ANSTO submission to Strategic Review of Health and Medical Research

The Australian Nuclear Science and Technology Organisation (ANSTO) is Australia's national nuclear research and development organisation and the centre of Australian nuclear expertise as applied to life sciences, including research in food and nutrition. With over 1000 employees and a large site at Lucas Heights as well as a site dedicated to biomedical research at Camperdown, Sydney, ANSTO operates the single largest research infrastructure in Australia, comprising a research reactor and several large-scale accelerators. Through the Australian Institute for Nuclear Science and Engineering (AINSE), ANSTO has formal links to essentially all universities in Australia and New Zealand.

- ***Why is it in Australia's interest to have a viable, internationally competitive health and medical research sector? (Terms of Reference 1 and 6)***

1. The need for Australia to build and retain internationally competitive capacity across the research spectrum, from basic discovery research through clinical translation to public health and health services research.

Importance of the health and medical research sector

Australia needs a viable, internationally competitive health and medical research sector to:

a. ensure best practice delivery of health care to its own population;

b. continue to extract value from its ongoing investments into biotechnology, a sector that has been an important contributor to national IP and generator of income; and

c. to remain a player in the international research and application sector for biotechnology innovation and an attractive destination for the highly skilled workforce that underpins research and innovation.

In order to assess what a viable, internationally competitive health and medical research sector will mean in future, we must recognise that other countries in the Asia Pacific with a much larger population base and a rapidly modernising health system are improving their capability to undertake sophisticated medical research (e.g. drug discovery and clinical trials that are fully compliant with international standards and regulations). Australia's current advantage in clinical applied research may thus diminish over time. Therefore, a concept of health research that extends into areas such as food and nutrition, i.e. aspects of population and environmental health where Australia has distinct natural advantages as a producer of food and agricultural innovations and marine-based food production, would seem a logical development. It would also link to national priorities beyond 'Promoting and maintaining good health'.

Internationally competitive capacity

As a Commonwealth agency, ANSTO builds and retains technology platforms that are a substantial part of Australia's internationally competitive capacity across the research spectrum - from structural biology, where the neutron beams at ANSTO's OPAL reactor are amongst the best in the word, to advanced radiochemistry and medical isotope-producing cyclotrons for medical research and clinical trials. ANSTO is actively engaging with the broader biomedical research community to increase existing capacity, improve efficacy, improve skills and plan for new infrastructure. One example is the ongoing national consultation on the possible future development of hadron therapy for the treatment of inoperable cancers. Beyond the immediate benefit for usually young patients with currently

incurable cancers, this accelerator-based nuclear technology affords a broad range of fundamental research opportunities.

The uniqueness of ANSTO's capabilities within the Australian research setting has long supported strong international collaborations with overseas counterparts, ensuring world's best practice, cutting-edge competitive research, and effective knowledge sharing. ANSTO's international research projects and collaborations are multifaceted and extensive. They incorporate both multilateral and bilateral collaborations and are implemented under a range of research agreements, which cover access to facilities, joint research and development, and researcher exchange and training.

ANSTO gives strength to Australia's international links with important partners overseas, such as CERN and large research organisations in the Asia-Pacific that provide Australian researchers with access to their large-scale research infrastructure. ANSTO is a preferred partner for national and overseas students and researchers. Students profit particularly from the highly transferable skills that the nuclear science and technologies at ANSTO can offer.

International collaborations enhance Australia's ability to deliver the outcomes relevant to the National Research Priorities, For example, ANSTO delivers on the National Research Priority "Promoting and Maintaining Good Health" by participating in joint research projects with France, Argentina, the United States, Canada, South Africa and Belgium regarding the most widely used radiopharmaceutical – technetium-99m.

The current - and in some cases leading - involvement of ANSTO in important national initiatives, such as the NCRIS Characterisation Council (National Imaging Facility (NIF), the National Deuteration Facility (NDF), the Australian Synchrotron and the Australian Microscopy and Microanalysis Research Facility (AMMRF), offers the opportunity to sustainably strengthen the national research effort by continuing the integration of the various technology platforms and making them more easily accessible across institutional barriers.

6. Strategies to attract, develop and retain a skilled research workforce which is capable of meeting future challenges and opportunities.

Early exposure to science and pathways of learning across the entire education sector and industry

The core elements of a successful strategy, as seen in other countries, are early exposure to the sciences as part of the national curriculum, and facilitated mobility across the entire education sector and training opportunities in industry.

Strong collaboration across the vocational and tertiary education sector opens opportunities for early career scientists to become involved on the national and global stage, promote careers in science and provide career paths for research scientists. The reduction of barriers between vocational and tertiary education is highly attractive to students. Australian universities which allow an easy transition between vocational and tertiary education and with strong links into industry have the highest level of employment amongst their graduates.

ANSTO is involved in educational activities that reach from schools to high-level post-graduate research training.

- ANSTO has extensive activities in relation to school education, with many NSW students befitting from visits to the site, and a number of other teachers' resources available, including professional development days for science teachers[1]
- ANSTO runs a highly successful graduate program that includes the application of nuclear science and technology for basic and applied health and medical research. The highly translatable skills that ANSTO provides are a major attractor to this program.
- ANSTO attracts a high number of post-doctoral young researchers, many from leading overseas institutions
- On-line distance learning, including assessment and some certification, can help in closing the skills gap, especially if combined with hands-on training. Currently, ANSTO has an education programme with IAEA, in medical radiation training with hands-on training in medical imaging (PET/CT).
- ANSTO provides radiation safety training for industry[2].

International 'connectedness': mobility, accessibility and participation

The involvement of Australia in human mobility programs is likely to become more important. Such programs have been shown to enhance 'connectedness' as an important indicator of sustained national prosperity[3].

There remains room for systematic reduction in hurdles to the engagement of Australian's overseas and researchers coming from overseas. This may range from a greater involvement in international consortia (such as at CERN where the application of physics and engineering for life sciences questions is becoming a strong theme) to more structured career paths for Australian scientists, improved employment conditions for overseas-trained European staff and others.

Mobility schemes like the Marie Curie actions in the European framework programme[4] are a mechanism to foster links and partnerships, especially with regards to intersectoral mobility and skills exchange. It might be useful to envisage such a funding mechanism for academia-industry partnerships that fosters collaboration between non-commercial & commercial research organisations.

An example of how outstanding future research leaders can be attracted to Australia is the EMBL Australia (European Molecular Biology Laboratory), the first branch of this internationally leading organisation outside Europe. ANSTO is currently in the process of actively engaging with EMBL Australia with the intention of facilitating access to its broad technology platform for life sciences research.

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[1] http://www.ansto.gov.au/education/teacher_resources

[2] http://www.ansto.gov.au/business_services/specialised_services/dates_and_enrolment

[3] United Nations Industrial Development Organization (UNIDO), *Networks for Prosperity: Achieving Development Goals through Knowledge Sharing*, http://www.unido.org/index.php?id=1001971.

[4] http://cordis.europa.eu/improving/fellowships/home.htm

- ***How might health and medical research be best managed and funded in Australia? (Terms of Reference 2, 3 and 7)***

2. Current expenditure on, and support for, health and medical research in Australia by governments at all levels, industry, non-government organisations and philanthropy; including relevant comparisons internationally.

3. Opportunities to improve coordination and leverage additional national and international support for Australian health and medical research through private sector support and philanthropy, and opportunities for more efficient use, administration and monitoring of investments and the health and economic returns; including relevant comparisons internationally.

7. Examine the institutional arrangements and governance of the health and medical research sector, including strategies to enhance community and consumer participation. This will include comparison of the NHMRC to relevant international jurisdictions.

Current resource provision, participation and coordination by ANSTO in the national health and medical research sector

ANSTO Health is Australia's prime provider of medical isotopes for clinical use. Through ANSTO LifeSciences, ANSTO has further grown its involvement in health and medical research through close partnerships with mission-oriented research institutes. ANSTO LifeSciences is broadening its scope from the relatively narrow provision of routine isotopes for nuclear medicine to support for research into environmental health, sustainable food production, nutrition and population health, fields in which quantitative analytical nuclear techniques (such as stable or radio- isotopic measurements) are often the most sensitive and accurate.

Examples of ANSTO's resource provision, participation and coordination are the partnerships with the Centre for Advanced Imaging at the University of Queensland, and the involvement of ANSTO scientists in the medical and other beam lines at the Australian Synchrotron, the Austin Hospital Melbourne and the Brain and Mind Research Institute (BMRI) at the University of Sydney. In the case of the BMRI, ANSTO and the university jointly operate an imaging and advanced radiochemistry research platform. This platform links to two national networks: the National Collaborative Research Infrastructure Strategy (NCRIS)-funded National Imaging Facility[5] and the National Cyclotron Network, a user group that comprises most current and some future operators of cyclotrons in Australia. Merit-based open-access, inter-institutional knowledge-transfer, interdisciplinary collaboration, improved capacity utilisation and standardisation of protocols are the guiding principles of both networks. As a provider of a national technology platform, ANSTO's operational experience contributes to the resilience and future growth of these networks. The networks have further made it their mission to address important skills shortages, such as in radiochemistry, image data analysis and modelling. Being a Commonwealth organisation familiar with governmental accountability structures, ANSTO's participation has also strengthened governance across the large number of network partners, who are often otherwise competitors for access to the national funding mechanisms, such as NHMRC and ARC.

[5] http://www.anif.org.au/

ANSTO LifeSciences conducts or in partnership supports biomedical research using nuclear-based technology platforms, such as cyclotrons, radio-labelling facilities and a range of imaging capabilities. Research applications range from probing molecular structure at the atomic level using neutrons or x-rays to bio-distribution in humans. A unique feature of nuclear technologies is their generic utility. Therefore, much of the research supported by ANSTO is strongly interdisciplinary and cross-sectoral. For example, food and nutrition-related research activities are within the remit of the Institute for Environmental Research, including the Australian Centre for Accelerator Science (ACAS), the Bragg Institute (including the National Deuteration Facility) and ANSTO LifeSciences. This creates the integrated research environment necessary to study the complex questions that underlie population health.

ANSTO has identified in the area of its own expertise a number of needs and opportunities that should be taken note of:

1. ANSTO's unique technology platforms and large-scale research infrastructure afford unique opportunities for interdisciplinary and cross-sectoral partnerships that could be more systematically encouraged.
2. The introduction of knowledge-led innovation in clinical practice requires the removal of a number of barriers, particularly in the area of diagnostic imaging using radioisotopes:
    - Currently, researchers have only very restrictive access to existing clinical imaging facilities. Shared use of such facilities, which is important for translational research, is not common practice. The recently established National Imaging Facility is a model of how facility access can be provided to a national user group.
    - There has not yet been the necessary standardisation of protocols that would allow for sufficiently robust multi-centre clinical trials that use biomedical imaging as one of the measures of outcome.
    - Routine production of medical isotopes and radiotracers by cyclotrons is currently provided by the State-funded health sector and is a subsidised activity exempt from some important regulatory requirements. Best practice laboratory standards, health and safety standards as well as compliance with regulatory requirements are therefore not uniformly applied to all providers of medical isotopes and radiotracers and operators of imaging equipment. This has reduced the capacity available for clinical translational research in two ways: it disadvantages providers that comply with internationally accepted regulatory requirements; and potentially puts at risk Australia's future eligibility to partner in clinical trials with overseas stakeholders that require adherence to international standards..
3. Better coordination of the access to existing cyclotron capacity and an increase in much-needed PET and SPECT cameras would allow improved capacity utilisation and future demand estimation. Systematic long-term development of biomedical imaging infrastructure should occur across area health services, universities and institute clinical research.
4. In ANSTO's experience, mission-oriented research institutes are a well-suited model to achieve operational integration while maintaining differentiation within a competitive national and international research environment.

- ***What are the health and medical research strategic directions and priorities and how might we meet them? (Terms of Reference 5, 12 and 13)***

5. Likely future developments in health and medical research, both in Australia and internationally.

12. The degree of alignment between Australia's health and medical research activities and the determinants of good health, the nation's burden of disease profile and national health priorities, in particular "closing the gap" between indigenous and non-indigenous Australians.

13. Opportunities for Australia's health and medical research activities to assist in combating some of the major barriers to improved health globally, especially in the developing world.

Future developments in health and medical research

In terms of health priorities, increasing attention will need to be paid to diseases of ageing like cardiovascular disease, neurological diseases, dementia and cancer. Radiopharmaceuticals already play a crucial role in the early diagnosis of such conditions. ANSTO LifeSciences continues to carry out cutting-edge research, such as the development of dual-use probes that combine diagnostic target identification with therapeutic targeting.

However, some of the most significant gains in population health have been achieved through the improvement of the status of the environment, such as the control of pollutants or the conditions under which communicable diseases may spread. This perspective informs ANSTO's involvement in health and medical research: complementing the efforts of modern medicine towards 'personalized medicine' through better diagnostic and therapeutic tools, such as advanced molecular imaging using radiotracers. ANSTO leads the use of nuclear technology for the diagnostics of environmental health. For example, ANSTO's 'Fine and Coarse Particle Ambient Air Data Base', and broad-ranging work on long range travel of pollutants, replenishment of aquifers, food webs, their adaptation under climate change, and food safety is a still unexploited national resource for health and medical research.

From this perspective, a more integrative approach to health and medical research becomes important, notably that classical 'disease-oriented' research is complemented by research and innovation that has disease prevention rather than treatment as its goal. This may include programmatic development that recognises the importance of sustainable precision agriculture, healthy food production and nutrition research (particularly as related to maternal health and youth and adolescent health) for the national priorities 'A healthy start to life'; 'Ageing well, living productively' and 'Preventive healthcare'. This broader approach implies that as its overarching priority, the funding model will create incentives to overcome siloed discipline-centred research and incrementalism.

Multidisciplinary teams are likely to play an increasingly important role in ensuring that the power of bioinformatics, IT, engineering and design is brought to bear in life sciences and clinical research. The strengthened role of multidisciplinary research should help to align health service delivery better to specific communities, and may help create a cultural shift that overcomes some of the disciplinary and professional boundaries that currently add to inefficiencies and structural deficits in the Australian health system.

Improved health globally

In regard to opportunities to assist in combating some of the major barriers to improved health globally, especially in the developing world, ANSTO has been supporting the introduction of vital cancer diagnosis and treatment modalities, such as radiation therapy and skills training for nuclear medicine technicians. This has been undertaken as part of international and regional collaborative arrangements[6].

As part of the broader context in which health is improved in developing countries, ANSTO provides expertise, in a range of nuclear technology applications, such as food safety, pest control (sterile insect technology) and control of vector-borne communicable diseases.

- ***How can we optimise translation of health and medical research into better health and wellbeing? (Terms of Reference 4, 8, 9, 10 and 11)***

4. The relationship between business and the research sector, including opportunities to improve Australia's capacity to capitalise on its investment in health and medical research through commercialisation and strategies for realising returns on Commonwealth investments in health and medical research where gains result from commercialisation.

8. Opportunities to improve national and international collaboration between education, research, clinical and other public health related sectors to support the rapid translation of research outcomes into improved health policies and practices. This will include relevant international comparisons.

9. Ways in which the broader health reform process can be leveraged to improve research and translation opportunities in preventative health and in the primary, aged and acute care sectors, including through expanded clinical networks, as well as ways in which research can contribute to the design and optimal implementation of these health reforms.

10. Ways in which health and medical research interacts, and should interact, with other Government health policies and programs; including health technology assessments and the pharmaceutical and medical services assessment processes.

11. Ways in which the Commonwealth's e-health reforms can be leveraged to improve research and translation opportunities, including the availability, linkage and quality of data.

In order to optimise translation of health and medical research into better health and wellbeing and arrive at knowledge-led innovation in clinical practice, health service delivery and population health programme, the removal of a number of barriers is required. In the domain that ANSTO is active in, particularly in the area of diagnostic imaging using radioisotopes, the following needs to be achieved:

- enabling of easy access for researchers to existing clinical imaging facilities for sharing use of such facilities which is important for translational research;

[6] For example, see the International Atomic Energy Agency's Programme of Action for Cancer Therapy (PACT) (http://cancer.iaea.org/index.asp)

- introduction of necessary standardisation of protocols that would allow for sufficiently robust multi-centre clinical trials; and
- consistent implementation of best practice laboratory standards and health and safety standards (including good manufacturing practice (GMP)) in research laboratories in order facilitate translation into clinical trials and applications.

Furthermore, it is important to provide operational support for existing infrastructure together with a renewal and replacement strategy for ageing infrastructure. As a matter of policy, funding and operation should have built-in strong incentives to reduce duplication and barriers to inter-institutional collaboration across the national health and medical research sector. As indicated earlier, it will be important to build partnerships between universities, research institutes and hospitals. Collaborative networks create and establish new infrastructure, and can be created by strategic infrastructure investment: both modalities are critical to world-class research. National research infrastructure can have a strong synergy with local initiatives; and thus it would be advantageous for research programs conducted by Commonwealth agencies to be coordinated with state / territory developments in research to strategically combine efforts in provision of infrastructure that provides scientific opportunities. Australia is simply too small to support nine uncoordinated research programs. We strongly support e-research, with a first-class underlying IT infrastructure, to advance research, particularly in view of opportunities afforded by modelling, simulation, and subsequent visualisation. Using these capabilities across disciplines will not only provide a mechanism to share and manage data sets, but also to learn from each other to develop best practice.