# Digital Health Surveillance

Unlocking the potential for real-time health data analysis in the Maltese Islands



Dr John Paul Cauchi MD, MSc, PhD



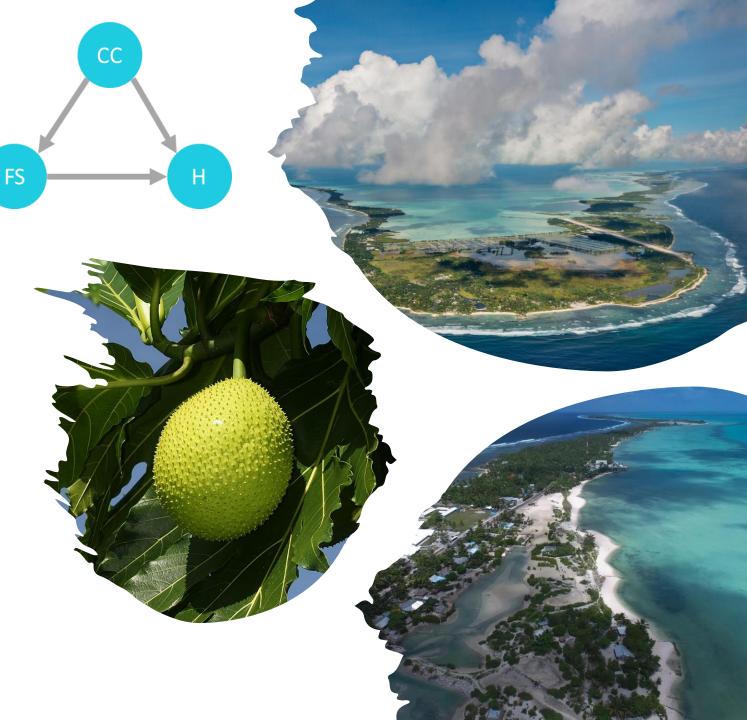
• Studied Medicine at the University of Malta

Educational journey

- Specialised at the LSHTM in Environmental public health
- Worked at UoM on ImaGenX, looking at environmental and lifestyle risk factors of Breast Cancer in Malta
- PhD in Brisbane, Australia, focusing on Climate Change, Food Security and Health. Fieldwork in Kiribati.

## Research

- Focus: Climate change, Food security and Health interactions
- Mixed methods, applying both qualitative and quantitative data analysis to triangulate closer to the truth.
- This experience taught me the importance of accurate data collection, ascertaining meaning from numbers and words, and applying that information.
- Data was often missing, making it very hard for me to come to conclusions



## Research

- Data which is absent can be both disappointing and dangerous – it fails to give you the complete picture, and makes it difficult to know the present situation.
- Data is key
- Data analysis is a process of inspecting, cleaning, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decisionmaking.

Attempted to get datasets for analysis in the form of Time Series Analysis for correlations:

- Precipitation

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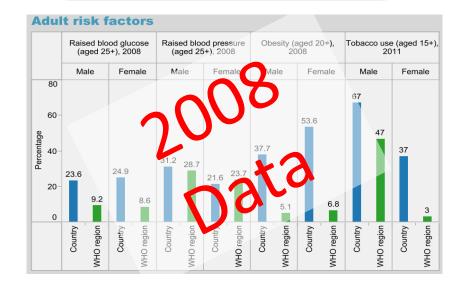
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- Temperature
- Health data

### Significant gaps in data

E.g. dataset obtained for monthly rainfall in Nonouti from 1953 to 2013 had Jan 1991 to Sep 2010 missing...



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How to transform this data into something useful?

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	Part time worke	Bus Driver	Tertiar
	Retired	Retired	Pensio
	Fisherman	Fisherman	Primar
	Part time worke	Bus Driver	Tertiar
	Full-time worke	Kiribati Police Se	Public
	Full-time worke	Ministry of Educa	Public
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	Full-time worke	Contracted build	Tertiar
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	Full-time worke	Airport	Tertiar
	Full-time worke	Self-employed,	Tertiar

Plan to stay long term Full-time worke Government Off Public

## Public Health Data Surveillance

### Data Analysis/Interpretation

- Data Analysis: lack of supervised information extraction, source identification (i.e. self-reported vs. general statements), lack of geo-spatial analysis
- Data Interpretation: lack of longitudinal analysis.

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• Evaluation method: lack of sensitivity and representativeness analysis, lack of longitudinal evaluation

### Planning/Design

- Scope (theme): lack of studies on disease burden, occupation safety, and nutrition.
- Scope (audience): no study on vulnerable populations.
- Scope (method): Lack of infoveiullance studies

o<u>≭</u>o ×) ∕∕ DIGITAL PUBLIC HEALTH SURVEILLANCE (DPHS)

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### **Data Collection**

- **Data source bias:** limited platforms/population and content bias/misinformation/small sample size
- Data collection: limited to specific hashtags and manual/subjective search term definitions, language limitations, and limited data types.

### **Dissemination/Action**

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• Public health actions: less than 1% utilized their results for public health actions



## Public Health Data Surveillance

- 2020 ongoing: Public Health IDCU department (currently part-time)
  - Working on Malta's Digital Health surveillance.
  - In 2020, the ECDC basically complained that John Hopkin's University (left) in the US had better data on COVID-19 in Europe than the ECDC did!
  - E-SARI Network was born involving 15 countries that pool their data on Severe Acute Respiratory Illness (SARI), which can be used for both decisions in policy-making AND in ascertaining vaccine effectiveness in Europe.

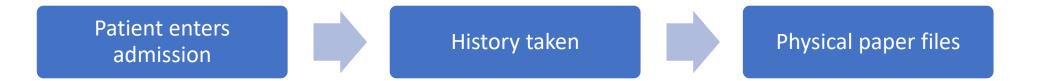


## Public Health Data Surveillance

- Problems identified:
  - Poor data collection methodologies
  - Lack of standardisation
  - Different definitions for the same illness
  - Archaic methods of data collection (Malta included)
  - Lack of coordination
  - Poor stakeholder engagement

## Malta had significant problems

• Malta had only JUST shifted from a paper-based system of reporting health data to a digital one!



Advantages: Standard format

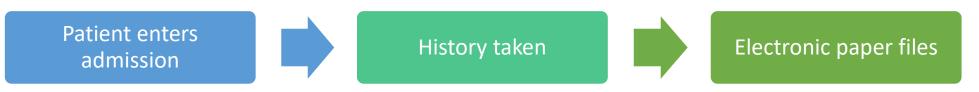
**Disadvantages**: Difficult to access, cumbersome, error prone

Impossible to carry out data surveillance



# New system – step in the right direction, but far from ideal...

• The new system was... a step in the right direction. However...



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Visited GP vesterday who prescribed Augmentin PO.	
Prior to presentation to the ED, pt took Paracetamol.	
Also c/o a long-standing history of 500 on exertion.	
Daughter experiencing similar symptoms. Fully vaccinated for COVID 19	
Denies any chest pain, pleurisy and syncope. Denies any LUTS, MBV.	
Denles any orthopnea or PND.	2
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Covid-19 accelerated an effort to digitise the system of data entry at admissions

**Data is now entered onto a system as text**. Effectively an 'electronic paper'. At least it is accessible from computers!

**Still insufficient**. More easily accessible, but no means of extracting data other than manual extraction

A significant change, but long way ahead

# Questionnaire based surveillance

- Data extraction of **symptoms and comorbidities** commences using available software
- Manual extraction is
  - time-consuming
  - prone to human error both at data entry and data extraction level

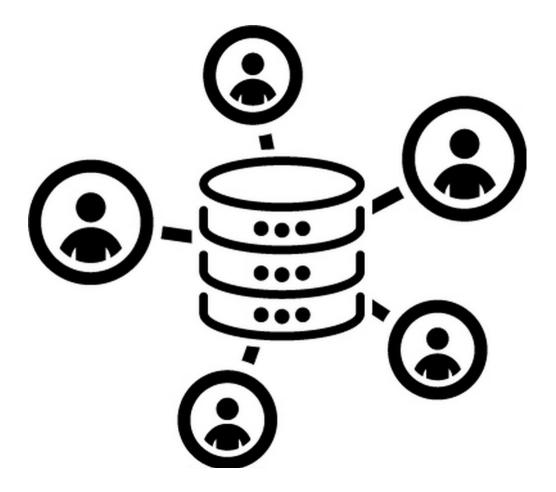




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## Over time, we identified other sources of data

- COVID-19 testing
- Respiratory panel of 32 pathogens
- COVID-19 vaccinations database
- Mortality data
- Hospital census
- Influenza vaccination



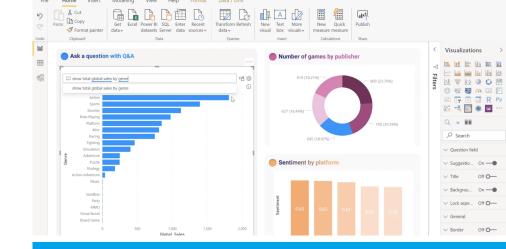
## **Tools required**

- R software statistical computing
- This software enabled us to link data from various databases using ID as a common identifier.
- Efficient, constantly upgradeable, allows heavy statistical analysis
- Magnitudes of speed better than using colour-coded excel sheets for work processing.



# Other Software being explored

- Microsoft Azure Text Analytics
- Power Bl
- SQL
- These software packages are being explored for their potential to extract data automatically, or to visualise data in a compelling way.



The Most Popular Azure cloud computing Services



### Patient Dashboard: mid 2023

- This system would involve **entering of symptoms into fields** that can be extracted from a database, allowing automation
- Cases can be extracted based on symptoms entered into respiratory forms
- Could also be **expanded to other illnesses**, allowing real-time surveillance
- This would permit faster, better decisionmaking. It could also provide real-time information of outbreaks based on symptom combinations.





### The importance of Health Data Analysis

- Can be integrated with other systems, such as Environmental Data, Zoonotic data which could lead to expanded surveillance.
- Allows for public health research to be carried out locally using large datasets.
- This can improve Malta's public health capacity, audit its abilities and improve on what we already know.
- Helps us be prepared for the next pandemic!

#### Coronaviruses

....show al

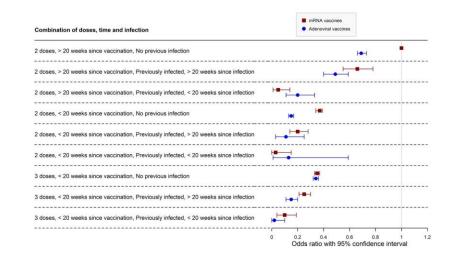
online:02 Jan 2023

### Hybrid immunity and protection against infection during the Omicron wave in Malta John Paul Cauchi S. Ausra Dziugyte, Maria-Louise Borg, Tanya Melillo, Graziella Zahra, Christopher Barbara,

Article: e2156814 | Received 11 Aug 2022, Accepted 05 Dec 2022, Accepted author version posted online: 13 Dec 2022, Published

66 Download citation 2 https://doi.org/10.1080/22221751.2022.2156814

#### Forest Plot showing odds ratios for Omicron infection, comparing mRNA and Adenoviral vaccine groups



# Imaginary Scenario: Pollox, 2025

## Imaginary Scenario: Pollox, 2025

### **Old system**

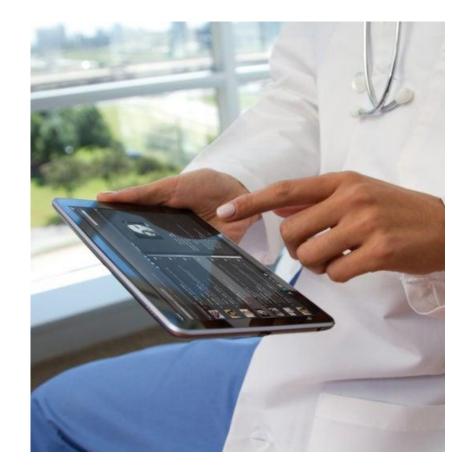
- Data is present in manual files.
- Virtually impossible to ascertain symptom combination to determine presence of disease in people entering hospital
- Have to wait for test kits to arrive from abroad. Considerable impact on economy and mounting anxiety
- Inability to trace the presence of symptom combination
- Mortality increase, draconian actions taken
- Clinicians anxious, unable to be sure who has what



# Imaginary Scenario: Pollox, 2025

### New system

- Data is present in digital files
- Symptom combination is immediately identified, determining presence of disease in people entering hospital
- Measures are taken to immediately quarantine those with symptom combination matching that of Pollox
- Ability to trace symptom combination in clinics across Malta and Gozo
- Prevalence of disease is kept under control
- Clinicians feel reassured, knowing who is likely to be an infected patient

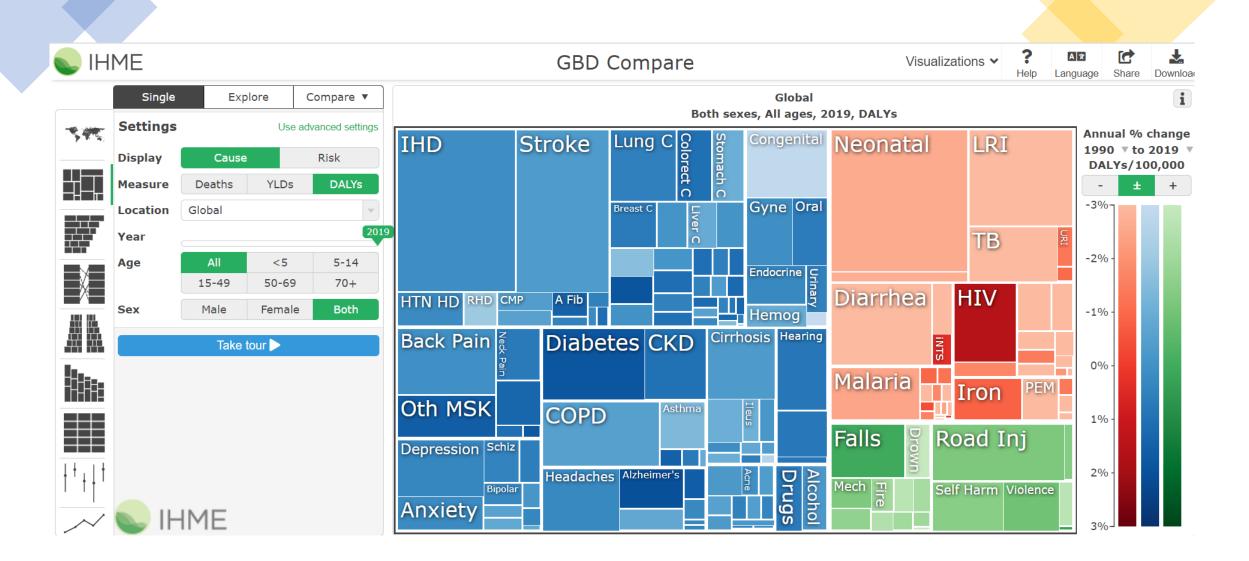


## In Summary

- Now is an exciting time to enter data visualisation
- Al tools, such as Chat GPT, are immensely powerful and can save a lot of time on searching and finding coding syntax
- Malta's requirements in this sector are increasing, especially because there is little to no such capacity in the health sector at this time

# **Examples of Visualising Data**

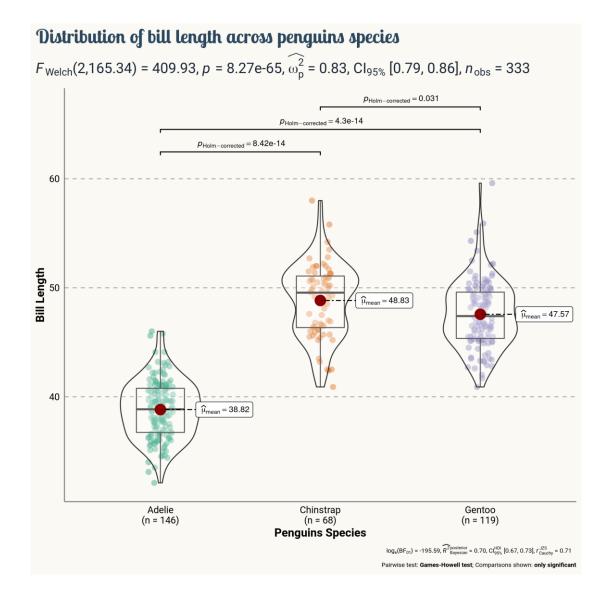
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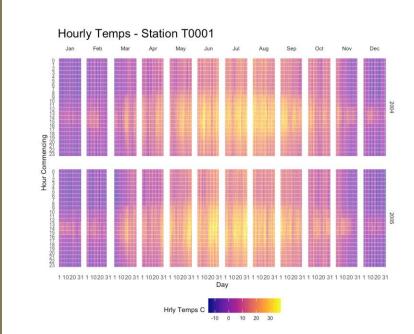


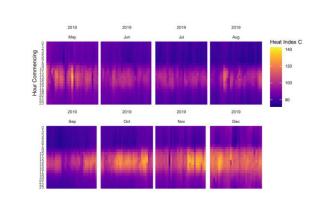
Source: IHME - https://vizhub.healthdata.org/gbd-compare/

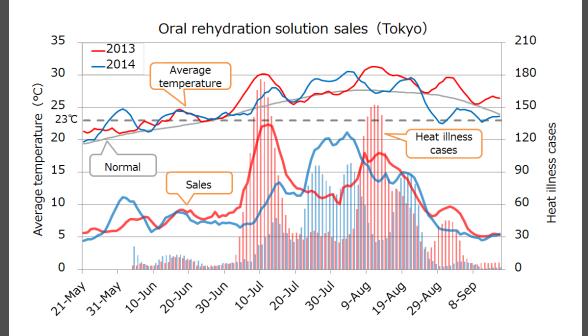
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	Measure	Deaths	YLDs	DALYs	6 Neoplasms		6 Musculoskeletal disorders	
	Location	Global		-	7 Other non-communicable		7 Mental disorders	
	Range 19	90		2019	8 Unintentional inj		8 Diabetes & CKD	
	_	A 11		5.44	9 NTDs & malaria		9 Unintentional inj	
	Age	All 15-49	<5 50-69	5-14 70+	10 Nutritional deficiencies		10 Chronic respiratory	
					11 Chronic respiratory		11 Neurological disorders	
╞┼┼╄╧	Sex	Male	Female	e Both	12 Musculoskeletal disorders		12 Enteric infections	
	Units	#	Rate	%	13 Mental disorders		13 Digestive diseases	
		<b>T</b> .1	trans N		14 Transport injuries		14 Transport injuries	
		läke	tour 🕨		15 Digestive diseases		17 NTDs & malaria	
<u>↓</u> ↓ ↓ ↓ ↓					17 Neurological disorders		19 Other infectious	
					18 Diabetes & CKD		20 Nutritional deficiencies	
$\sim$		IME						1

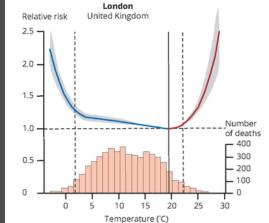


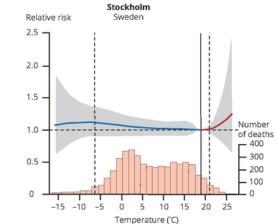


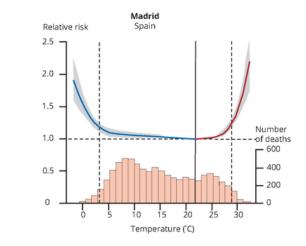


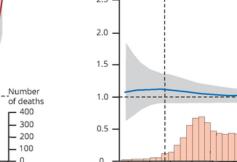


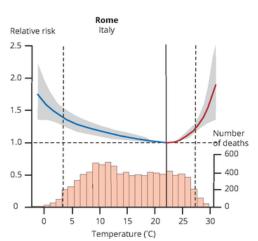


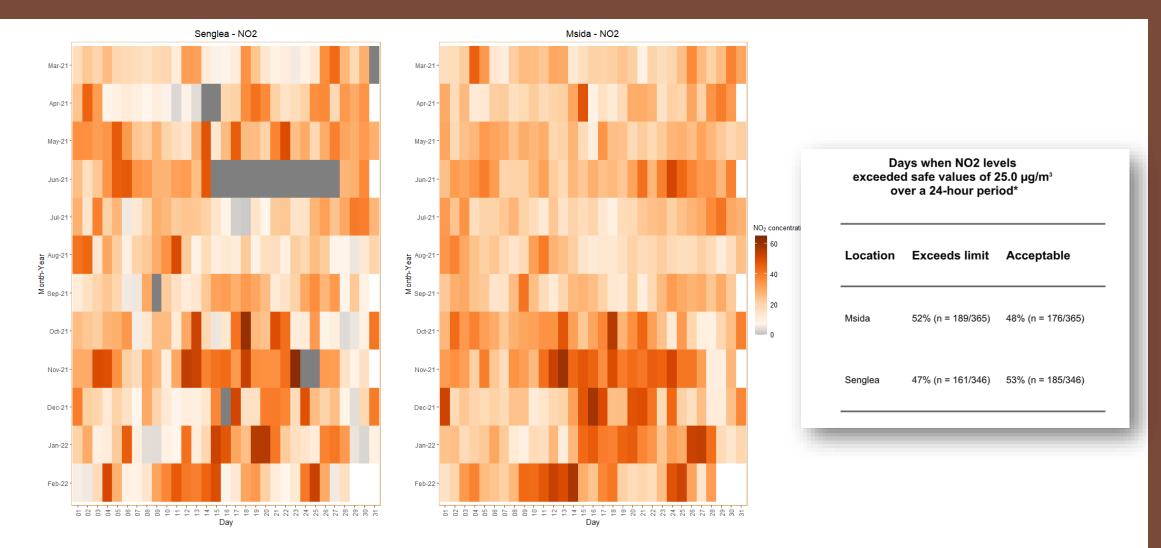




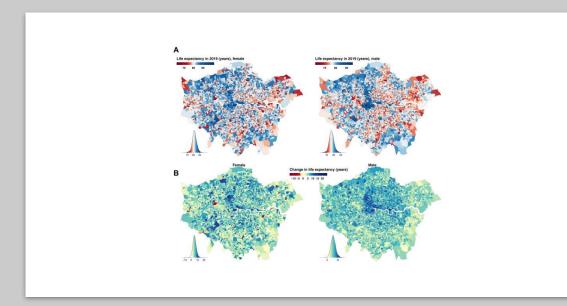


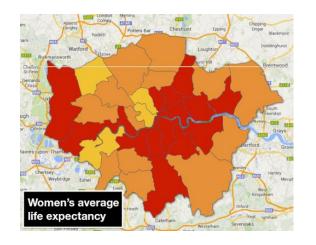


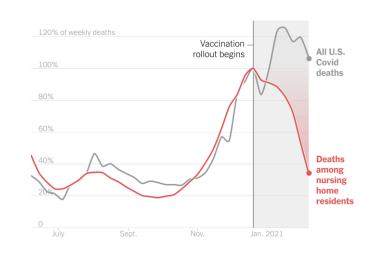


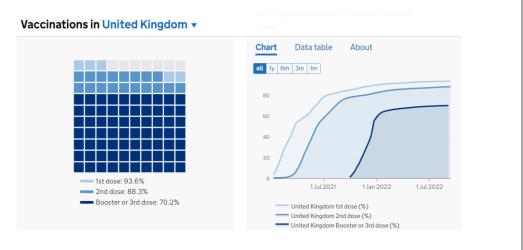


Levels above 25  $\mu$ g/m3 (light orange) are dangerous to health...









## Conclusion

- Data analysis is key to effective policy decision-making
- Malta needs to invest in its capacity to carry out effective health surveillance
- 'We've always done it this way' just doesn't hold water any longer things are rapidly changing and we need to improve our capabilities
- Centralisation of data makes it easier to carry out effective health data analysis
- Integration with other data sources is possible geographical, environmental, economic, sociological
- **Result**: better community health care, better health outcomes, cost-saving