AI SINGAPORE
AI IN HEALTH GRAND CHALLENGE

Challenge Rules & Guidelines

CONTENTS

PART 1
OVERVIEW

Aim

1. **AI Singapore AI in Health Grand Challenge** is a competitive research funding initiative aimed at encouraging and supporting new ideas that adopt AI technologies and innovations to enhance primary care for health promotion, wellness maintenance, and disease management in Singapore and the world.

2. The objective is to stop or slow disease progression and complication development in major chronic diseases in Singapore, specifically those related to the 3 "High's" (or **3H**) – **Hyperglycemia (diabetes), Hypertension (high blood pressure), Hyperlipidemia (high cholesterol)**, through better prevention, treatment, and management.

3. The Challenge contributes to the United Nations Sustainable Development Goal No. 3: To ensure healthy lives and promote well-being for all.[1]

4. To incentivise original and significant solutions, the problem scope, clinical context, design approach, and potential impact will be defined by the team addressing the Challenge.

5. The Challenge **is open to the six (6) public-funded Institutes of Higher Learning (IHLs)[2] and the A*STAR Institutes in Singapore**.

6. Proposals are invited from multidisciplinary teams and consortium of academics, researchers, scientists, clinicians, clinician scientists, engineers, and other professionals.

Background

1. In 2010, the Ministry of Health (MOH) Singapore estimated that there were around 1.2 million residents in Singapore with hyperglycemia (diabetes), hypertension (high blood

---

[1] UN Sustainable Development Goal No. 3 (2015), https://www.un.org/sustainabledevelopment/health/, retrieved 20-May-2018.
[2] Institutes of Higher Learning (IHLs): National University of Singapore (NUS), Nanyang Technological University (NTU), Singapore Management University (SMU), Singapore University of Technology and Design (SUTD), Singapore Institute of Technology (SIT), Singapore University of Social Sciences (SUSS).

CHALLENGE RULES & GUIDELINES

pressure), hyperlipidemia (high cholesterol), or 3H. This number is expected to increase by 25% to 1.5 million in 2020.[3]

2. According to a Straits Times article published in 2016, it is estimated that more than half of Singapore's population aged 18 to 69 years have high cholesterol, while one-fourth have pre-diabetes or diabetes and one-fifth have hypertension.[4] Usually, the H's co-occur, leading to serious health conditions and death if left untreated.[5] Fifty percent of 3H patients develop one or more major complications such as *stroke, cardiovascular diseases, renal failure, eye and foot complications*. Incidentally, disease burden is high in Singapore, with cardiovascular diseases being the leading cause of death, accounting for 1 out of 3 deaths in Singapore in 2016.[6]

3. MOH identified 3H as the top three chronic diseases prevalent among adults aged 18 to 69.[7] Additionally, 3H has been listed as the top three causes of polyclinic attendance in Singapore.[8]

4. Primary care capacity and efficiency is critical for prevention, diagnosis, treatment, and management of 3H complications. In addition, if 3H complications were not reduced, it would severely overtax secondary (specialist) and tertiary (hospital) in Singapore and in the world.[9] This makes the role of primary healthcare personnel even more vital in identifying and providing timely care for 3H patients.

[3] Singapore Burden of Disease Study 2010. *Ministry of Health Singapore Reports,* 2010. Retrieved from, https://www.moh.gov.sg/content/dam/moh_web/Publications/Reports/2014/Singapore%20Burden%20of%20Disease%20Study%202010%20Report_v3.pdf.
[4] Ng, W. C., Start now to prevent and manage chronic diseases (September 27, 2016). *Straits Times*, September 2016. Retrieved from, https://www.straitstimes.com/singapore/health/start-now-to-prevent-and-manage-chronic-diseases.
[5] 1 in 2 at risk of chronic diseases (October 09, 2016). *The New Paper,* October 2016. Retrieved from, https://www.tnp.sg/news/singapore-news/1-2-risk-chronic-diseases.
[6] Principal causes of death. *Ministry of Health Singapore Reports*, August 2017. Retrieved from, https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Principal_Causes_of_Death.html.
[7] Disease Burden. *Ministry of Health Singapore Reports*, July 2017. Retrieved from, https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Disease_Burden.html.
[8] Top 4 conditions of polyclinic attendances. *Ministry of Health Singapore Reports*, May 2018. Retrieved from, https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Top_4_Conditions_of_Polyclinic_Attendances.html
[9] John McDermott, An affordable necessity Both in rich and poor countries, universal health care brings huge benefits. *The Economist*, April 2018. Retrieved from, https://www.economist.com/special-report/2018/04/28/both-in-rich-and-poor-countries-universal-health-care-brings-huge-benefits

CHALLENGE RULES & GUIDELINES

What is the Challenge?

Under the theme of AI-enhanced primary care for good health and well-being, AI Singapore AI in Health Grand Challenge aims to achieve the following aspirational goal:

By 2030: Halve the prevalence of 3H complications through AI-enhanced primary care across Singapore.

The challenge statement is:

"How can Artificial Intelligence (AI) help primary care teams stop or slow disease progression and complication development in 3H patients by 20% in 5 years?"

Example Solution Foci and Technology Anchors

1. Example solutions may include, but are not limited to, the abilities to:

   • Better predict risks for 3H complications from electronic health records and other information such as family network, social economic status, etc.

   • Support situation understanding from multiple information sources and effect resource optimisation.

   • Design and develop personalised care plans and customised treatment options based on past treatment history.

   • Enhance primary care teams' capabilities in prevention, diagnosis, treatment, and management of 3H conditions with potential complications.

2. In particular, example solutions may include an **Expert AI** that dynamically acquires, integrates, and analyses information from multiple sources, solves large scale, complex problems in a context-dependent manner, and provides personalised care support in a cost-effective way.

3. Additionally, example solutions may also include a **Team AI**, i.e. one that coordinates activities and resources among human and other AI agents. Specifically, it will facilitate communication, integration and organisation of care support from multiple sources.

4. The solution could adopt various **Approaches**, including **intelligence augmentation** (enhanced cognitive automation, cognitive insight, cognitive engagement, cognitive choice – process information, improve understanding, change behaviour, support decision making) **behavioural interventions**, **natural and smart interactions**, **smart**

monitoring, **situation understanding**, **resource optimisation**, **crowdsourcing**, **on-demand**, **context-sensitive solutions and services**.

5. The solution could involve the use of **AI Technologies and Techniques** to improve both clinicians' and patients' abilities to comply with treatment guidelines, as well as to improve patient monitoring and feedback. A good solution will also help to manage costs and minimise or delay use of medications. Some examples include **multimodal information fusion**, **predictive analytics**, **preventive**, **diagnostics and intervention planning and decision support**, **prognostic analysis**, **adaptive learning and dynamic decision making**.

6. The evaluation criteria are defined in the **Assessment and Evaluation** section below.

7. The solution should clearly define and meet the **Outcome Indicators**, which can include relevant medical outcomes, surrogate endpoints[10], and/or service levels in one or more of the major complications of 3H.

8. The solution should also define and meet the **Functional Metrics**, in terms of accuracy, efficiency, usability, affordability, scalability, connectivity, reproducibility, adaptability, and safety.

---

[10] A surrogate endpoint is one that is measured in place of the biologically definitive or clinically meaningful endpoint. It usually tracks the progress or extent of the disease, and is often used in clinical trials to check the efficiency of a new intervention or treatment.

PART 2
HOW TO PARTICIPATE

Registration and Application

1. Research teams that intend to apply to participate in the AI in Health Grand Challenge must first register their interest at: www.aisingapore.org/grandchallenge/health.

2. The **Registration Portal** will be accessible by the **end of July 2018**.

3. Only one member from each research team needs to sign up. This is to facilitate the planning and organisation of the information and networking workshops and the proposal review process. The registrant will be the primary contact for the team.

4. The application package, complete with the endorsement of the relevant institutional authority / director of research (or equivalent), must be submitted to AI Singapore via the AI Singapore Grand Challenge Application Portal (https://www.aisingapore.org/grandchallenge/health).

5. The **AI Singapore Grand Challenge Application Portal** will be open to receive applications by the **end of July 2018**.

6. Each of the 6 public-funded Institutes of Higher Learning (IHLs) and A*STAR may submit

   (i) For Research Teams with Lead PI and all Co-PIs from the same institution,
     - no more than three (3) applications each for NUS, NTU, and A*STAR.
     - no more than one (1) application each for SMU, SUTD, SUSS, and SIT.

   (ii) For Research Team with Lead PI and Co-PIs from multiple institutions (2 or more institutions),
     - up to five (5) applications per institution (as Lead PI or Co-PI).

   Each Institution may only submit a maximum of five (5) applications subject to the above criteria.

7. Closing date for submissions is **31 August 2018**.

8. The set of Grand Challenge terms and conditions and application materials can be downloaded at: www.aisingapore.org/grandchallenge/health.

CHALLENGE RULES & GUIDELINES

1. Each application should be submitted by a research team or consortium which must consist of one (1) Lead Principal Investigator (Lead PI) and <u>at least</u> one (1) Co-Principal Investigator (Co-PI).

2. The Lead PI must hold a primary appointment and salaried in one of the six (6) IHLs and/or A*STAR Institutes. Co-PIs can be from any publicly funded institution in Singapore. At least one of the PIs must be a clinician or a clinician scientist.

3. The Lead PI must have extensive background and qualifications in AI.

4. Overseas collaborator(s) and/or visiting experts should spend sufficient time in Singapore to build up a strong local research group in new areas with the assistance of a local PIs to ensure continuity. If the visiting expert plays a major role in the AI in Health Grand Challenge project, he/she should be based in Singapore for at least six (6) months each year. Alternatively, the overseas collaborator(s) and/or visiting experts may be invited to Singapore on short term engagements to assist with specific project tasks. In either arrangements, the costs of airfare, accommodation and per diem can be budgeted under the operating expenses of AI in Health Grand Challenge project.

5. Staff of overseas collaborator(s) can be hired directly through the local IHLs as full-time visiting research fellows (or equivalent). The staff must be based in Singapore for at least one (1) year.

6. Notwithstanding the above, AI Singapore strongly encourages international collaborations and may consider alternative special arrangements proposed by the Lead PI.

Intellectual Property (IP)

1. Ownership of IP developed under an AI in Health Grand Challenge grant will be determined based on contribution of the creators and the IP policies of their respective institutions.

2. The resulting IP will be automatically licensed to AISG Limited [11], a not-for-profit Singapore company limited by guarantee, managed by the participant IHLs, A*STAR, and AI Singapore.

---

[11] Company registration number: 201811298W, registered with the Accounting and Corporate Regulatory Authority of Singapore.

CHALLENGE RULES & GUIDELINES

3. AISG Limited is responsible for the management, exploitation and/or commercialisation of IP developed from activities/ projects/ initiatives of the AI Singapore Programme.

4. The resulting IP will be deposited into an AI knowledge base (tentatively called the "AI Singapore Commons") and accessible on a source-available basis – the source will be free of charge for research and government use.

5. IP Royalties and licensing fees, where applicable, from the resulting IP will be retained by the IP owners, sans minimum administration fees.

6. The following infographic illustrates the AI Singapore IP Model.
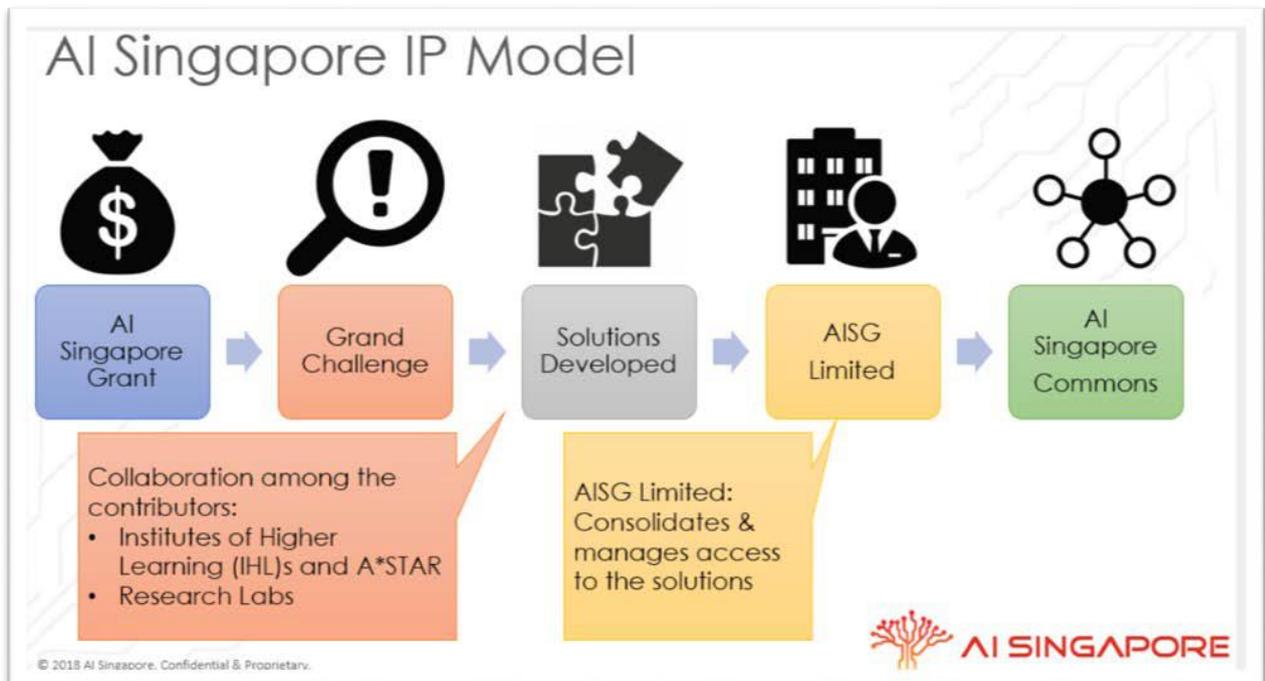
PART 3
CHALLENGE RULES

Proposal Content

1. Applicants for the AI in Health Grand Challenge grant should submit their application via the AI Singapore Grand Challenge Application Portal, [https://www.aisingapore.org/grandchallenge/health], which will be open to receive applications by the **end of July 2018**.

2. Proposal contents should not exceed **10 pages.** Diagrams, references, tables, charts, CVs and other supporting details should be attached as appendices. Please use **Arial font size 10, single line spacing and at least 2.5 cm margins all round. Note that the 1-page executive summary and documents in the appendices are excluded from the 10-page limit.**

3. All application forms must be preceded by a 1-page **executive summary** written in layman terms avoiding scientific jargons, where practicable.

4. All proposals must be submitted using the AI Singapore Grand Challenge application form, and should address the following points:

    4.1. **Proposed solution:** What are the objective, scope, approach, and expected results?

    4.2. **AI technology and innovation:** What are the AI techniques and applications to be developed and/or used? Why are these critical for the solution?

    4.3. **Performance metrics:** What are the indicators for measuring the AI or system functionalities and the domain-specific targets or outcomes?

    4.4. **Test plans and test suites:** How will the solution be evaluated? What are the testing scenarios?

    4.5. **Team and expertise:** Who are the principal investigators (lead PI and co-PIs), leaders, participants, and collaborators? How would the team collaborate?

    4.6. **Originality and impact:** What is novel and significant about the solution? Will the solution transform or just provide incremental changes to existing practice? How

will the proposed solution benefit different stakeholders?

4.7. **Timeline:** What is the schedule? What are the yearly milestones in Stage 1 and Stage 2?

4.8. **Translating solution into practice:** How is the solution applicable in real cases addressing the grand challenge? How can the solution be put into practical use?

4.9. **Budget:** What are the details of how the funding will be used? Are there any special budget for relevant items to be included in proposal? How much will it cost? *(*The budget must be prepared with close reference to Annex E: AI Singapore Grand Challenge Non-fundable Direct Costs. Strong justifications must be provided for requests exceeding S$5 million (Stage 1) or S$20 million (Stage 2), respectively.)*

4.10. **Datasets:** What are the available sources of data (if any), especially for Stage 1? What are the plans for accessing or collecting the data for the project?

Evaluation Criteria

Test plans and test suites should clearly define and explain how the solution will be evaluated based on **most if not all of the** following functional metrics and outcome indicators:

Functional Metrics	Define and Explain - Example criteria (for information only)
✓ Accuracy	Effectiveness (e.g. sensitivity/specificity of tests), quality management
✓ Efficiency	Resource use (people, time, money, equipment)
✓ Usability	Healthcare settings, ease of use, behavioral/cultural issues
✓ Affordability	Value for money for the intended users (patient, doctor, health service)
✓ Scalability	Large-scale implementation, sustainability, competitive landscape
✓ Connectivity	Synergy/Integration with other complementary solutions
✓ Reproducibility	Reproducible research practices, code & data management & sharing
✓ Adaptability	Different cultural or developmental settings
✓ Safety	Risks vs. benefits, regulatory legislation & processes

CHALLENGE RULES & GUIDELINES

Outcome indicators	Define and Explain - Example criteria (for information only)
✓ Medical outcomes	Repeat Acute Myocardial Infarction (heart attack) rate over 3 year period: mortality
✓ Surrogate endpoints	Reduction of HbA1c level
✓ Service levels	Specialist outpatient clinic referral rate

Expected Deliverables

1. Each grand challenge project is expected to produce most, if not all, the following deliverables:

   a. Solution reference architecture
   b. Solution prototype system
   c. Processed data and development tools
   d. Robust evaluation plans and test suites
   e. Publications in highly reputable scientific and professional venues.
   f. Training of specialised and/or skilled manpower
   g. Demonstrated potential for deployment, licensing, and spin-off opportunities

## System Development Requirements

1. The solution, **at the end of the 5-year project**, should be an implemented, functioning prototype, with possibly multiple, distributed, and connected components or subsystems.

2. The solution should be ready for performance evaluation and field-testing.

3. The solution should conform to general guidelines for reproducible research and include a code and data management plan.

4. The newly created and non-proprietary parts of the solution should be ready to be packaged for general distribution, for further development or commercialisation.

5. The solution must not infringe on the intellectual property rights of others; reasonable steps must be taken to ensure that all the components or subsystems can be used, and if appropriate, included for distribution according to the Terms and Conditions of the AI Singapore Grand Challenge Funding Scheme.

PART 4
PROGRAMME GUIDELINES

Programme Structure, Duration of Support and Budget

1. In **Stage 1**, <u>THREE</u> **(3) teams** with diversified approaches will be selected to pursue the AI in Health Grand Challenge projects of up to two (2) years.

2. The teams will "compete" on different technical approaches/solutions. The performance and potential of each team's solution will be evaluated during a mid-term review which will be carried out 1.5 years into the project.

3. AI Singapore will double-down on the promising approach and only <u>ONE</u> **(1) team** will be selected to move on to **Stage 2** and complete the AI in Health Grand Challenge solution.

4. The Programme Execution Plan is illustrated below:
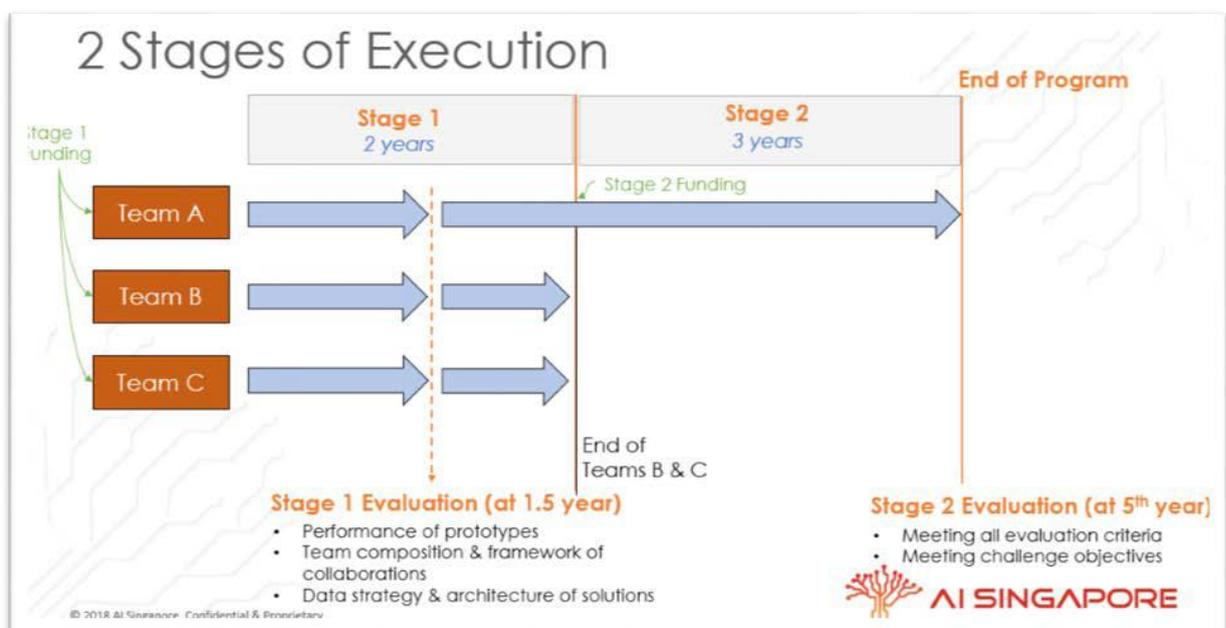
CHALLENGE RULES & GUIDELINES

5.   The funding quantum available to teams at each stage is shown below:

Stage (Duration of Support)	No. of Teams	Quantum per Project/Team	Estimated Budget
Stage 1 (2 years)	3 teams	Up to $5 million	Up to $15 million
Stage 2 (3 years)	1 team	Up to $20 million	Up to $20 million

Review and Selection

Proposals will be evaluated through a two-stage selection process. The grant call process and the corresponding timeline are summarised in the table below:

Grant Call Process	Timeline
Challenge announcement	4 June 2018
Full proposal submission	31 Aug 2018
Presentation of shortlisted proposals (by invitation only)	Oct 2018
Award of grants	Oct-Nov 2018

Assessment and Evaluation

1.   Stage 1 projects will undergo a mid-term review at 1.5 years into the project. Teams will be assessed primarily based on initial prototype demonstration as well as team composition and collaboration framework, solution architecture and data strategy.

2.   The team that succeeds in moving on to Stage 2 will undergo an evaluation at the end of the 5th year. The selected team will be assessed on whether they have met all the evaluation criteria and the Challenge objectives.

3.   AI Singapore reserves the rights to terminate, at any point in time, a research project that does not meet the minimum expectations of progress and achievement, upon recommendations by the evaluation committee.

Ethics and Confidentiality

1.   All the PIs, collaborators, staff, and students working on the project must comply with the relevant local laws or regulations governing the research.

CHALLENGE RULES & GUIDELINES

2. All teams are responsible for ensuring that ethical issues relating to their respective projects are identified and brought to the attention of the relevant regulatory bodies for approval. Approval to undertake the research must be granted before any work requiring approval begins.

3. Ethical issues should be interpreted broadly and may encompass, among other things, relevant codes of practice, the involvement of human participants, tissue or data in research, the use of animals, research that may result in damage to the environment and the use of sensitive economic, social or personal data.

4. The work should be conducted under strict international, national, and/or institutional guidelines on privacy and confidentiality protection of personal data use.

5. Whenever possible, all datasets used should be de-identified and anonymised, and/or proper consents and approvals should be obtained for the use of the data.

6. All the PIs, collaborators, staff, and students working on the project should obtain CITI certification (https://about.citiprogram.org/en/homepage/) on biomedical data use or similar training and certification.

7. All participating parties must fully comply with the **AI Singapore AI in Health Grand Challenge: Challenge Rules & Guidelines**, and the **Terms and Conditions of the AI Singapore Grand Challenge Funding Scheme**.

Project Support and Facilitation

1. When possible, AI Singapore may facilitate or support project work in the following areas:

   i. Health informatics expert advice and consultation (from international experts)
   ii. Project management
   iii. AI and software engineering
   iv. Health data access and retrieval

2. Budget for relevant items needs to be included in the proposal.

PART 5
GLOSSARY

References

1. UN Sustainable Development Goal No. 3 (2015), https://www.un.org/sustainabledevelopment/health/ retrieved 20-May-2018.

2. Singapore Burden of Disease Study 2010. *Ministry of Health Singapore Reports,* 2010. Retrieved from, https://www.moh.gov.sg/content/dam/moh_web/Publications/Reports/2014/Singapore%20Burden%20of%20Disease%20Study%202010%20Report_v3.pdf.

3. Ng, W. C., Start now to prevent and manage chronic diseases (September 27, 2016). *Straits Times*, September 2016. Retrieved from, https://www.straitstimes.com/singapore/health/start-now-to-prevent-and-manage-chronic-diseases.

4. 1 in 2 at risk of chronic diseases (October 09, 2016). *The New Paper,* October 2016. Retrieved from, https://www.tnp.sg/news/singapore-news/1-2-risk-chronic-diseases.

5. Principal causes of death. *Ministry of Health Singapore Reports*, August 2017. Retrieved from, https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Principal_Causes_of_Death.html.

6. Disease Burden. *Ministry of Health Singapore Reports*, July 2017. Retrieved from, https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Disease_Burden.html.

7. Top 4 conditions of polyclinic attendances. Ministry of Health Singapore Reports, May 2018. Retrieved from, https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore/Top_4_Conditions_of_Polyclinic_Attendances.html.

8. John McDermott, An affordable necessity Both in rich and poor countries, universal health care brings huge benefits. *The Economist*, April 2018. Retrieved from, https://www.economist.com/special-report/2018/04/28/both-in-rich-and-poor-countries-universal-health-care-brings-huge-benefits.

Contact Information

For any enquiries, please contact grantsupport@aisingapore.org.