesses to meet key stakeholders from the Israeli precision medicine ecosystem.

In this publication we share the information and insights gathered during the delegation's time in Israel.

UK MISSION DELEGATES	KEY ISRAELI STAKEHOLDERS ENGAGED
Public sector: <ul style="list-style-type: none"> <li>• Innovate UK</li> <li>• Knowledge Transfer Network</li> <li>• NHS</li> </ul>	Public sector: <ul style="list-style-type: none"> <li>• Israel Innovation Authority</li> <li>• Ministry of Health</li> </ul>
Industrial stakeholders: <ul style="list-style-type: none"> <li>• Almac</li> <li>• AstraZeneca</li> <li>• PinPoint Data Science</li> <li>• QuantuMDx</li> </ul>	Industrial stakeholders: <ul style="list-style-type: none"> <li>• Curesponse</li> <li>• The Deteriorating Patient</li> <li>• Genetika+</li> <li>• iGentify</li> <li>• i-Metadata</li> <li>• MDClone and Synthetic Data</li> </ul>
Research: <ul style="list-style-type: none"> <li>• The University of Manchester</li> <li>• The Wellcome Sanger Institute</li> </ul>	Research/Hospitals: <ul style="list-style-type: none"> <li>• Ben Gurion University</li> <li>• Haifa – Israel Institute of Technology</li> <li>• Hebrew University</li> <li>• Ichilov</li> <li>• Sheba Medical Centre</li> <li>• The Weizmann Institute</li> </ul>

## Definition of Precision Medicine

Innovate UK defines precision medicine as “technology that enables early and accurate diagnosis to inform patient treatment, as well as the availability of targeted therapies. This includes combining clinical biomarker knowledge with advances in diagnostic technologies, data analysis and tailor-made therapeutics. Precision medicine is also commonly referred to as stratified medicine or personalised medicine”.<sup>3</sup>

<sup>1</sup> [www.gov.uk/government/organisations/innovate-uk](http://www.gov.uk/government/organisations/innovate-uk)

<sup>2</sup> [www.ktn-uk.org](http://www.ktn-uk.org)

<sup>3</sup> <https://ktn-uk.co.uk/news/accelerating-innovation-in-precision-medicine>

# 1. Introduction

Israel is a country in the Middle East with a size of 20,000km<sup>2</sup> and a population of 9 million – it is the same size as Wales with a population slightly larger than London.<sup>4,5</sup> Israel has a reputation as highly entrepreneurial with an innovative business environment meaning the economy is highly developed with a 2019 GDP of US\$43,654<sup>6</sup> per capita.

Israeli culture has a strong belief in Tikkun Olam – a concept that means improving the world and building a model society. Healthcare is no exception, with Israel making healthcare freely available for all citizens and digitising medical record data for the greater good.<sup>7</sup>

This programme leveraged financing from foreign companies and institutions. As a result, Israel is often considered one of the countries with the highest R&D expenditure as a percentage of gross domestic expenditure in the world.<sup>10</sup> This has encouraged an entrepreneurial culture, producing new companies, products and services at world-leading rates and earning Israel the label “Start-up” Nation.<sup>11</sup>



Figure 1: The Israeli innovation ecosystem<sup>8</sup>

## 1.1 Start-up Nation and Current Support of Innovation in Israel

The Israeli Government has prioritised investment in research and development (R&D) centres for more than 20 years, with start-up support including incubators and accelerators and public universities to ensure there is a coordinated innovation ecosystem.

The first interventions of the Israeli Government in support of the formation of this ecosystem was the creation of the Yozma venture capital funds in the 1990s,<sup>9</sup> part of an ongoing effort to incentivise investment in start-up companies.

### 1.1.1 Who Funds Innovation in Israel?

Innovation in Israel is supported by the government’s research grant awards and public procurement policies. The country has a favourable financial environment, with easy access to venture capital that led the World Economic Forum Global Competitiveness Report 2019 to rank Israel 20th in the world for competitiveness, while the UK is in 9th position.<sup>12</sup>

Science and innovation national research policy is both promoted and funded by the Israel Innovation Authority (IIA), as part of the Ministry of Economy and the Council for Higher Education.

- The IIA executes government policy to support industrial R&D. It has a budget of 1.2 billion shekel (US\$348 million) per year and gives funding to Israeli companies, including those taking part in internationally-collaborative R&D programmes.
- The Ministry of Science and Technology has research grants to bridge the gap between basic and applied research, scholarships from undergraduate to post-doctoral levels, and to form knowledge centres at existing research institutions.
- The Council for Higher Education gives around US\$60 million per year to the Israel Science Foundation – the country’s main source for comparative research funding which makes 1,600 grants per year.

<sup>4</sup> <https://www.cbs.gov.il/en/mediarelease/pages/2019/population-of-israel-on-the-eve-of-2020.aspx>

<sup>5</sup> <https://mfa.gov.il/MFA/AboutIsrael/Maps/Pages/Israel-Size-and-Dimension.aspx>

<sup>6</sup> <https://www.ceicdata.com/en/indicator/israel/gdp-per-capita>

<sup>7</sup> [https://innovationisrael.org.il/en/sites/default/files/2018-19\\_Innovation\\_Report.pdf](https://innovationisrael.org.il/en/sites/default/files/2018-19_Innovation_Report.pdf)

<sup>8</sup> Presentation by Shir Zilberstein, Taglit Innovation Centre, Bioinformatics GEM 2018

<sup>9</sup> <http://www.yozma.com/home/>

<sup>10</sup> [https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?most\\_recent\\_value\\_desc=false](https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?most_recent_value_desc=false)

<sup>11</sup> <https://www.forbes.com/sites/adrianbridgwater/2020/02/21/how-israel-became-a-technology-startup-nation/>

<sup>12</sup> [http://www3.weforum.org/docs/WEF\\_TheGlobalCompetitivenessReport2019.pdf](http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf)

### 1.1.2 Who Approves New Medicines and Technologies in Israel?

The Ministry of Health approves new medicines and technologies in Israel and provides additional functions, including regulatory requirements such as ethics and consent to institutional review boards. The Ministry of Health also governs reimbursement coverage and plays a role in payment, with a system to prioritise new technologies with an assigned budget. Hence regulatory and reimbursement approval processes proceed more quickly in Israel than in the UK.

The reimbursement and regulatory requirements in Israel appear to be less arduous than in the UK. Evidence requirements can also vary compared to the UK; for example, an economic value proposition is not necessarily required to gain reimbursement coverage.

The Ministry of Health responds quickly to requests for the use of new technologies and seems to be an integral organisation that provide services carried out by a variety of bodies in the UK (e.g. National Institute for Health and Care Excellence [NICE], Medicines and Healthcare Products Regulatory Agency [MHRA], National Health Service England [NHSE], Department of Health and Social Care [DHSC]).

### 1.1.3 Who Provides Healthcare and Health Insurance in Israel?

The 1995 National Insurance Law in Israel ensures universal healthcare coverage for all citizens, which is funded primarily through a special income-related health tax in combination with general government revenues.

The Israeli public healthcare system operates under the Israeli National Health Services Basket system, a budget-based rather than a code-based system – meaning a hospital is given a fixed budget for a certain period, rather than billing the payor based on a diagnosis code for each treatment.<sup>13</sup> The Ministry of Health also manages and funds national hospitals.

The mandated benefit package includes hospital, primary and speciality care, prescription drugs, certain preventative services, mental health care, dental care for children and other services.

Healthcare is provided in Israel via four competing non-for-profit health maintenance organisations (HMOs): Clalit Health Services<sup>14</sup>, Maccabi Healthcare Services<sup>15</sup>, Meuhedet (Kupat Holim Meuhedet)<sup>16</sup> and Leumit Health Care Services<sup>17</sup>.

Key facts:

- Clalit Health Services
  - Established in 1911 and the largest HMO.
  - Services around 60% of Israel's population with 3.8 million insured members.
  - Receives a share of health tax collected by the National Insurance Institute on a capitation basis according to the number and age of its members.
  - Employs 7,500 physicians, 11,500 nurses, 1,300 pharmacists, 4,400 paramedics and laboratory/imaging technicians, and 9,400 administrative personnel.
  - Responsible for establishing the Israeli healthcare system.
  - Runs a network of 14 university-affiliated hospitals, although it provides other services such as emergency care for members of the other national health funds.
  - Runs more than 1,200 primary and specialised care clinics, a network of pharmacies and dental clinics.
  - Operates as a decentralised organisation, with the country divided into eight districts (varying from 340,000 members to over 600,000 and 60-to-180 clinics) with budgeting based on a capitation system.
- Maccabi Healthcare Services
  - Began operating in 1941.
  - A system of independent salaried physicians.
  - Has over two million members.
  - Decentralised organisation with six regional centres including 150 branches and clinics.
  - Has a unique programme for foreign citizens and returning Israeli citizens.
  - Conducts medical research and development through the Maccabi Institute for Health Services Research, the Clinical Research unit and MaccabiTech, and participates in technological incubators in the medical field.
  - Members can access physicians, dental clinics, assisted living centres, pharmacies, medical laboratories, complementary medicine, after-hours urgent care, mental health clinics, X-ray clinics, public and private hospital facilities.
- Meuhedet (Kupat Holim Meuhedet)
  - Founded in 1974 through the merging of two other HMOs (Amamit and Merkazit).
  - The third-largest healthcare provider serving over one million members.
  - Operates four district administrative offices and over 300 clinics, most with an associated laboratory.

<sup>13</sup> <https://link.springer.com/article/10.1007/s10198-019-01114-6>

<sup>14</sup> [http://www.clalit-global.co.il/en/\\_the\\_story\\_of\\_clalit\\_health\\_services.html](http://www.clalit-global.co.il/en/_the_story_of_clalit_health_services.html)

<sup>15</sup> <https://www.maccabi4u.co.il/1781-he/Maccabi.aspx>

<sup>16</sup> <https://www.meuhedet.co.il/en/customer-information/about-meuhedet/>

<sup>17</sup> <https://www.leumit.co.il/eng/Useful/AboutLeumit/>

- Employs around 4,000 physicians.
- Members can access pharmacies, imaging, child development, physiotherapy, gynaecology, diabetes and cardiology services, physiotherapy, dentistry, and assisted living care.
- Leumit Health Care Services
  - Established in 1933.
  - Serves over 720,000 members.
  - Focus on preventative healthcare.
  - Over 320 medical centres and 150 pharmacies.
  - Advanced laboratory services analysing over one million tests per month.

Along with four patient funds or medical insurance providers all HMOs provide a similar list of health services. Patients can change HMO if they wish to see a particular consultant, but this is unusual. There are different levels of health plan, and supplemental plans can be paid for, but in general this is seen as unnecessary, and there is no significant uptake.<sup>18</sup>

Maccabi has the largest electronic health records (EHR); however, many of these are in Hebrew and are in the form of scanned hand-written notes.

In comparison, the NHS<sup>19</sup> was founded in 1948 and is funded by general taxation. The NHS is divided into four main subgroups for each of the countries making up the UK (NHS England, NHS Scotland, NHS Wales, and Health and Social Care in Northern Ireland). The NHS has, at its core, the principles of comprehensive healthcare services that are free at the point of use for people ordinarily resident in the UK, excluding optic and dental care. Together, the NHS employs around 1.6 million people, making it the fifth-largest employer worldwide.<sup>20</sup> The NHS has a combined budget of over £130 billion.<sup>21</sup>

## 1.2 A Culture of Entrepreneurship

Israeli culture is highly entrepreneurial – they are the “Start-up” Nation,<sup>22</sup> and the entire culture is geared towards innovatively finding solutions to problems rather than letting problems stand in their way. Young people are well-versed in start-up culture, what it takes to start a business and are encouraged to begin problem solving and innovating early in their careers. Age is not seen as a limiting factor for entrepreneurs, who have gained life experience, confidence and a network through their military service (which is compulsory for most

young adults). There is a sense of urgency to the innovation landscape, pushing past problems to deliver a solution. The culture values failure as a necessary component of success, meaning people are less tentative to try new ideas.<sup>23</sup>

Words commonly used in Israel give a glimpse into the culture that supports innovation:<sup>24</sup>

- Chutzpah – the ability to be courageous and daring in a responsible way.
- Balagan – a state of chaos with a side of opportunity.
- Tachles – being straightforward and reaching the bottom-line quickly and efficiently.
- Firgun – being genuinely happy for other people’s success.
- Leezrom – go with the flow and leave room for the unexpected.

## 1.3 A Network of Support

There is a strong culture of internal networking within Israel – it is not frowned upon to go straight to the top with enquiries or requests for support, and the confidence to do so, to get things done, is a cultural foundation. The nation is known for its chutzpah, and this is seen when networking for support of a new idea. Business in Israel tends to be based on direct personal relationships, and this may reflect why there are such strong links between Israeli companies and those in Germany and the US due to strong academic and historical ties.

Israel has a military service programme for all over 18-year olds, and around 80% of the population complete the two or three years.<sup>25</sup> Military conscription promotes networking opportunities and provides connections that last a lifetime. In addition, students are older when they begin university, potentially with a greater sense of purpose as to why they are undertaking a specific course and what they will do after university.

## 1.4 Academic Foundations

At the very foundation of education, the Israeli Ministry of Education has a National Program for the Promotion of Math and Science in Israel, making science, technology, engineering and mathematics (STEM) subjects accessible for all students. Without this foundation, Israel believes the country will see stagnation in innovation and the economy.<sup>26</sup>

Israel has a strong internationally-recognised research base. There are seven research universities:

- Bar-Ilan University

<sup>18</sup> <https://international.commonwealthfund.org/countries/israel/>

<sup>19</sup> <https://fullfact.org/health/what-is-the-nhs/>

<sup>20</sup> <https://www.nuffieldtrust.org.uk/chart/the-nhs-is-the-world-s-fifth-largest-employer>

<sup>21</sup> <https://fullfact.org/health/spending-english-nhs/>

<sup>22</sup> <https://www.startupnationcentral.org/>

<sup>23</sup> <https://innovationmatters.economist.com/telaviv/culture-of-entrepreneurship>

<sup>24</sup> <https://medium.com/@cynthia.phitoussi/chutzpah-why-israel-is-a-hub-of-innovation-and-entrepreneurship-311b7a052c18>

<sup>25</sup> <https://www.bbc.co.uk/news/world-44646267>

<sup>26</sup> [https://innovationisrael.org.il/en/sites/default/files/2018-19\\_Innovation\\_Report.pdf](https://innovationisrael.org.il/en/sites/default/files/2018-19_Innovation_Report.pdf)



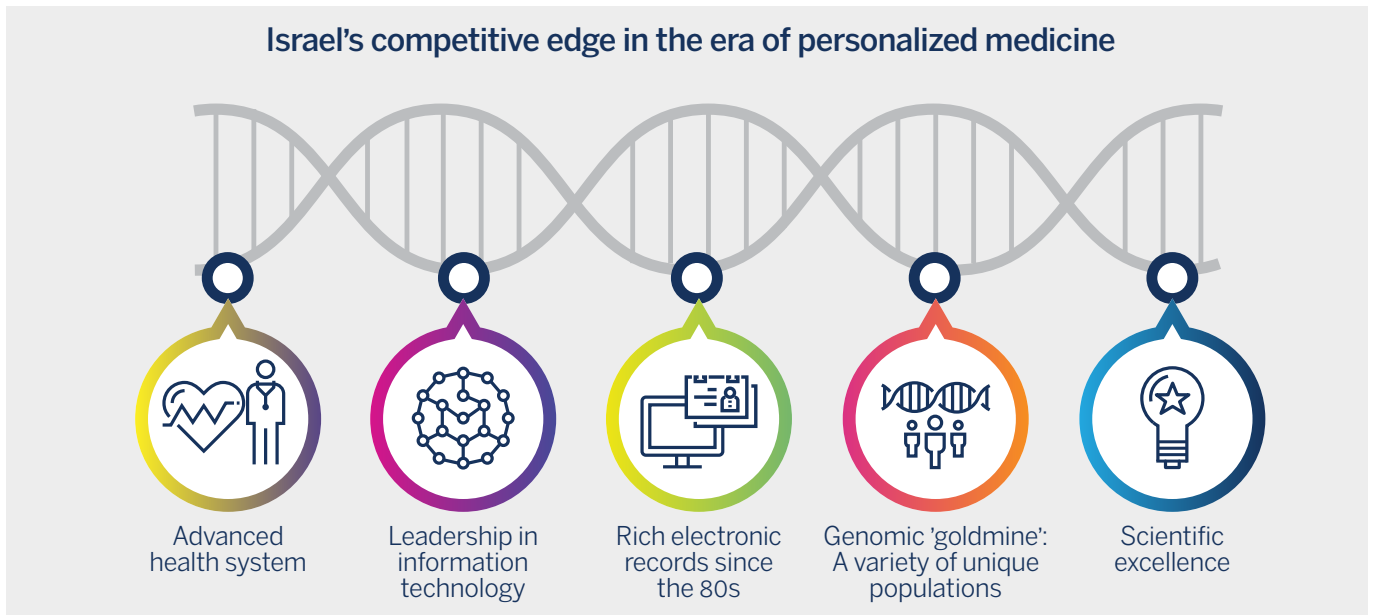


Figure 2: Israel's competitive edge in precision medicine<sup>27</sup>

- Ben-Gurion University of the Negev
- Hebrew University of Jerusalem
- Tel Aviv University
- the Technion-Israel Institute of Technology
- University of Haifa
- Weizmann Institute of Science.

In the life and computer sciences – both key in the precision medicine arena – Israeli institutions are ranked among the top fifty in the world.

### 1.5 The Geography of Innovation

The relatively small size of the country means Israel has an external outlook on business endeavours. Innovation is based on the idea that products should be sale-able to the outside world, not just within Israeli borders.

Israel is made up of a range of singular population groups within a small geographical area, making it a “genomic goldmine” – the addition of years of electronic medical record data available add to this potential. The healthcare system – providing support for every Israeli citizen – provides a platform for collaboration.

### 1.6 The Challenge of Translation

Despite many years of excellence in the biomedical sciences, Israel has struggled to translate basic science into mature real-world solutions in the biopharma sector. The ability to

merge excellence in computational sciences with biosciences is a focus for Israel to bring real solutions to the precision diagnostics and therapeutics sectors. The IIA sees this as an area to ‘harness [...] as an engine of growth for Israel’s biopharma ecosystem’.

Both industry and academia feel a key area Israel would benefit from improvement, is translation of scientific discovery into launching of a commercial drug product. They feel there could be earlier involvement of business-industry bodies specialising in the filtering of academic projects with commercial potential. There is also a need for improved ability to design appropriate clinical trials, and in laboratory-industrial development.

With this in mind, translation is a key focus of the IIA. They plan to improve testing and filtration of technologies that arise from basic research and bring international translational research experts to Israel.

### 1.7 Precision Medicine in Israel

The worldwide focus on personalised medicine to stratify, diagnose and treat patients is seen as a potential turning point in the Israel biopharma industry. Israel can combine expertise in biopharma and information technology to emerge as a player in the biopharma market, as shown in Figure 2. The focus of the Israeli plan is a bio-convergence model – bringing together the life sciences with engineering – that would allow the development of a multidisciplinary ecosystem to utilise

<sup>27</sup> [https://innovationisrael.org.il/en/sites/default/files/2018-19\\_Innovation\\_Report.pdf](https://innovationisrael.org.il/en/sites/default/files/2018-19_Innovation_Report.pdf)

the genomic and clinical data in Israel. Bio-convergence is discussed in Section 2.2.2.

### 1.7.1 Drug Discovery and Precision Medicine

Israel has identified precision medicine as a key focus, and the pharmaceutical sector is a specific area of interest where it has yet to reach its potential. The majority of drugs discovered in Israel have been developed overseas by non-Israeli companies, with the drug Copaxone from Teva being the only exception.<sup>28</sup> A clear example of this is the exit of Kite Pharma in 2017, a company valued at around US\$12 billion. Kite Pharma was founded based on research at the Weizmann Institute.<sup>29</sup>

The biopharma industry in Israel is made up of around 200 companies, with 15 added each year. Investments are increasing, with the average funding round growing three-fold, reflecting the establishment of new investment bodies, such as FutuRx – an incubator partly funded by the IIA.<sup>30</sup>

Israel is focused on the transition to personalised medicine as a way to break into the pharmaceutical arena. They see their scientific excellence as a key foundation on which this transition will occur. They do not lack the scientific foundations – developments from Israeli academics led to eight innovative drugs being sold for around US\$40 billion to 2014. The Israeli academic community is strong in oncology, immunology, and degenerative disease – all key areas in personalised medicine.

Israel also has unique data sources, including genomic and medical data. To capitalise on these advantages, Israel is keen to ensure the connection between relevant research fields are strong – integrating the fields of bioscience and computational science in a bio-convergence model at all levels.

Personalised medicine makes use of huge genomic and clinical data sets in order to identify new target sites that are specific for certain population groups. This means the integration of Israel's genomic and clinical data with computational abilities has a large potential in precision medicine. There are already a number of companies using these methods in Israel.

Ayala Pharmaceuticals<sup>31</sup> developed a cancer treatment for a specific group of patients carrying a genetic mutation using a diagnostic marker identified through clinical and genomic data. ImmPACT-Bio – supported by the IIA through the FutuRx incubator – is developing a CAR-T technology personalised based on databases of patients' samples and bioinformatics tools.<sup>32</sup> CytoReason uses machine learning to understanding

biological models of the immune system.<sup>33</sup>

This precision medicine activity in academia and industry has received support from government projects. An example of this is the Mosaic Project (see Section 1.7.3.2) between the IIA, Ministry of Health, Planning and Budgeting Committee-Council for Higher Education and Ministry for Social Equality, aiming to establish new genomic and clinical data infrastructure.

The IIA is also establishing a users' association for digital health – a medical data infrastructure that will be shared with industry to promote innovation. This is jointly funded by the National Digital Israel Initiative and the Ministry of Social Equality. The association will include start-ups, mid-to-large cap companies, and multinationals. The objectives are to:

- share new and existing medical data
- make data accessible
- establish regulatory infrastructure and information security; and
- advance existing companies and aid the establishment of new ones.

Knowledge transfer from academia to industry is a key focus in Israel.

### 1.7.2 Clinical Trials and Precision Medicine

Israel is looking to develop an ecosystem to support clinical trials – the goal is to make the country an international focal point. The transition from preclinical and early clinical development to providing drug efficacy in patients is known as the “valley of death”. There are funding challenges, a need for experienced regulatory process managers, and the clinical data produced often does not fulfil regulatory requirements.

Israel hopes that the move towards precision medicine – and with it a requirement for fewer patients to pass regulatory hurdles during fast-track approval – will allow more clinical trials to be conducted in the country.

Making genomic and clinical data accessible to industry will hopefully aid not only drug development but also selection of patients for clinical trial, which in precision medicine is also referred to as patient stratification. The IIA is looking to increase the support they provide for the early clinical phases of smart trials, and attraction of regulatory process experts to Israel.

Israel has several resources that could make it a hub for personalised medicine clinical trials – high-quality research

<sup>28</sup> <https://www.copaxone.com/>

<sup>29</sup> <https://en.globes.co.il/en/article-kite-pharma-the-huge-exit-that-israel-missed-1001203173>

<sup>30</sup> <https://www.futurx.co.il/>

<sup>31</sup> <https://www.ayalapharma.com/>

<sup>32</sup> <https://www.futurx.co.il/portfolio/impact-bio/>

<sup>33</sup> <https://www.cytoreason.com/>

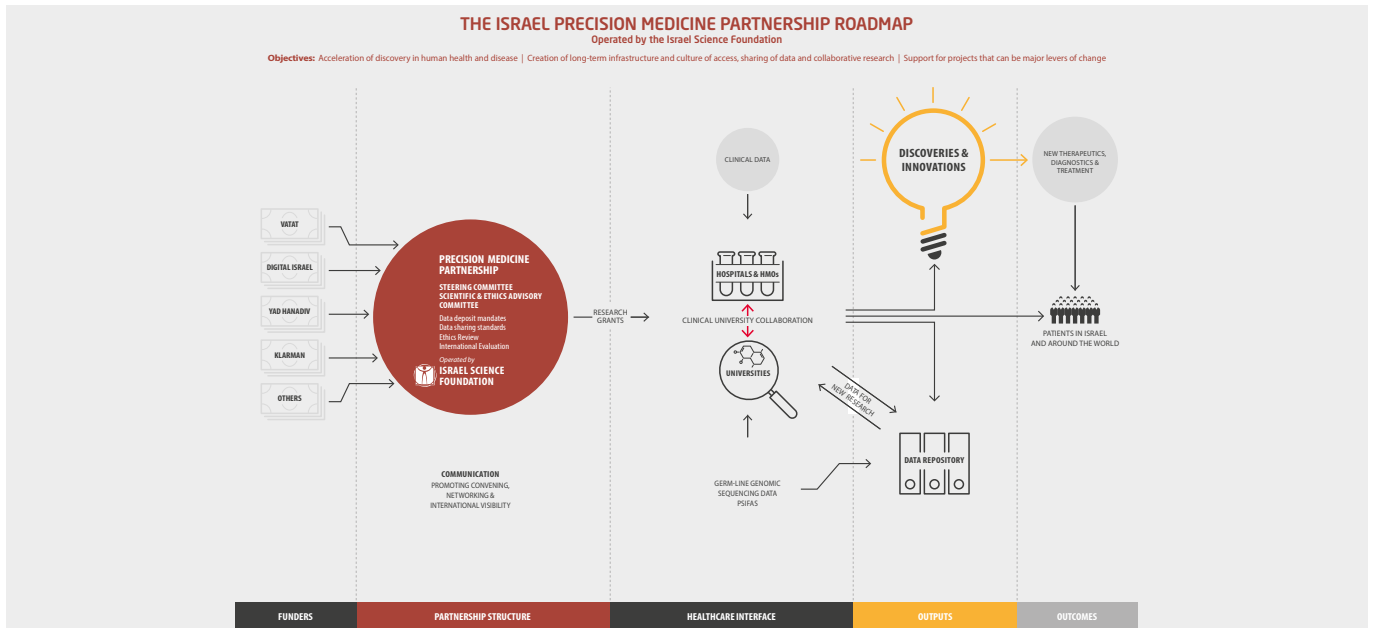


Figure 3: Israel Precision Medicine Partnership Road Map<sup>35</sup>

hospitals, experience in clinical trials, advanced medical care, and a small geographical area including diverse genetic populations. In 2017, there were more than 1,500 requests from companies to conduct clinical trials in Israeli hospitals. The overall move towards personalised medicine and digitisation in clinical trials could improve Israel's global standing in this area.

### 1.7.3 Key Policies and Mechanisms Supporting Precision Medicine

#### 1.7.3.1 Israel Precision Medicine Partnership (IPMP)

The IPMP<sup>34</sup> is a joint initiative of Yad Hanadiv, the Klarman Family Foundation, the Planning and Budgeting Committee of the Council for Higher Education, Digital Israel and the Israel Science Foundation. The partnership aims to combine genomic and post-genomic studies with advanced biomedical research and computational technologies to develop new diagnostics and therapeutics. The research will be carried out in Israeli universities, hospitals and health organisations.

The grant-making framework, as shown in Figure 3, will be operated by the Israel Science Foundation, supporting excellent research projects that address the molecular mechanisms underlying human health and disease with extreme precision with the end-goal of developing personalised therapies. The partnership will allow the establishment of biomedical data infrastructure, and a collaborative culture between clinical and research settings –

crucial to the long-term success of precision medicine. A key component of the partnership is a commitment to advancing public good via open sharing of data, operating through transparent and responsible public frameworks.

Total funding is expected to be US\$60 million over the next seven years.

#### 1.7.3.2 Mosaic Initiative for Personalised Medicine

The Israeli healthcare system is unifying existing databases of digital medical records in a National Digital Health Plan.<sup>36</sup> The medical records have been collected over a 20-year period for nine million residents and will be available to researchers and enterprises with the goal of attracting researchers and industry leaders from around the world. These medical records hold data for more than 98% of the population – each individual will need to consent to their data being digitised and made available. This is part of the Mosaic Health Project, creating a national information infrastructure for health research in genetics and medical information.

There will also be technological innovation laboratories established, with the goal of strengthening cooperation between multinational companies and Israeli digital health start-ups, encouraging joint ventures and development of academic courses to produce graduates who will support the sector.

The Mosaic Initiative has funding of US\$287 million.

<sup>34</sup> <https://www.yadhanadiv.org.il/sites/default/files/media/document/2019-03/IPMP%20Roadmap.pdf>

<sup>35</sup> <https://www.yadhanadiv.org.il/sites/default/files/media/document/2019-03/IPMP%20Roadmap.pdf>

<sup>36</sup> <https://health.gov.il/services/tenders/doclib/121118-mosaic-brief.pdf>

## 2. Current Collaborations and Synergies

There are several existing mechanisms of collaboration between the UK and Israel.

### 2.1 Existing Mechanisms for Collaboration Between the UK and Israel

#### 2.1.1 UK Science and Innovation Network in Israel

The UK SIN in Israel<sup>37</sup> was formed to promote international collaboration on Science and Innovation. The Department for Business, Energy and Industrial Strategy (BEIS) and the Foreign & Commonwealth Office jointly fund the UK SIN in over 40 countries.

The goal is to provide opportunities to work in a mutually beneficial way, exchanging students and researchers, gaining access to large scale international facilities via the following global objectives:

- Influence science and innovation policies of the Israeli Government, industry and academia to benefit the UK.
- Improve UK policy based on international experience and emerging opportunities and challenges with Israel.
- Stimulate strategic science collaborations with Israel to benefit the UK and deliver wider policy goals.
- Harness Israeli science partnerships and investment to grow UK innovation capability.

The priorities for UK engagement with Israel are set by the UK-Israel Science Council, a group of 30 leading scientists and policymakers from both countries, chaired by the UK Ambassador in Israel. Priorities are:

- nanoscience
- neuroscience
- regenerative medicine
- agri-sciences
- water science
- researcher mobility
- regional collaboration.

SIN Israel is based in the British Embassy in Tel Aviv and co-located at the British Council. SIN Israel works closely with the Department for International Trade and the UK Israel Tech Hub. SIN Israel coordinates Science and Innovation Network Grants, events and funding opportunities.

#### 2.1.2 UK-Israel Tech Hub

The UK-Israel Tech Hub is a not-for-profit organisation operating from the British Embassy since 2011. The organisation was formed by the UK Government to build strategic partnerships between Israeli innovation and UK businesses, to drive economic growth by aiding British companies partnering with cutting-edge technology from Israel. The Tech Hub organises and leads:

- innovation advisory projects
- bespoke business delegations
- workshops
- networking events
- information and policy.

#### 2.1.3 UK-Israel Science Council

This group is a body of 23 leading scientists from the UK and Israel; its core goal is to improve collaboration in science between the two countries via annual face-to-face meetings and regular online communications.<sup>38</sup>

#### 2.1.4 Britain Israel Research and Academic Exchange Partnership (BIRAX)

The BIRAX programme is a £10 million initiative between the British Embassy and the British Council in Israel.<sup>39</sup> Researchers from the UK and Israel are jointly funded in cutting-edge research projects. Over £8 million has been awarded to 19 projects in regenerative medicine in leading universities in the UK, including Oxford, Cambridge, Edinburgh and Nottingham.

BIRAX-funded research has been cited over 600 times, and funded projects have registered patents, work with biotech companies to licence their intellectual property and are securing further funding. BIRAX has also held scientific conferences and workshops. Additionally, BIRAX offers fellowships to early career researchers towards short research trips.

BIRAX is focused on funding healthy ageing-related projects as a next step, in line with the priorities of the Industrial Strategy Challenge Fund.

<sup>37</sup> <https://www.gov.uk/world/organisations/uk-science-innovation-network-in-israel>

<sup>38</sup> <https://www.ukisraelhub.com/>

<sup>39</sup> <https://www.britishcouncil.org.il/en/birax>

### The UK Industrial Strategy Challenge Fund

The Department for Business Energy and Industrial Strategy (BEIS) launched the Industrial Strategy Challenge Fund (ISCF) to be delivered by UK Research and Innovation (UKRI) to bring together the UK's world-class research expertise with business investment. The ISCF programme aims to foster technologies and industries that can help the UK prepare for the four Grand Challenges identified by the government as key drivers for change – Clean Growth, Future of Mobility, Artificial intelligence and Data and Ageing Society. We will be referring to the latter two in this report, as they have driven the ISCF investments in healthcare.

The ISCF has invested in various health-related challenges,<sup>40</sup> but the most relevant in this context are:

- Data to Early Diagnosis and Precision Medicine Challenge where the UK Government will invest £210 million to ensure the UK will be a world leader in the development of innovative new diagnostic tools, medical products, and treatments. The main three strands of the challenge are:
  - Digital pathology, radiology, and AI: £50 million has been allocated to five UK-wide centres of excellence and an additional £22 million allocated to integrated diagnostics.
  - Digital Innovation Hubs: Health Data Research UK (HDRUK) will deliver a £37.5 million stream to enable the safe and responsible use of health-related data at scale for research and innovation.
  - Genomics: The Wellcome Sanger Institute and the UK Biobank are among the key players to enhance UK capability in large-scale whole-genome sequencing through sequencing of the 500,000 subjects of UK Biobank.
- The £98 million Health Ageing ISCF<sup>41</sup> will drive the development of new products and services which will help people to live in their homes for longer, tackle loneliness, and increase independence and wellbeing. The programme will be investing in tackling many of the toughest medical challenges facing society today.

Over the last decade Innovate UK has spent a sum comparable to the £210 million being invested in the Data to Early Diagnosis and Precision Medicine Challenge via a range of other Innovate UK competitions in the areas of precision and stratified medicine.

#### 2.1.5 UK-Israel Memorandum of Understanding in Innovation

The UK Government (BEIS) signed an agreement in June 2018 with the Israeli Government (Ministry of Economy) for a bilateral, multi-year, £4 million programme to support business-to-business research and innovation collaboration between Israel and partners in the UK. The programme is led by the IIA and UKRI.<sup>42</sup>

#### 2.1.6 UK-Israel Memorandum of Understanding in Bilateral Science and Technology

In May 2018, the UK Minister for Universities, Science, Research and Innovation, Sam Gyimah and the Israeli Minister of Science and Technology, Ofir Akunis, signed a Memorandum of Understanding. The goal was to provide a mechanism by which both nations can build on their scientific

strengths and collaborate in key priority areas. Those relating to precision medicine include biotechnology and health (specifically ageing, antimicrobial resistance, infectious diseases, and neuroscience).<sup>43</sup>

### 2.2 Synergistic Themes

#### 2.2.1 Data - UK Biobank, NHS and Israeli Medical Records

##### 2.2.1.1 The UK Biobank

The UK Biobank is a medical research project set up as a not-for-profit charity by the Wellcome Trust, Medical Research Council, UK Department of Health & Social Care, Scottish Government and the Northwest Regional Development Agency. It also has funding from the Welsh Government, British Heart Foundation, Cancer Research UK and Diabetes UK and is supported by the National Health Service. It can be

<sup>40</sup> <https://www.ukri.org/innovation/industrial-strategy-challenge-fund/>

<sup>41</sup> <https://www.ukri.org/innovation/industrial-strategy-challenge-fund/healthy-ageing/>

<sup>42</sup> <https://www.gov.uk/government/news/uk-israel-strengthen-ties-with-new-innovation-agreements>

<sup>43</sup> <https://www.gov.uk/world/organisations/uk-science-innovation-network-in-israel>

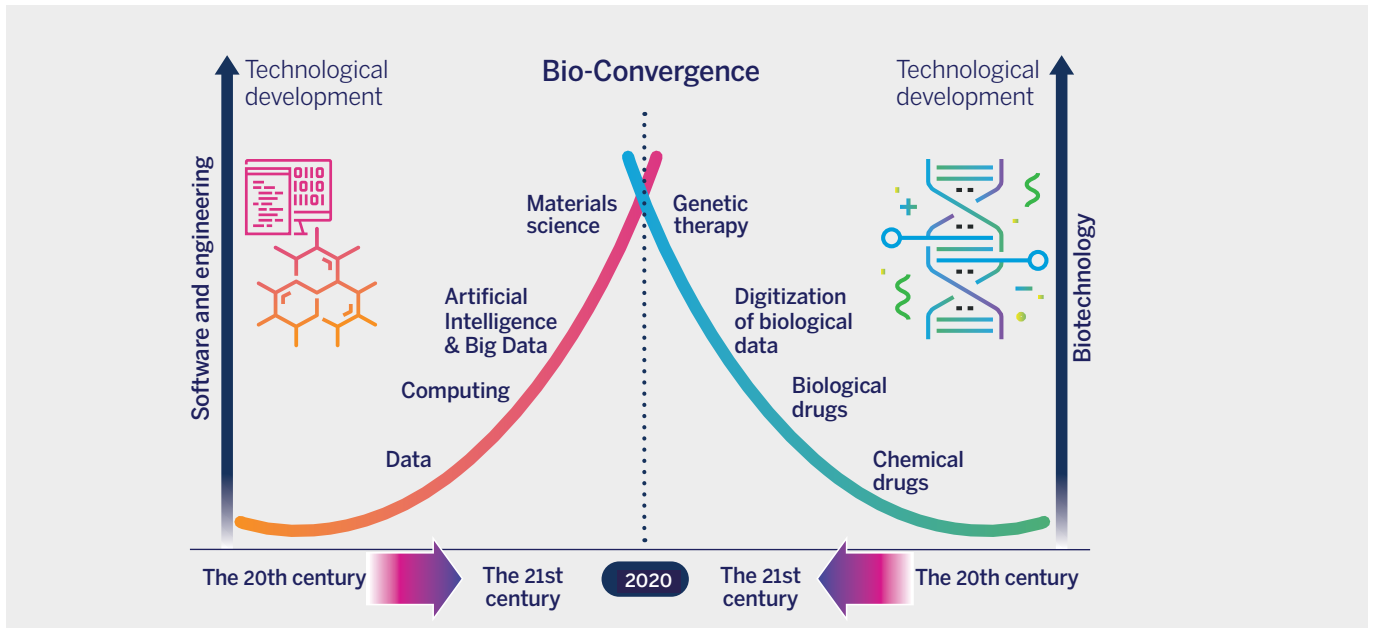


Figure 4: Technological breakthroughs in biotechnology and engineering paving the way for bio-convergence<sup>46</sup>

used by legitimate researchers anywhere in the world, funded by either academia or industry. The project had initial funding of about £62 million.

The project began in 2006 and recruited 500,000 participants who will be followed for at least 30 years to research the effect of genetic predisposition and environmental exposure on disease. The project aims to improve prevention, diagnosis, and treatment of illnesses including cancer, stroke, heart disease, diabetes, arthritis, osteoporosis, eye disorders, depression and dementia.<sup>44</sup>

The UK Biobank represents a key player in the UK precision medicine landscape, providing researchers from around the world with the opportunity to study the long-term impact of certain biomarkers on disease outcomes.

**2.2.1.2 The NHS Medical Records**

Unlike Israel, access to medical records is a challenge within the NHS due to the number of different medical records (records are not held in a centralised NHS repository, but instead are held at separate hospital trusts), and the fact many records have yet to be digitised.

**2.2.1.3 Israeli Medical Records**

Ease of access to the EHR database was highlighted during the mission. While each HMO has its own record-keeping system, these are all electronic and have been kept for

20 years. This dataset, in addition to the Mosaic initiative, is of value in multiple ways to both Israel and external stakeholders. A potential challenge when working with the records is that many are in Hebrew.

In addition to the medical records, Israel is setting up tissue banks within hospitals. For example, the MIDGAM initiative within the Meuhedet HMO. Some regulatory issues were highlighted, which may impede progress.

**2.2.2 The Concept of Bio-Convergence**

The concept of bio-convergence was a strong theme throughout the mission. As shown in Figure 4, bio-convergence brings together life sciences with engineering.

Israel is operating a National Bio-Convergence Program run by the IIA, with an open call for proposals under the European Horizon 2020 Health programme.<sup>45</sup> The call is for projects relating to:

- Accelerating the uptake of computer simulation for testing medicines and medical devices.
- Use of real-world data to advance research in the management of complex chronic conditions.
- International cooperation in smart living environments for ageing well.

<sup>44</sup> <http://www.ukbiobank.ac.uk/about-biobank-uk/>

<sup>45</sup> <https://www.innovationisrael.org.il/ISERD/event/when-engineering-and-biology-meet-open-call-bio-convergence-projects-advanced-medicine-under>

<sup>46</sup> <https://innovationisrael.org.il/en/reportchapter/bio-convergence>

Bio-convergence is the bringing together of engineering, biology and bioinformatics – from school education to funding at the business level. It is based on four core pillars:

- Multidisciplinary research excellence.
- Development of multidisciplinary human capital.
- Building infrastructure to support bio-convergence research.
- Acceleration of industrial growth and international collaborations.

Within Israel, investment in bio-convergence has thus far been around US\$500 million. This is an area where the UK is already working. The GlaxoSmithKline Galvani Bioelectronics<sup>47</sup> centre in London was mentioned as an exemplar of the bio-convergence model.

Bio-convergence represents a framework on which Israel-UK collaboration should occur given the strong compatibility between countries.

The IIA is collaborating with other organisations in Israel to create a competitive ecosystem to support bio-convergence, with key policy tools in place to promote advancement in this area, as shown in Figure 5.



Figure 5: Israel policy tools to promote bio-convergence<sup>48</sup>

<sup>47</sup> <https://www.galvani.bio/>

<sup>48</sup> <https://innovationisrael.org.il/en/reportchapter/bio-convergence>

# 3. Fertile Areas for Inspiration and Collaboration

During the mission a number of areas for collaboration were identified, where Israeli groups are working in a similar way to UK organisations, or areas where organisations or programmes can learn from each other.

## 3.1 Working with our Similarities

### 3.1.1 The UK-Israel Academic Relationship

Throughout the mission, delegates were told by Israeli stakeholders that the US is where Israeli students head when looking to study abroad. This perhaps explains the strength of the Israel-US bond when it comes to research further down the line.

However, there are a number of Israel-UK academic support networks already in place. The Union of Jewish Students<sup>49</sup> supports Jewish students studying in the UK and states that there are over 8,500 Jewish students in the UK – although these students may not be from Israel.

There are a number of scholarships and funding opportunities for Israeli students in the UK,<sup>50</sup> a few of which would be relevant to students in precision medicine are highlighted below:

- Chevening Scholarships
  - Funded by the Foreign & Commonwealth Office and partner organisations.
  - Awarded to outstanding emerging leaders for a one-year masters at any university.
- Anglo-Israel Association – the Kenneth Lindsay Scholarship Trust
  - For students studying any subject at university in the UK, £500-£2,000.
- AJA Karten Scholarship Programme
  - In partnership with the B'nai B'rith Leo Baeck (London) Lodge, the Anglo-Jewish Association and the Ian Karten Charitable Trust.
  - For Israeli postgraduates studying in the UK.
- Jewish Widows and Students Aid Trust
  - For Jewish students from the UK, France, Israel and Commonwealth countries who are under 30 years and studying a postgraduate course.
- Said Foundation
  - For students of Jordanian, Lebanese, Palestinian or Syrian nationality who are usually resident in their country of nationality.

Highlighted funding from universities:

- The University of Manchester and Weizmann Institute of Science PhD Studentships<sup>51</sup>
  - Jointly-funded PhD studentships in biological sciences.
  - Students spend years one and four at The University of Manchester and years two and three in Israel.
  - Two fully-funded studentships are available each year.
- Reuben Scholarship, Oxford or Cambridge University
  - Supports Israeli students looking to pursue a masters or PhD at the University of Oxford or Cambridge.
- Rhodes Scholarship, Oxford University
  - £25,000 for outstanding Israeli students on the basis of exceptional intellect, character, leadership and commitment to service.
- The Frost Scholarship Programme, Oxford University
  - Funds students of Israeli universities to study one year, full-time masters courses in STEM subjects.
- Menasseh Ben Israel Room Scholarship, Oxford University
  - For graduates of any Israeli university gaining a graduate place at Lincoln College in any subject, value is one year of free accommodation.

The University of Manchester is in discussion with higher education institutions in Israel to further bilateral collaborations in research and innovation.

### 3.1.2 Expertise in Basic Science and Translation Challenges

A key strength in Israel (and the UK) is expertise in basic science. However, the challenge is in taking this basic scientific research into the commercial realm and creating innovative products that solve real-world problems. Israel has identified translation as a key barrier to innovation within the precision medicine landscape, as discussed previously regarding the biopharmaceutical sector in Israel.

Translation is a global challenge.<sup>52</sup> Israel sees precision medicine as the foundation on which they can solve their problems in translation, due to expertise in the required areas of basic science, their national data and tissue banks, and the requirement for fewer clinical trial participants for precision

<sup>49</sup> <https://www.ujs.org.uk/>

<sup>50</sup> <https://www.britishcouncil.org.il/en/scholarships>

<sup>51</sup> <https://www.bmh.manchester.ac.uk/study/research/funded-programmes/weizmann-studentships>

<sup>52</sup> <https://www.frontiersin.org/articles/10.3389/fbioe.2016.00043/full>



medicine trials. The UK also has many of these strengths and could follow Israel's lead in areas where we are lacking. The UK has a strong understanding and adoption of regulatory systems which represent a key strength when translating to the healthcare market.

### 3.1.3 The Shared Challenge of Collaborating with Bigger Partners

Both Israel and the UK are geographically small countries who must innovate with an outward-facing perspective, selling to countries outside their own to ensure a big enough market. With this comes the challenge of collaborating with larger partners who may have the capacity to take innovation out of the country – presenting a challenge for funding models which fund in-country innovation but do not gain revenue from a product that is later sold to a larger country. This may present as a point of collaboration between Israel and the UK, to work together to solve this challenge, and to understand how each is dealing with the issue.

Israel often looks to their international partnerships, including those with the UK, France and Germany to facilitate market entry. Despite the fact Israel already has a large amount of foreign direct investment, the IIA appreciates the scope international partnerships have for their small and medium-sized enterprises to work with corporations in these other countries. Israel also has the opportunity to gain from the translational infrastructure of the UK, such as the Catapult programmes.<sup>53</sup>

### 3.1.4 Israeli Biorepository Network for Research (MIDGAM)

The Israeli Biorepository Network for Research was formed under the Chief Scientist of the Ministry of Health in 2014 and involves the collection of bio-samples from the four main medical centres in Israel (Tel-Aviv, Sheba, Hadassah and Rambam). These samples are donated by consenting patients, collected and preserved alongside relevant health information of the donating patient to form a bank of tissue available to scientists.<sup>54</sup> MIDGAM is actively involved in the legal and ethical side of biobanking and identifies the project's key goals as:

- Identification of biomarkers and prognostic factors.
- Development of tools for diagnosis and early detection.
- Development of innovative tailored treatments.
- Encouragement of collaborations between medical centres and researchers from academia in Israel and abroad.

The MIDGAM tissue bank supports researchers in their work, with Curesponse an example of a company which uses tissue

while developing their product (see 3.3.2.4). While the UK has examples of tissue banks including the Breast Cancer Tissue Bank<sup>55</sup> and the Imperial College multiple sclerosis tissue bank<sup>56</sup>, delegates on the mission felt the UK could learn from the Israeli model. A centralised bank with fresh tissue available to researchers will be of value to industry, and of great value to research leading to innovation in precision medicine.

### 3.1.5 Israel Innovation Authority – Innovate UK

During the mission we learned that the IIA functions in a broadly similar way to Innovate UK,<sup>57</sup> and has similar goals in the realm of precision medicine and collaboration with international partners. Both parties are keen to collaborate in the area of precision medicine. The Israel Science Foundation and IIA appear to be the main funding bodies of academia and companies, similar to the Research Councils and Innovate UK under UKRI although the relationship between the bodies does not parallel those in the UK. Projects are also funded in a similar manner. The drivers for funding are also similar to those in the UK, i.e. improving efficiencies to maximise patient outcomes within a fixed budget, rather than looking to increase revenue.

### 3.1.6 Israel Science Foundation

The Israel Science Foundation (ISF)<sup>58</sup> is the equivalent of the research councils in the UK, it is the main body supporting breakthrough basic science in Israel. The ISF is a fully independent non-profit run by scientists with funding activities largely in academia. ISF is funded by Israel's Council for Higher Education (CHE) through its Planning and Budgeting Committee (PBC) – the active arm of the council for higher education. The only criteria used for grant-giving is excellence of scientific proposals. They have an annual budget of around US\$181 million and over 2,000 research applications per year. The funding rate is around 33%.

Average size of grant within research area:

- basic science and technology US\$70,000
- life sciences and medicine US\$77,000
- humanities US\$38,500
- social sciences US\$49,000.

The ISF see the UK as their most promising potential collaboration partner. ISF is working to identify British partners for collaboration with the help of the British Embassy and the British Council.

## 3.2 Universities and Technology Transfer Offices

During the mission, delegates visited the following universities

<sup>53</sup> <https://catapult.org.uk/>

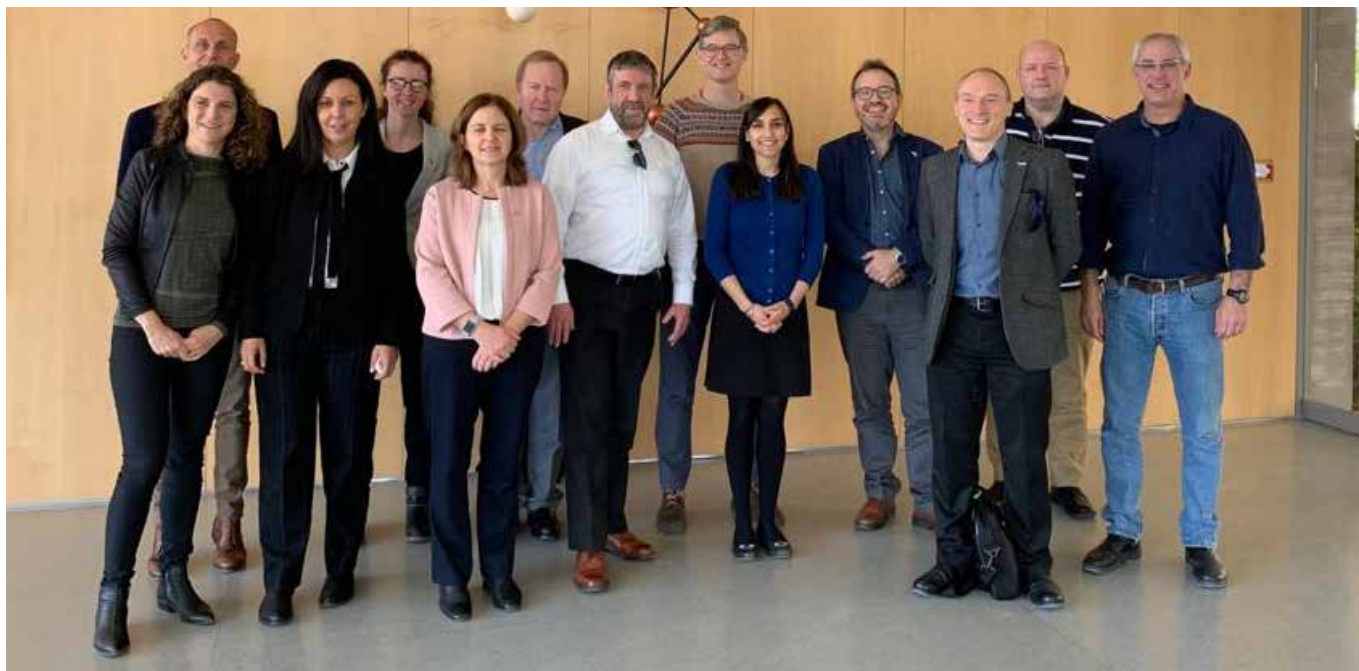
<sup>54</sup> <https://www.midgam.org.il>

<sup>55</sup> <https://www.breastcancertissuebank.org/>

<sup>56</sup> <https://www.imperial.ac.uk/medicine/multiple-sclerosis-and-parkinsons-tissue-bank/>

<sup>57</sup> <https://innovationisrael.org.il/en/>

<sup>58</sup> <https://www.isf.org.il/>



UK delegates with researchers from the National Institute for Biotechnology in the Negev

and their associated technology transfer offices and organisations designed to take basic science to commercial innovation.<sup>59</sup>

### 3.2.1 Ben Gurion University – National Institute for Biotechnology in the Negev (NIBN)

The National Institute for Biotechnology in the Negev (NIBN) was established in 2009 and is the first self-organised, independent research entity set up under the umbrella of a university in Israel. The long-term vision is the development of a successful biotechnology industrial hub in Israel, and particularly in the Negev area. The goal is to plant scientific seeds that lead to the commercialisation of innovative ideas and technologies developed by NIBN researchers. The NIBN was established through a trilateral agreement between the Israeli Government, Ben-Gurion University and banker and philanthropist, Edgar de Picciotto.

The specific scientific goals of the NIBN are to bridge the gap between basic and applied innovation research using a multidisciplinary, applied research approach guided by a clear biotechnology vision.

The research focus is on:

- cancer
- infectious diseases
- autoimmune and metabolic diseases
- human genetic disorders
- neurodegenerative diseases
- applied biotechnology (including agriculture biotechnology).

With core facilities in:

- bioinformatics
- genomics
- cytometry
- crystallography
- cryotherapy.

The NIBN provides researchers with:

- laboratories
- grants
- infrastructure support units
- intellectual property
- project management
- business development leadership.

The NIBN is funded by a US\$90 million pot from 10 years ago; there is around US\$25 million left – the NIBN is currently exploring future funding options. The NIBN expressed their interest in working with the UK, with the barrier being how to access collaboration.

The NIBN is seen as a unique institute; they have restructured to ensure all key staff have an industry background and the experience to commercialise researcher ideas. The NIBN has 225 students, 24 researchers and five fellows with 19 projects currently running.

NIBN owns the IP of projects they commercialise but are looking to license out and consider joint development and

<sup>59</sup> <https://www.sciencedirect.com/topics/engineering/technology-transfer-office>

joint spin-outs. There have been 816 papers published from NIBN research, 47 patent families and five licenced projects.

### 3.2.2 Hebrew University – Yisum Technology Transfer

Yisum<sup>60</sup> is the technology transfer company of The Hebrew University of Jerusalem. Founded in 1964, it serves as a bridge between cutting-edge academic research and a global community of entrepreneurs, investors, and industry.

In 2018 Yisum had 100 license options, 128 SRO, 156 new patents and ten spinouts, including blockbusters like MobilEye<sup>61</sup> and cherry tomatoes.<sup>62</sup>

#### 3.2.2.1 Genetika+

An example of a company on the incubator site within the Hebrew University of Jerusalem, Genetika+ is a company using a screening model to choose the best treatment for a patient based on biological, medical and genetic data.<sup>63</sup> The product is focused on treating depression but has the potential to explore a wider treatment group. The company employs five and is funded by the IIA.

### 3.2.3 The Weizmann Institute – Yeda Technology Transfer

The Weizmann Institute<sup>64</sup> is a multidisciplinary basic research institute covering the natural and exact sciences established in 1934 by Daniel and Rebeca Sieff. In 2012 the institute formed The Nancy and Stephen Grand Israel National Center for Personalized Medicine (G-INCPM) which covers genomics, protein profiling, bioinformatics, drug discovery and medicinal chemistry.

The G-INCPM aims to enable collaboration between basic research scientists and clinicians in Israel. Scientists live together at the Weizmann in family housing, and research projects are often sparked from personal relationships as scientists from different academic backgrounds discuss their work. During the first few years the focus has been on building infrastructure and knowledge. The G-INCPM is shifting towards a focus on translational research via the creation of services and products.

Yeda Research and Development<sup>65</sup> is the technology transfer office of the Weizmann Institute. It has an agreement to commercialise the IP created by scientists, with income generated being used to fund basic science research and education.

Its mission is to:

- Identify and assess research projects with commercial potential.
- Protect the intellectual property of the Institute and its scientists.
- Create business relationships and licence the Institute's inventions and technologies to the industry.
- Channel funding from industry to research projects.

## 3.3 Hospitals and Precision Medicine

### 3.3.1 Sheba Medical Centre – ARC Innovation Centre

Sheba Medical Centre is the biggest hospital in the Middle East<sup>66</sup> with around 10,000 staff of whom 1,700 are doctors, 200 PhD students and 3,000 nurses. The centre covers an area of 800,000m<sup>2</sup>. The hospital is heavily focused on research, works with Tel Aviv University and was ranked as 10th in the world by Newsweek.<sup>67</sup> Sheba is a national hospital and works with all HMOs. The hospital is working towards the goal of creating a Future City of Health.<sup>68</sup> The hospital has been paperless for twenty years – all records are kept digitally using Enterprise Data Warehouse.<sup>69</sup>

Sheba has well-established systems and processes, significant clinical trials infrastructure for all phases of research and a biorepository.

Sheba Medical Centre is open to collaborations with UK researchers and organisations; they highlighted that these relationships take time to develop.

The ARC (Accelerate, Redesign, Collaborate)<sup>70</sup> is the innovation centre for Sheba Hospital and works with the goal of improving patient care using innovation and thereby transform healthcare delivery.

The ARC innovation centre has six core innovation hubs:

- Big data and artificial intelligence.
- Precision medicine.
- Telemedicine.
- Virtualisation in medicine.
- Innovation in surgery.
- Rehabilitation.

The ARC centre intends to replicate the innovation model they have established in Sheba in Chicago and Ottawa.

<sup>60</sup> <http://www.yisum.co.il/>

<sup>61</sup> <https://www.mobileye.com/>

<sup>62</sup> <http://www.yisum.co.il/success-stories/Blockbusters>

<sup>63</sup> <https://www.genetikaplus.com/>

<sup>64</sup> <https://www.weizmann.ac.il/pages/>

<sup>65</sup> <https://www.yedarnd.com/Overview>

<sup>66</sup> <https://www.shebaonline.org/>

<sup>67</sup> <https://www.newsweek.com/best-hospitals-2019/israel>

<sup>68</sup> <https://www.shebaonline.org/city-of-health-new-healthcare-paradigm/>

<sup>69</sup> <https://www.ibm.com/uk-en/analytics/data-warehouse>

<sup>70</sup> <https://arc.sheba.co.il/>



UK delegates in meeting with Genetika+

### 3.3.2 Tel Aviv Sourasky Medical Center (Ichilov) Hospital – Innovation and Technology Transfer Office

Ichilov Hospital<sup>71</sup> is one of the largest medical research centres in Israel. It has a strong focus on translational research and aims to build links with commercial spinouts in order to become a testing site for new technologies. The technology transfer office is the Innovation and Tech Transfer Office<sup>72</sup> which promotes licenced IP resulting from researchers work in the hospital. The IP is owned by the Medical Research Infrastructure and Health Services fund.

There are three innovation programmes run out of the Innovation and Technology Transfer Office:

- The Medical Device Accelerator – to support and manage the development of ideas for new medical devices into patented prototypes and proof of concept studies supported by an internal seed fund.
- The Innovation Workshop – provides the basic tools for inventing and developing new medical devices.
- The Med-Tech Club – a group of researchers who meet several times a year with entrepreneurs and industry experts.

#### 3.3.2.1 i-Metadata and the Deteriorating Patient

i-Metadata is a hub within Ichilov Hospital for data-driven translational research, with a team of 20 people. It collects

a large amount of data and makes it available for analysis. A current project, the “Super Nurse” algorithm, makes decisions on which patients are likely to need the most care based on data from a camera watching the patient, clinical observations (e.g. blood pressure) and the patient’s medical record.<sup>73</sup>

#### 3.3.2.2 MDClone

MDClone provides synthetic data, where a realistic database is re-created synthetically using real-world data.<sup>74</sup> This allows organisations to share data while protecting individual privacy and could represent a means by which organisations such as the NHS could utilise their data resources.

#### 3.3.2.3 iGenify

iGenify is a digital platform that allows counselling of patients undergoing genetic screening.<sup>75</sup> The system can interpret and analyse genomes enabling physicians to identify patients at risk from certain conditions. If a patient is identified as low risk, the physicians can use video reporting for the screening results. If high-risk, patients are called into the clinic. Patients are also able to give consent via the app. The company was set up after winning a grant from the IIA to meet the need for genetic counsellors in Israel, which was creating a bottleneck when screening for genetic abnormalities.

#### 3.3.2.4 Curesponse

An example of a company founded within the Medical Device

<sup>71</sup> <https://www.tasmc.org.il/sites/en/Pages/default.aspx>

<sup>72</sup> <https://www.tasmc.org.il/sites/en/Research/Tech-Transfer/Pages/Technology-Transfer.aspx>

<sup>73</sup> <https://www.israel21c.org/a-new-ai-super-nurse-monitors-patients-in-israeli-hospital/>

<sup>74</sup> <https://www.techworld.com/data/what-is-synthetic-data-how-can-it-help-protect-privacy-3703127/>

<sup>75</sup> <https://www.igenify.com/#2>

<sup>76</sup> <https://www.curesponse.com/>



UK delegates in meeting with researchers from Sheba Medical Centre

Accelerator, Curesponse<sup>76</sup> has created a three-dimensional tissue culture system to model cancer growth and drug response. Using this system, a personalised approach to cancer treatment can be taken by enabling physicians to test how a patient will respond to any given drug in a tissue model taken from that patient. The system is the only genomic and functional diagnostic allowing a more precise and accurate drug response and keeps tissues alive for longer than other methods.

Curesponse is an example of the ease with which technology can gain access to the clinical setting in Israel. They were able to gain access without an Investigational Use Only (IUO) level of analytical validation or software lifecycle accreditation for bioinformatics algorithms. Curesponse is setting up a laboratory in the UK.

### 3.4 Other Organisations

#### 3.4.1 Peres Center for Peace and Innovation

During the mission, delegates visited the Peres Center for Peace and Innovation.<sup>77</sup> The centre was founded in 1996 by Shimon Peres, the late President of Israel. The centre promotes prosperity in Israel with a focus on developing and highlighting innovation, with the overriding aim of encouraging lasting peace between all citizens of Israel and between Israel and its neighbours.

Delegates learned about the cultural focus on innovation, along with examples of Israel's best innovation. Innovation springs from need, and from a nation not afraid of failure.

- Failure is an essential component of success.
- Dream big; there is no room for small dreams.



A sculpture in front of the Peres Center for Peace and Innovation advises visitors to "Dream Big" while reminding them the missing pieces of the puzzle are theirs to complete.

<sup>77</sup> <https://www.peres-center.org/en/the-organization/about-us/>

## 4. Barriers and Challenges to Working Together

### 4.1 Creating a Clear Picture of the UK Funding Landscape

A constant theme throughout the mission was the complexity of funding in the UK landscape and a need for improved clarity for international stakeholders, including how other countries can access potential funding for collaboration or even information on this funding.

### 4.2 Understanding Entry to the NHS

Another common theme was a need for greater understanding of how an innovative treatment or technology could gain access to the NHS, and how to access advice on achieving this. Although the Israeli and UK healthcare systems are broadly similar, they do not share the same access approach for innovative technologies. The feeling among Israeli businesses was in general that accessing the NHS is so difficult it may not be worth attempting. Accessing the healthcare market in Israel is very different, with individual doctors taking much of the responsibility and new technologies potentially gaining access to real-world patients in a matter of weeks. This represents a huge difference between the UK and Israeli approach that may hinder collaboration within innovation.

### 4.3 IP Issues and Working with Bigger Partners

The UK and Israel share the barrier of IP issues when working with bigger partners. While this makes it a challenge to work with, for example, the US, this could be a potential strength when collaborating with the UK. Although collaborations can be mutually beneficial, neither country wishes to lose its investment once a product is commercialised.

### 4.4 Creating UK-Israel Academic Ties

During the mission it became apparent that Israeli students favour the United States as a place to study. While this is partly due to existing ties, it is not clear why quite so few Israeli students choose to study in the UK. The number of Israeli students in the UK is falling; in 2007-2008 there were 620 Israeli-domiciled undergraduates and postgraduates enrolled at British universities, in 2015-2016 there were only 420<sup>78</sup>. A better understanding would help overcome the barrier of encouraging Israelis to study in the UK, and vice versa, in order to create academic ties between the two countries which then become research and innovation ties.

### 4.5 Culture Clash

While the cultures of both the UK and Israel have their strengths, the difference between the two could present challenges. Israelis are used to working with fewer regulatory hurdles, gaining funding and easy access to people at the top of the organisations, which is not replicated to the same extent in the UK.

### 4.6 Language

While the language of science is English and the vast majority of Israelis speak English, the health records are still partially in Hebrew, and this may present a challenge for collaborations aiming to work with the EHRs.

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<sup>78</sup> <https://jewishnews.timesofisrael.com/israelis-studying-in-uk/>

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# Annex 1

## List of UK Participants

Almac

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AstraZeneca

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Innovate UK

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Knowledge Transfer Network

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NHS

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PinPoint Data Science

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QuantuMDx

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The University of Manchester

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The Wellcome Sanger Institute

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## List of Israel Participants

Ben Gurion University

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Curesponse

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The Deteriorating Patient

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Genetika+

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Haifa - Israel Institute of Technology

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Hebrew University

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Ichilov

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iGentify

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i-Metadata

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Israel Innovation Authority

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MDClone and Synthetic Data

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Ministry of Health

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Sheba Medical Centre

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The Weizmann Institute

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