

SQA skillset, AI and
advancing medical research

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PNSQC.ORG **OCTOBER 14-16 2024**

SQA skillset, AI and advancing medical research

About Me

- More than 20 years in SQA as a manager to I.C.
- Worked in gaming industry, ISO/QS software, education software, accounting, wearables and currently working in Public Transportation
- Dabbling in the citizen science world, diving into research, goal to use my QA skills to make a contribution to ending a variety of diseases.



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Inspiration

<https://www.ycombinator.com/rfs#a-way-to-end-cancer>

A WAY TO END CANCER

- [Surbhi Sarna](#)

The technology to diagnose cancer at an early stage already exists. Since most cancers are now treatable if caught early enough, this technology would dramatically reduce cancer deaths if rolled out widely and affordably.

The technology we're talking about is an MRI. Modern MRIs are sensitive enough to detect cancer masses as small as a millimeter.

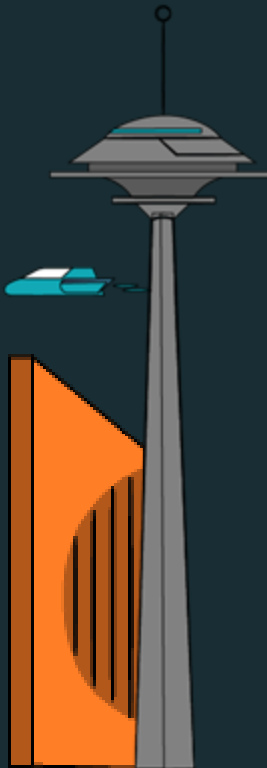
Some companies are already having success on a small scale offering MRIs to patients for a high cash price. However, there is backlash from the medical community as MRIs also create incidental findings (or false positives), that cost our healthcare system valuable time and money to investigate.

For this to work, the world would need to scale up the number of MRI scans it does by at least 100x. Doing that will require innovations in the MRI hardware, the AI algorithms to interpret scans and reduce false positives, and the business models and consumer marketing to make it a viable business. We're interested in funding companies looking to tackle this multifaceted problem.

While much exciting progress is being made on cancer therapeutics, finding cancer early enough for our existing therapeutics to be curative might be the opportunity with the greatest potential impact.

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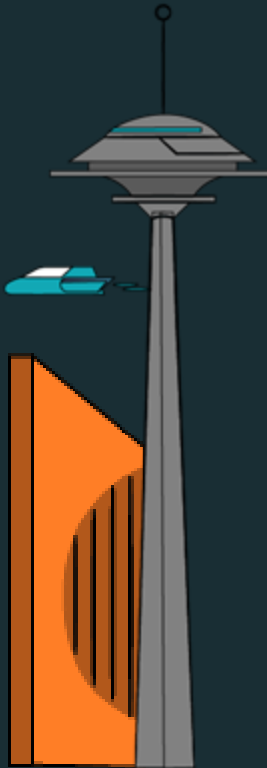
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How can SQA & AI tools help?

Ultimately, how can SQA use AI tools to help medical research:

With better prompt engineering validation

1. Eliminate possible contributors to a given disease
2. Eliminate possible causes of a given disease
3. By doing the 2 above we narrow down the list, not waste time
4. We offer outside perspective, we are not invested in any single theory
5. Our goal is to find the start of the defect
6. Traceability - Audit trail
7. We eliminate/reduce the possibility of false positives



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Diseases I chose to focus on

Narrowed the list to Multiple Sclerosis (**MS**) and Amyotrophic lateral sclerosis (**ALS**), also known as Lou Gehrig's disease

Why MS and ALS

- Both are sclerosis,
- Male and Female diseases
 - MS - Female dominant
 - ALS - Male dominant
- Smaller population of victims and neither gets the attention of some better known diseases.

Sclerosis:

1: pathological hardening of tissue especially from overgrowth of fibrous tissue or increase in interstitial tissue

also : a disease characterized by sclerosis

2 : an inability or reluctance to adapt or compromise

<https://www.merriam-webster.com/dictionary/sclerosis>

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Define the Project/Approach

The human being is our software program.

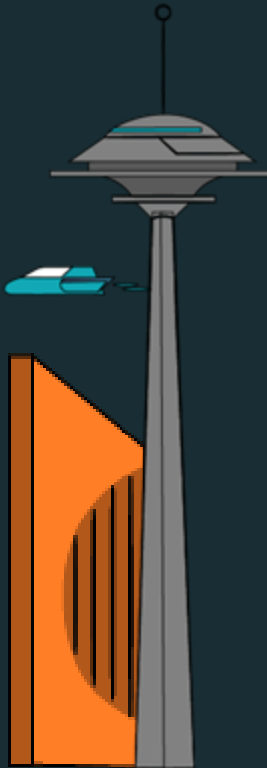
It is a dynamic program with many complex and unique features. Unfortunately, it's also a program that is riddled with defects.

- Some defects are benign, such as being a Yankees fan.
- Some defects are the opposite, outright damaging, such as Cancer, Alzheimer's, Multiple Sclerosis, ALS - Lou Gehrig's disease

Some defects are remedied with a “fix” or “patch” at the right stage of a defect.

A FIX can be deployed during the following stages:

- Preventive
- Early stage (Stage 1 or Primary)
- Mid stage (Stage 2 /3 or Middle)
- Late/End stage (Stage 4)



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Approach

AGILE SOFTWARE DEVELOPMENT LIFE CYCLE



* Iterations are repeated until the software is completely ready

Tools: Mind map, to narrow down large datasets or organize disorganized information

Define the defect: Description, environment, expected and actual behavior. Rate of repeatability.

Observations and recommendations

In this situation the objective of a mind map is a way to assemble documentation to create Requirements – remember, we're QA and if we don't have requirements, we make requirements.

Initial findings ... Insufficient documentation

As QA with poor with documentation, I start with ad-hoc or Exploratory testing to first understand the defect.
Create User scenarios; I want to trigger the defect.

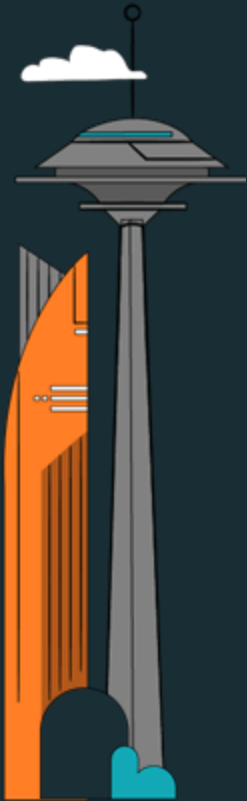
- Uniquely, this defect we are taking on comes with Use Chat Gpt to help get through large datasets that are focused on:
 - a. MS and ALS
 - i. Autoimmune disease
 - ii. MRI's
 - b. In addition, potentially:
 - i. Recent Studies
 1. International
 2. Domestic
- Use Knowledge Graphs to parse the datasets:
 - a. Pull/Graph the known:
 - i. Validation of current theory
 - ii. Challenge current theory
 - iii. Find the gaps in current theory
 - b. Pull/Graph new findings and theories
 - c. Develop new theories



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Mind map



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Define the disease (defect) that will be used as a Use case

Because of the complexity of diseases listed above, I chose to focus on MS for the following reasons:

- There are many theories that Vitamin D deficiency is a potential contributing factor
- Vitamin D deficiency is an established condition
- Vitamin D can be researched
- MS is a disease, in comparison to ALS, with theories

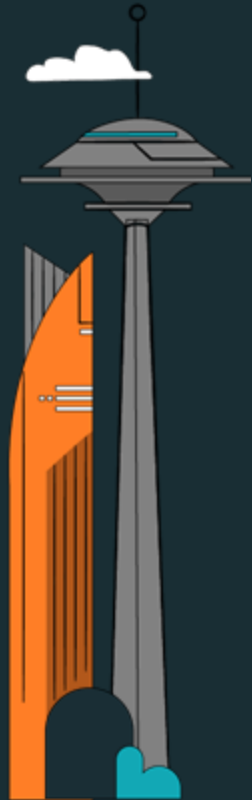
As a Tester, I am given a program and told that it will:

- Not run optimally in 1 out of 300 installs
- Once the poor performance starts the program can never be reset
- There are tools that help the program to run as close to optimal as possible – still not optimal

My approach is not going to be that of an SQA Lead (planning/proactive), it will be as a tester engineer (reactive/ all types of testing). The project is underway:

Tester characteristics defined as (3):

- Reactive to a program that has been assign
- Focus on finding bugs
- Conduct a variety of test techniques, both manual and automated
- Support the development process

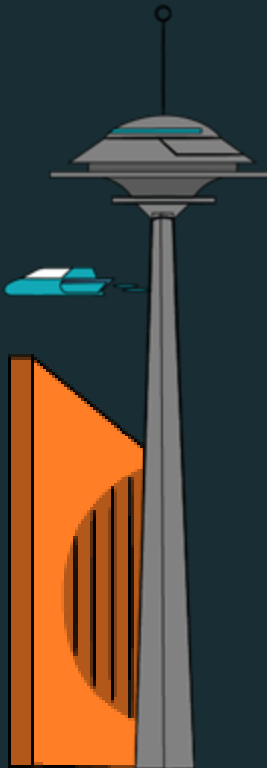


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Table to create understanding of ideal human vs defect in human:


Ideal/Expected	Defect
Absorbs Vitamin D	Does not absorb Vitamin D from sun or diet
Immune system does not attack person	Immune system over protects, attacks the person.
Muscles grow and regenerate	Muscles degrade and not repaired
Vision is assisted with glasses, not pharma	Vision degrades and cannot be repaired
Walks with ease until a senior citizen or injury	Ability to walk becomes a struggle and only gets worse




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Prompt Engineering- 1

ChatGPT 4.0: Countries with high levels of Vitamin D3 deficiency



 Vitamin D deficiency is a global health issue, but certain regions and countries are more affected due to factors like geographic location, lifestyle, skin pigmentation, and cultural practices. Here are some of the countries and regions with the highest levels of Vitamin D deficiency:

- 1. Middle East and North Africa (MENA)**
 - Saudi Arabia, UAE, Egypt, Iran: Despite abundant sunlight, cultural practices like clothing that covers most of the body and limited outdoor activities contribute to high deficiency rates. Some studies show deficiency rates as high as 60-90% in these regions.
- 2. South Asia**
 - India, Pakistan, Bangladesh: High population density, pollution, and darker skin pigmentation reduce the synthesis of Vitamin D. Deficiency rates in urban areas can exceed 70%.
- 3. Northern Europe**
 - Norway, Sweden, Finland, UK: Limited sunlight during the long winters and higher latitudes contribute to lower Vitamin D synthesis. Despite fortification efforts, deficiency is still a concern, especially during the winter months.
- 4. East Asia**
 - China, Japan, South Korea: Urbanization, indoor lifestyles, and air pollution contribute to Vitamin D deficiency. Studies in these countries report deficiency rates ranging from 40-60%.
- 5. Africa**
 - Morocco, Tunisia, Algeria: Similar to the MENA region, despite high sunlight, cultural clothing and indoor lifestyles result in high deficiency rates, particularly among women.
- 6. North America**
 - Canada, Northern United States: In Canada and the northern parts of the U.S., the long winters and limited sunlight exposure lead to lower Vitamin D levels, particularly in the winter months.
- 7. Australia and New Zealand**
 - Despite being sunny regions, cultural practices like avoiding the sun to prevent skin cancer contribute to Vitamin D deficiency, especially in Australia.
- 8. South America**
 - Argentina, Chile: Higher latitudes and colder climates in southern parts of these countries contribute to higher deficiency rates.

Key Factors Contributing to Vitamin D Deficiency:


- **Latitude:** Countries farther from the equator have less sunlight, especially in winter.
- **Cultural Practices:** Clothing that covers most of the skin, particularly in Muslim-majority countries.
- **Urbanization:** Increased time spent indoors and air pollution blocking UVB rays.
- **Skin Pigmentation:** Darker skin synthesizes less Vitamin D from sunlight compared to lighter skin.
- **Diet:** Inadequate intake of Vitamin D-rich foods or lack of fortified foods.


Addressing Vitamin D deficiency often requires a combination of public health measures, including supplementation, fortification of foods, and education about safe sun exposure.









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Prompt Engineering- 2

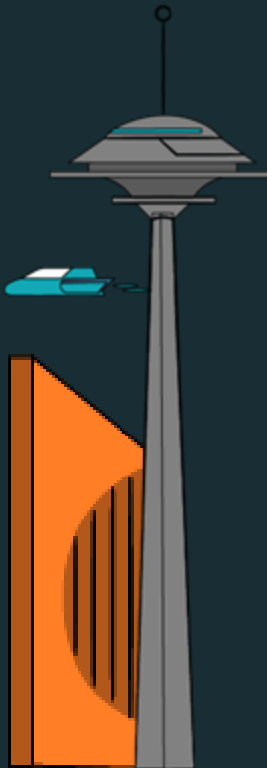
Google AI search results

 Search Labs | AI Overview

Some countries with high levels of vitamin D deficiency include: 

- Pakistan: Has the highest prevalence of vitamin D deficiency in adults, at 73% 
- Bangladesh: Has a prevalence of 67% 
- India: Has a prevalence of 67% 
- Nepal: Has a prevalence of 57% 
- Sri Lanka: Has a prevalence of 48% 
- Afghanistan: Has a high prevalence of vitamin D deficiency, with 45–65% of the population having levels below 20 nmol/L 
- Iran: Has a high prevalence of severe vitamin D deficiency in infants, at 86% 
- Turkey: Has a high prevalence of severe vitamin D deficiency in infants, at 51% 

Some reasons for vitamin D deficiency include diet, sun exposure, and darker skin pigmentation. 



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Alignment of Regions/Countries with Vitamin D deficiency and High levels of MS

Country/Region with Vitamin D deficiency		Country with High Levels of MS
Saudi Arabia, UAE, Egypt, Iran		
S.Asia: India, Pakistan, Bangladesh		
Northern Europe: Norway, Sweden, Finland, UK		Norway, UK, Germany
East Asia: China, Japan, South Korea		
Africa: Morocco, Tunisia, Algeria		
N.A.: Canada, Northern United States		United States, Canada
Australia and New Zealand		
S.A.: Argentina, Chile		

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Where is MS found in the United States?

ChatGPT 4.0



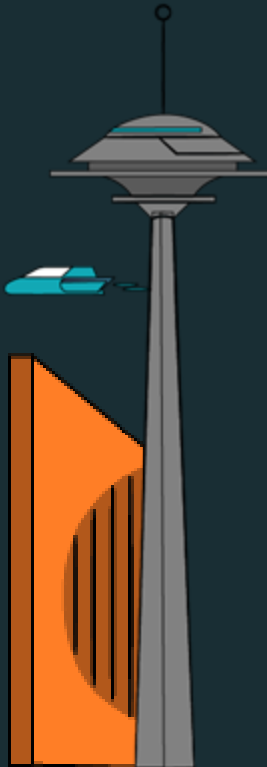
Multiple Sclerosis (MS) prevalence can vary significantly by region, but generally, higher rates are observed in areas farther from the equator. In the United States, certain states have been identified as having higher prevalence rates of MS. Some of these states include:

1. **Minnesota:** Known for having one of the highest rates of MS in the U.S.
2. **Vermont:** Also reports high MS prevalence.
3. **New Hampshire:** Similar to Vermont, New Hampshire has a higher-than-average rate of MS.
4. **Maine:** High prevalence of MS, consistent with trends in other northern states.
5. **Wisconsin:** Another state with a significant MS population.
6. **Iowa:** Reports higher rates of MS compared to the national average.
7. **Washington:** Has one of the higher prevalence rates on the West Coast.
8. **Oregon:** Similar to Washington, Oregon reports higher MS rates.

These states are generally located in the northern part of the United States, consistent with the global pattern where MS is more common in regions farther from the equator. However, it's important to note that MS prevalence data can vary over time and with new research, and access to healthcare services and diagnostic practices can also impact reported rates.

Alignment of Regions/States with Vitamin D deficiency and High levels of MS

Regions/States with Vitamin D deficiency	Regions/States with High Levels of MS
Northeastern States Maine, Vermont, New Hampshire Massachusetts, New York	Vermont, New Hampshire, Maine
Midwestern States Michigan, Wisconsin, Minnesota Illinois, Ohio, Indiana	Minnesota, Wisconsin, Iowa
Pacific Northwest Washington Oregon	Washington, Oregon
Northern Plains States North Dakota, South Dakota, Montana	
Alaska	



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Bug Report - 1

Date	9/1/2024	Disease	Multiple Sclerosis	AI resources	ChatGPT 4.0 Google AI
Stage/Status	Pre-	Duration	Unknown	Severity	HIGH
Reproducibility	.33% (1/300)	Expected Result	Person w/Vitamin D deficiency <u>DOES</u> develop MS	Actual Result	Person w/Vitamin D deficiency <u>DOES NOT</u> develop MS.
Environment:					
	Age	Gender	Diet	Geography	
	20 –40 yrs old	Female	Unknown	Pacific Northwest	



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Bug Report - 2

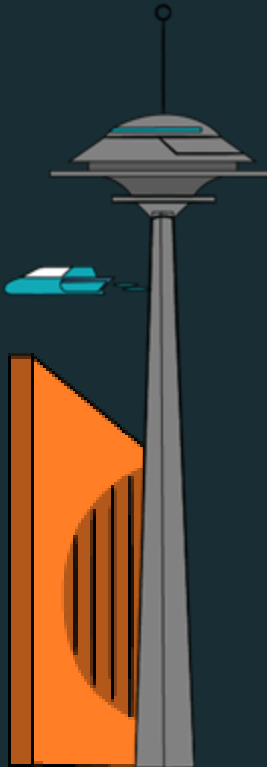
Description

It is found that persons who develop MS also have a deficiency in Vitamin D. It is therefore theorized that if a person has low levels of Vitamin, they are at risk of developing Multiple Sclerosis.

Based on an evaluation of the sources of Vit D – geography and diet. Initial focus on Geography, as it is a factor that is easier to evaluate on its own. Contrast to diet where there is great variety (vegetarian, vegan, pescatarian) in the US and the world.

Findings: **More correlation over causation.** Looking at the common countries/regions from Chat vs Google, the Countries and Regions with high levels of Vit D deficiency are not nations/regions with high levels of MS.

In the US, there is a greater, almost confirmable correlation that those who live in areas with high levels of Vit D deficiency and MS rates are in direct correlation, possible causation.



Bug Report - 3

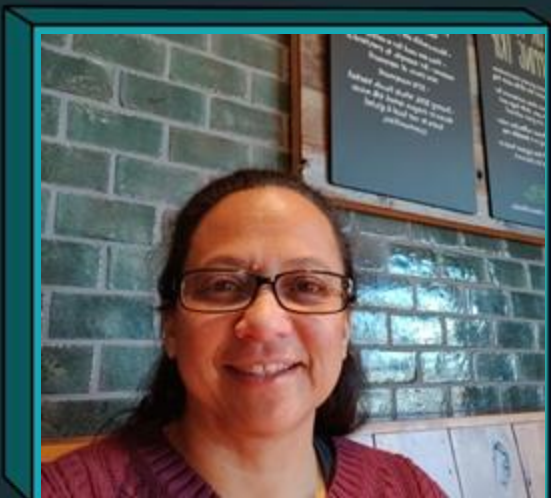
Recommendation

Vitamin D deficiency occurs in everyone who is diagnosed with MS.

Not everyone who has a Vitamin D deficiency develops MS.

Based on publicly available data, the Vitamin D deficiency theory is at best a correlation, not a cause.

If this were a software defect, I would remove Vitamin D deficiency from my list of possible cause and continue testing. I would look for a possible cause with a much greater reproducibility rate, .33% is not enough.



THANK YOU

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