



# Which STEC are important in meat – a work in progress

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# Which STEC are important in meat?

- Why do we need to know?
- A history of deciding which STEC are important
- Time to review decision making
- Recent recommendations
- Sum up

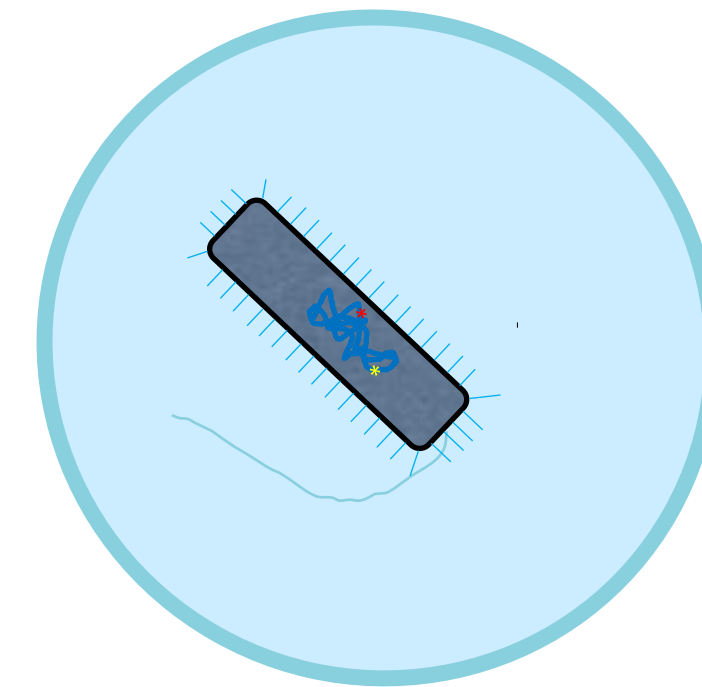
# Why do we need to know?

Detecting STEC in food is an important tool in preventing foodborne STEC infections

- Food safety management
- Public health surveillance and investigations

**HOWEVER,**

- Not all STEC strains we detect are able to cause illness
- So, when we detect STEC in food etc. what is the public health risk?



**Need an agreed risk-based approach for STEC characterisation**

# Early medical observations and research

- 1977 Some *E. coli* produce Shiga toxin and cause bloody diarrhoea (BD) = STEC
- 1983 STEC cause sporadic cases of haemolytic uraemic syndrome (HUS)
- 1986 Most STEC causing BD & HUS produce attaching and effacing lesions in the intestine via intimin
- 1990s Genes identified that encode Shiga toxin, *stx*, and intimin, *eae*

**Most important STEC causing severe illness  
= several serotypes, carrying *stx* and frequently *eae* genes**



# STEC and food

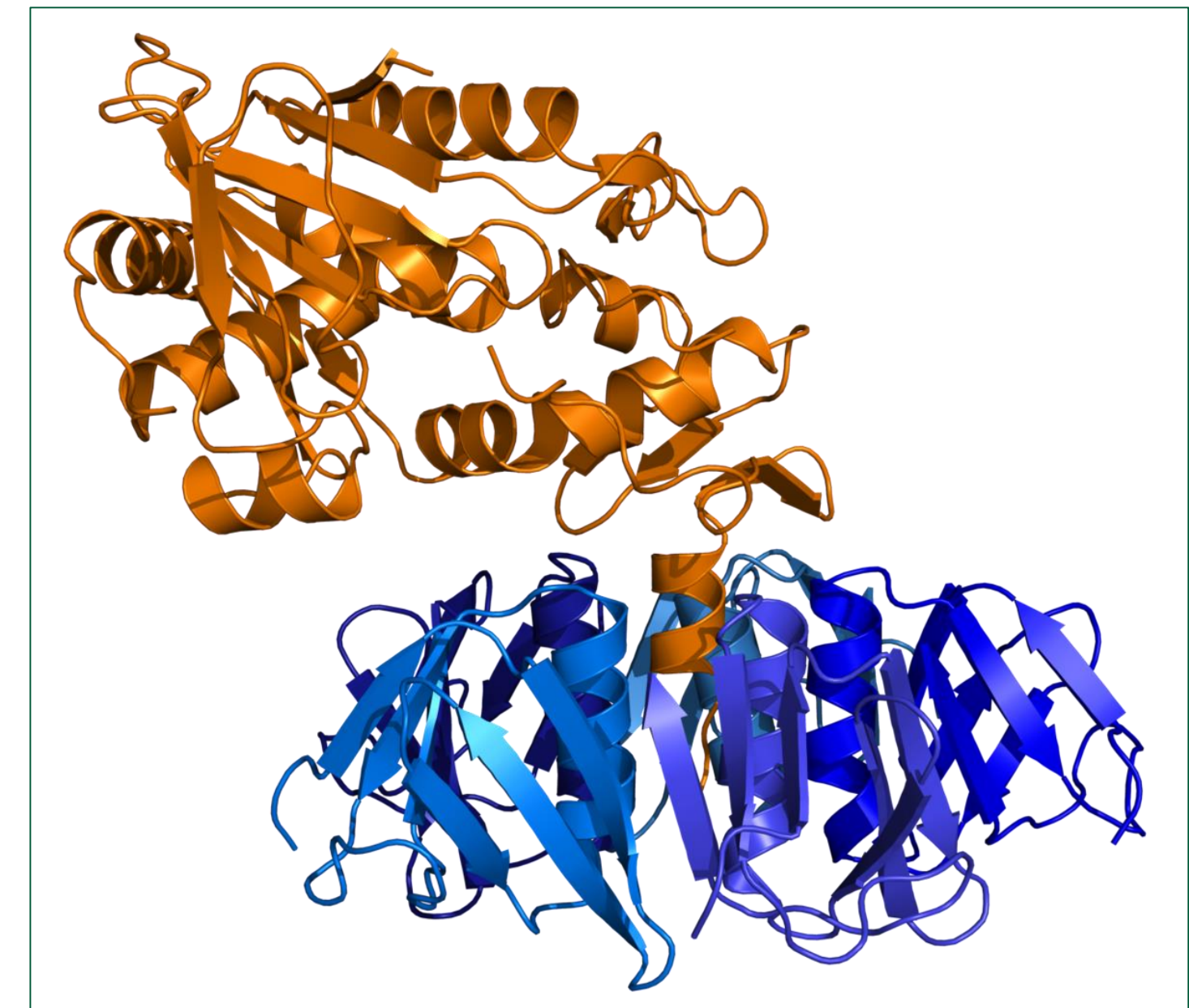
## Key foodborne outbreaks and research



From Meat+ Poultry at <https://www.meatpoultry.com/articles/19158-pink-burgers-persist-at-foodservice>



From: West Coast Seeds <https://www.westcoastseeds.com/shop/vegetable-seeds/sprouting-seeds/fenugreek-organic/>



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# USA 1982

## STEC 0157:H7 emerges as a cause of severe foodborne illness

- 2 outbreaks of BD linked with undercooked hamburgers
- Caused by, then rare STEC serotype, O157:H7
- 1980's-90's cases foodborne STEC O157:H7 increasing
- BD, HUS and deaths reported
- Ground beef frequently implicated



From Meat+ Poultry at <https://www.meatpoultry.com/articles/19158-pink-burgers-persist-at-foodservice>

# Implications for the meat industry?

**STEC O157:H7 become the prototype STEC in food**

- USA declared STEC O157:H7 an adulterant in ground beef

**Most important STEC in meat causing severe illness  
= O157:H7, carrying *stx* and *eae* genes**



# EU 2011, major foodborne outbreak

## Enteroaggregative *E. coli* (EAEC) producing Shiga toxin

- Outbreak gastroenteritis and HUS linked with fenugreek sprouts
  - (3,816 cases, 845 HUS cases, 54 deaths)
- *E. coli* with unusual combination of traits:
  - serotype 104:H4
  - *stx* and *aggR* (enteroaggregative adhesion)
  - no *eae* genes
  - antimicrobial resistance genes





# STEC of importance in food evolving

## Serotypes

- ⑩ 100/470 caused illness, O157 and non-O157
- ⑩  $\geq 75\%$  illnesses caused by a few serotypes e.g. Big X, Big Y,...
- ⑩ Severity of illnesses variable

## Shiga toxins

- ⑩ 12 subtypes *stx*
- ⑩ Some consistently associated with BD and HUS
- ⑩ *stx2a*, *stx2d*, *stx2c*, *stx1a*

## Adherence

- ⑩ Critical for STEC infection
- ⑩ Intimin (*eae* gene) is most common factor;
- ⑩ Others e.g. *aggR*, putative factors and combinations?

## ➤ *E. coli* opportunistic

- ⑩ Genes mobilised creating novel strains
- ⑩ Food production systems and changing populations



# Changing foodborne transmission

## Beef



[https://www.oregonlive.com/cooking/2018/09/recall\\_of\\_ground\\_beef\\_linked.html](https://www.oregonlive.com/cooking/2018/09/recall_of_ground_beef_linked.html)

## Produce



From: <https://knowmoregrowmore.com/protect-lettuce-disease-wet-weather/>

## Dairy



<https://www.nowtolove.com.au/health/diet-nutrition/raw-unpasteurised-milk-killed-victorian-toddler-13031>



# Reviews of risk characterisation of STEC 2018

- Codex Alimentarius Commission (FAO/WHO)
- USA agencies
- Various EU reviews



# Findings: which STEC are most important?

## Serotype is not a virulence factor

- Any serotype can potentially cause illness if it can adhere to and produce Stx in colon
- Useful epidemiological marker, historical significance

## Essential virulence markers linked with risk of severe illness:

- **Shiga toxin** – some subtypes more important than others
- **Adherence factors** – *eae* most common, not the only one
- **Combinations of the above** are important, some may be novel

**Host risk factors are important** e.g. age, health, therapy



# Proposed new approaches

## FAO/WHO, Codex

Potential risk level	Virulence traits (genes)	Potential to cause:		
1	<i>stx</i> <sub>2a</sub> + <i>eae</i> or <i>aggR</i>	D	BD	HUS
2	<i>stx</i> <sub>2d</sub>	D	BD	HUS**
3	<i>stx</i> <sub>2c</sub> + <i>eae</i>	D	BD <sup>^</sup>	
4	<i>stx</i> <sub>1a</sub> + <i>eae</i>	D	BD <sup>^</sup>	
5	Other <i>stx</i> subtypes	D <sup>^</sup>		

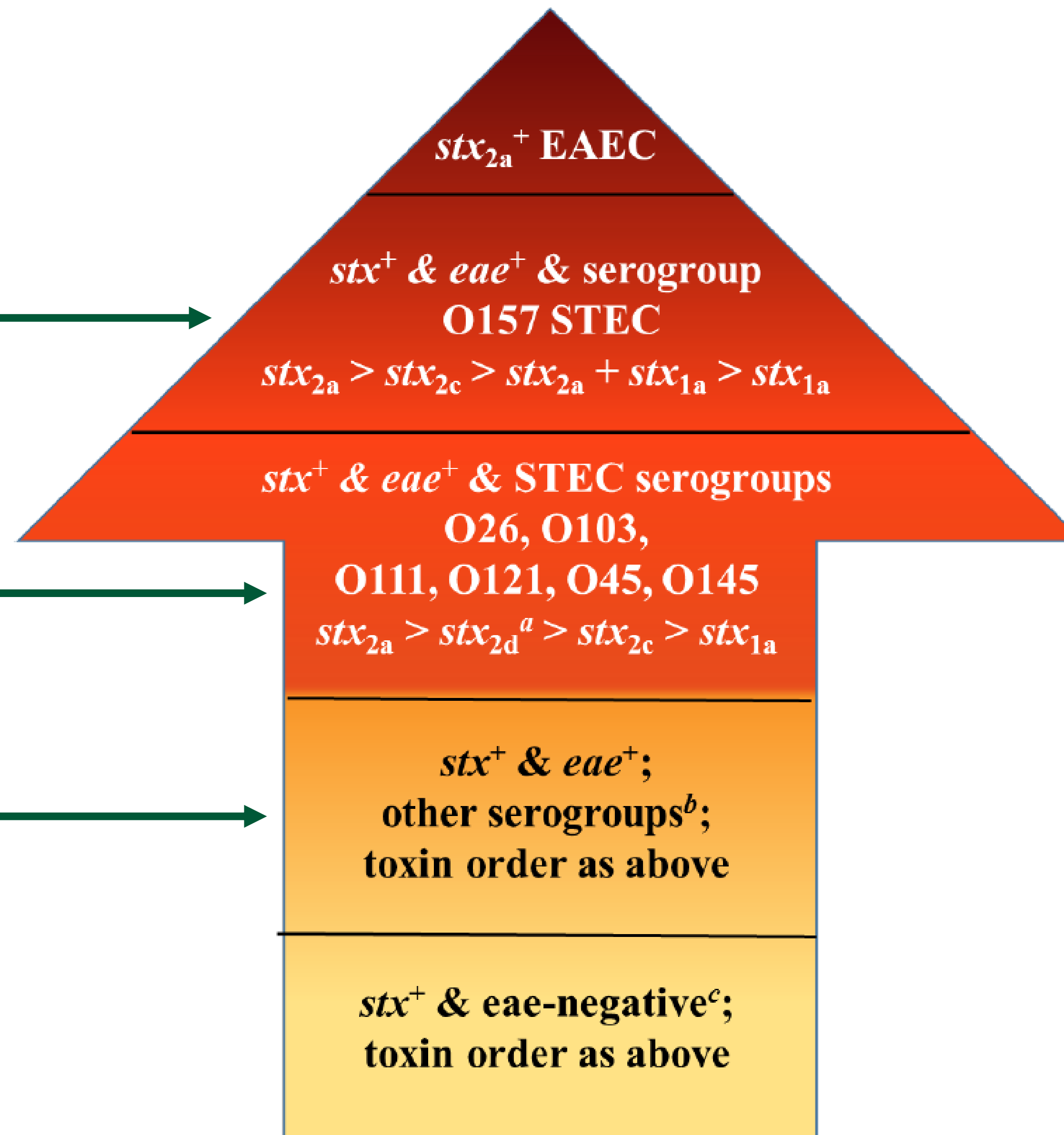
\* depending on host susceptibility or other factors; e.g. antibiotic treatment

\*\*association with HUS dependent on *stx*<sub>2d</sub> variant and strain background

<sup>^</sup> some subtypes have been reported to cause BD, and on rare occasions HUS

# NACMCF, USA

serotypes as  
additional markers





# Risk-based strategy for STEC testing proposed

## Aligned with STEC risk characterisation

Based primarily on:

- Combinations of virulence genes and their subtypes

Secondary considerations:

- Other markers e.g. serotypes, lineages etc.

# Sum up

- STEC will continue evolving
  - A revised risk-based approach for characterisation of STEC in food proposed
  - Risk managers will decide the appropriate level of protection for their consumers
  - Likely lead to revised testing protocols and methods in future
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- Work in progress.....