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How to develop an (early stage) R&D proposal

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WHAT IS THE GOAL OF AN R&D PROPOSAL?

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To get the money you need to do your work!

Or, more specifically, to convince the panel and reviewers that they should give you the money you need to do your work

How do you convince them?

You write a proposal that makes them think that your work **needs** to be funded!

YOUR PROPOSAL SHOULD MAKE REVIEWERS THINK THAT …

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This work needs to be done (now!)

There is an important unmet health need

The core technology required has just become available

(or just been demonstrated to be transformative in a related context)

This is a unique opportunity

The dataset is special

The pairing of clinicians and data scientists is special

You are the right people to do the work

The clinical team are regional leaders in this specialty

The data science team created the core technology

(or have already used it successfully in a related context)

The team(s) have a strong track record of success

YOUR PROPOSAL SHOULD MAKE REVIEWERS THINK THAT …

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You have obviously thought this through

The motivation is specific and compelling

The research plan has no obvious flaws or ambiguities

You have been building toward this

Previous work has prepared foundation

Examples: epidemiology; technology development; training and networking

You have a long-term vision in which this is just one step

There is a plausible path from successful R&D to impactful product

Examples: regulatory approval; commercialization; adoption

YOUR PROPOSAL SHOULD MAKE REVIEWERS THINK THAT …

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You know what R&D success looks like

Chosen metrics are relevant indicators of ultimate success

i.e., that the final product will function as intended in the real world

You know what the impact of ultimate success will be

Clear link between technology performance and patient outcomes

You know how you might fail and how to prevent it

(or you have a backup plan)

Most likely failure modes clearly identified

Risks assesed accurately

Sufficient contingencies in place

YOUR PROPOSAL SHOULD MAKE REVIEWERS THINK THAT …

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This is good value for money

You also have contributions from other sources

Proposed spending is not wasteful / superfluous

The students/staff who work on this will be very lucky

Training in advanced methods

Career development opportunities

This will be good for me (the funder or reviewer)

Clear alignment with the funding call / priority areas

Development of shared resources

THE APPLICATION DEVELOPMENT PATHWAY

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TECHNOLOGY READINESS LEVEL (TRL)

You must have some idea of the full plan even if you are only in the early stages!

ThAIMed Innovation Challenge

Helmund's Syndrome

- Etiology unknown; not transmissible
- Rare (1/10000 people)
- Onset in mid-20s to mid-30s.

- Early symptom: sudden onset joint pain
- Treatable if diagnosed early, deadly if not
- If untreated, progressive pain and disability followed by premature death approximately five years after onset

- Treatment is amputation
- Diagnosis through X-Ray; signs are subtle and only recognizable by specialists
- Six-month window after onset of symptoms for effective treatment

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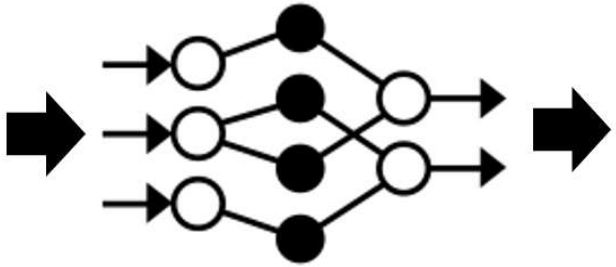
Automated diagnosis of Helmund's Syndrome

X-Ray images



Yes or No?

1. What is the clinical or public health need that you intend to address? Why is it important?

Some key considerations:

Population (ages, countries) and condition

Quantitative evidence of the scale – premature deaths, burden of disability, economics

Helmund's Syndrome example:

Occurs in 1/10000 people globally, onset mid-20s to mid-30s

Approximately 10,000 preventable deaths last year

Economic burden associated with the untreated disease of $1B/year

Too generic, not yet specific to our innovation!

Treatment near optimal in high-resource settings with sufficient specialists

Burden largely borne by low- and middle-income countries

2. How is this need currently addressed? What are the shortcomings of the current approach?

Some key considerations:

Describe state-of-the-art and problems (insufficiency, inefficiency, inaccuracy)

Quantitative evidence of the problems – untreated illness, misdiagnoses, excessive use of resources

Helmund's Syndrome example:

Diagnosis via X-Ray with subtle signs in first 6 months evident only to trained specialists

Lack of specialists in low-income countries results in many undiagnosed cases and ultimately deaths, while death is rare in high-income countries

Approximately 10,000 preventable deaths last year

3. What is your proposed innovation? How will it improve on the current approach?

Some key considerations:

High-level description of the long-term goal (i.e., the final product)

How will the result be different from the current state-of-the-art?

How much of the current shortcoming can the innovation address?

Helmund's Syndrome example:

Long-term goal: automated analysis of images to flag likely cases for specialist referral

Allows patients in low-resource settings to get diagnosis and treatment that they would otherwise not, preventing suffering, economic burden, and death

~50% people in LMICs have reasonable access to X-Ray, with WHO focusing on increasing this number with new portable imaging approaches

Could potentially support reduction of 30-50% of the preventable deaths annually

(Now you should be starting to worry that actually realizing this benefit will also require solving many complex non-technical problems …)

4. What are the key objectives that need to be achieved to reach proof-of-concept validation?

Some key considerations:

List key milestones during the exploratory phase (~6 months) to have confidence that further development of the innovation is worthwhile.

Helmund's Syndrome example:

1. *Assemble reasonable dataset of specialist labelled cases (ideally already done)*
2. Explore several AI frameworks for diagnosis/triage tool
3. Train prototype on local dataset
4. Validate prototype on local dataset
5. *Validate prototype on external dataset (perhaps too much for initial short project)*

5. How will you achieve these objectives?

Some key considerations:

Provide an overview of the plan for the work to be carried out in the exploratory phase.

Aim to provide enough detail that an expert reader would be able to guess the rest.

Helmund's Syndrome objectives:

1. Assemble reasonable dataset of specialist labelled cases
2. Explore several AI frameworks for diagnosis/triage tool
3. Train prototype on local dataset
4. Validate prototype on local dataset
5. Validate prototype on external dataset

Helmund's Syndrome example:

What exactly is the dataset that you will use - what population? how many? quality control?

Which AI frameworks and why?

Detailed methodology not necessary, i.e., choice of optimizer, learning rate, train/dev/test split etc.

Performance measures critical ...

6. What performance metrics will you use? What are your go / no-go criteria?

Some key considerations:

Quantitative targets for final proof-of-concept validation (and for intermediate milestones if appropriate).

Be clear about levels of performance necessary to pursue development and justify the choice of those levels.

Helmund's Syndrome example:

Sensitivity - what percentage of true cases are labeled as true?

Specificity - what percentage of false cases are labeled as false?

How much capacity is there for specialist referral?

Need enough sensitivity to catch most cases but also enough specificity to avoid overwhelming limited specialists

You must actually crunch the numbers, you cannot pull targets out of thin air!

7. Are there any non-technical challenges that might impede your progress? How will you address them?

Some key considerations:

How might your plan fail? Ethical concerns, recruitment issues, insufficient datasets, etc.

Describe preventative steps to avoid failure and/or alternative approaches.

Helmund's Syndrome example:

For the proposed work: getting the dataset (it's a rare disease)

Long-term challenges will typically be addressed separately

For the ultimate goal: integration into care pathways (e.g., maintaining relationships with remote specialists)

8. How will you involve stakeholders in the development process?

Some key considerations:

How will you ensure your innovation address the most important concerns for the population in need? Consider stakeholder chain – clinicians, patients, carers, etc.

What outcomes are important to patients?

What are the major frustrations of clinicians and carers?

What is required to integrate the innovation into health systems?

8. How will you involve stakeholders in the development process?

Stakeholders:

Clinicians in low-resource settings

Patients in low-resource settings

Specialists who will assess the triaged images.

Helmund's Syndrome example:

Have users (local GPs or analog) on the project team.

Hold focus groups with groups of each to understand:

1. Capacity of specialists
2. Key components of diagnoses to consider? Image quality, transfer of data, etc? How could the referral work in practice?
3. Disease knowledge of clinicians and patients in low-resource settings to ensure that people come in for diagnoses and get referred for X-rays
4. Potential effects of false positives on clinicians, patients and specialists