A Novel Blood Test for the Diagnosis of Celiac Disease

Docket: 12-342

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iFarms OTL
We are Team 1:

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TECHNOLOGY DESCRIPTION

Celiac disease is estimated to affect at least 1% of the worldwide population. Over 3,000,000 people in the US may have celiac disease. Standardized Test = TGAA. Gold Standard = Endoscopy.

Invention:
Gut-homing T Cell detection after short burst of Gluten Diet.

- Non-invasive
- Inexpensive - less costly than endoscopy
- Short 1-3 day period of gluten exposure instead of 4 or more weeks
- Diagnostic for people already on a gluten-free diet to determine if they do indeed have Celiac.
- Proof of concept already completed in 11 patients.
The Science - T Cell Trafficking

After immune response to antigen develops, memory T Cells remain that recognize that antigen.

When antigen returns, memory T Cells reactivate and home to site of antigen exposure. T Cells traffick to specific tissues by expressing integrins, which stick to addressins that are only expressed in the target tissue of interest.
The Data - CD8+ aeB7+ T Cell Expansion in Blood of CD patients

CD patients on GFD lose most gliadin positive T Cells. Upon reexposure to gluten, T Cells reactivate and home to gut.

A dimer of ae (CD103) and B7 (CD49d) called AeB7 directs T Cells to the gut.

A population of CD8+ T Cells displaying aeB7 is found in blood of CD patients (N = 6) but not non-CD patients (N = 5) after exposure to gluten.
INTELLECTUAL PROPERTY LANDSCAPE

A. Patent Status
   International PCT filed but allowed to lapse. No INTL rights.
   U.S. Application filed in 2014

B. Patent Coverage
   Patent covers method: specifically, CD8, CD38 (activation status), B7 integrin/CD103 (gut-homing)

C. Similar Technologies
   TGAA
   HLA-typing
   Other antibodies against novel epitopes
   Peptide-MHC complexes for detecting reactive T Cells
# SWOT Analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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| - Scientific rationale well established  
- Proof of concept completed  
- Potential licensees have expressed interest | - Needs more clinical trials  
- Mostly effective for subset of the market that is already gluten free. |

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
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| - Could eventually be used in non gluten-free, undiagnosed, population in combination with existing assay to provide increased predictive power.  
- Market could grow as number of undiagnosed GFDs increase. | - Norwegian Group with their own T Cell focused blood test, in trials now.  
- Focus on gluten could be a fad -> fewer people on GFD? |
MARKET ANALYSIS: PRIMARY RESEARCH

- Quest Diagnostics, a strong potential licensee, performed in-house market research. Results:
  - “Cynthia Ray has conducted market research to determine the market potential of a celiac disease test with a 3 day gluten challenge. The results are positive: the respondents see a need for a 3 day gluten challenge test.”

- Promising Feedback from SPARK: Kevin Grimes M.D.
  - Current dx is ~80% accurate, room for improvement
  - Biology makes sense

- Support from Inventor Arnold Han M.D., who has experience with GI doctors.

- Support from OTL
REGULATORY ANALYSIS

Regulatory Requirements:

- Uncertain if diagnostic requires FDA registered trial
- However, our competitors have run/are running registered FDA trials, so insurers and doctors may require them.
- TGAA assay and competing blood test have been registered with FDA.

Regulatory timeline and costs.
- Timeline: per patient time very short (~6 days). Time to plan, launch, and recruit unknown, likely > 1 year.
**INDUSTRY ANALYSIS: Porter’s Five Forces**

<table>
<thead>
<tr>
<th>Threat of New Entrants</th>
<th>Low. Would require a new technological breakthrough. Otherwise, our method is patent protected.</th>
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<tbody>
<tr>
<td>Threat of Substitutes</td>
<td>Main substitute is to live gluten-free lifestyle without verification that you do in fact have Celiac.</td>
</tr>
<tr>
<td>Supplier Power</td>
<td>Strong. IP protection. Specialized equipment and distribution required.</td>
</tr>
<tr>
<td>Buyer Power</td>
<td>Weak. Insurance companies are the buyers, many companies in U.S., and they don’t want to be a company that doesn’t reimburse a valuable test.</td>
</tr>
<tr>
<td>Degree of Rivalry</td>
<td>Some. One other blood test we know of also in trials in Norway.</td>
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OPPORTUNITY ASSESSMENT - Industry

Industry assessment:


- Many fragmented sub industries centered around specific indications. Market power within indication.

- Our sub-market of patients has no effective competition.

- Quest and Lab Corp biggest public companies. Stable profit margins but slow/no revenue growth.

- All suggests that creating a startup with the
OPPORTUNITY ASSESSMENT - Patients

Unmet Patient Need:

- Many patients already GFD. Don’t know if they have Celiac or not, were never diagnosed.
- Strict adherence to GFD is hard, want to know if it’s necessary.
- Once patients stop eating gluten, hard to determine if they have Celiac by conventional measures.
- Don’t want to start eating gluten for fear of causing harm to themselves.
POTENTIAL PARTNERS

SPARK
AT STANFORD

Quest Diagnostics

OFFICE OF TECHNOLOGY LICENSING
## SUMMARY AND RECOMMENDATION

<table>
<thead>
<tr>
<th>Have Accomplished:</th>
<th>Still Need:</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>● Scoped out potential for the project</td>
<td>● Finalized trial plan</td>
<td>● It is not feasible to license to bigger companies without another trial first.</td>
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<tr>
<td>● Reached out to potential licensees.</td>
<td>● Business plan</td>
<td>● Need funding to run a trial</td>
</tr>
<tr>
<td>● Created a preliminary plan for a clinical trial</td>
<td>● Funding</td>
<td>● Therefore: create a startup to raise funds to run the trial</td>
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<tr>
<td>● Created a preliminary plan for funding the trial</td>
<td>● Firm commitment from a clinician to run a trial</td>
<td>● Once the trial is completed, sell the company to a large diagnostics firm.</td>
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<tr>
<td>● Have had initial conversations with people who could run a trial</td>
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- Finalized trial plan
- Business plan
- Funding
- Firm commitment from a clinician to run a trial

- It is not feasible to license to bigger companies without another trial first.
- Need funding to run a trial
- Therefore: create a startup to raise funds to run the trial
- Once the trial is completed, sell the company to a large diagnostics firm.
Thanks! Questions?