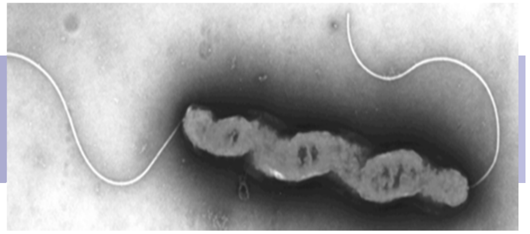
Campylobacter and Listeria: factory control models

Dr. John Holah, Technical Director,
Holchem Laboratories

IAFP Europe, 20-22 April 2015, Cardiff, Wales

Campylobacter pathogenicity

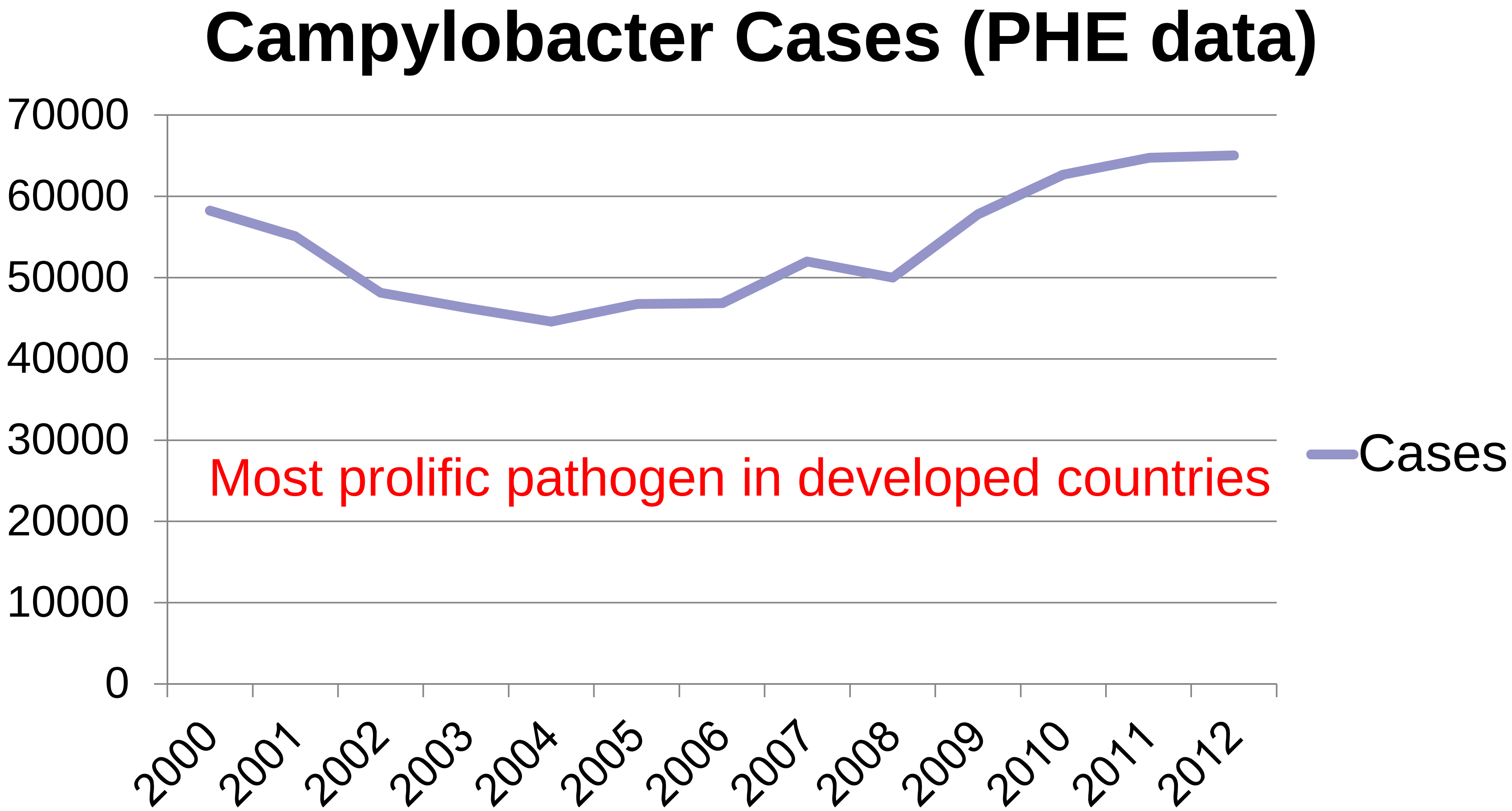


- *C. jejuni, C. coli*
- Gram negative spiral rod
- Wild birds reservoir for infection to food and domestic animals
- Poultry, red meat, vegetables, fruit, shellfish, raw milk, water
- Infective dose 50 - 500 cfu/g, Incubation period 1-10 days (typically 3 days)
- Colonisation of lower GI tract, may enter blood stream (bacteraemia), enterocolitis watery diarrhoea, abdominal pain, fever, nausea
- Complications may occur e.g. reactive arthritis, recurrent abdominal pain and Guillain–Barré syndrome

Hmmmmm... ... explosive diarrhoea

a clear case of *Campylobacter jejuni*

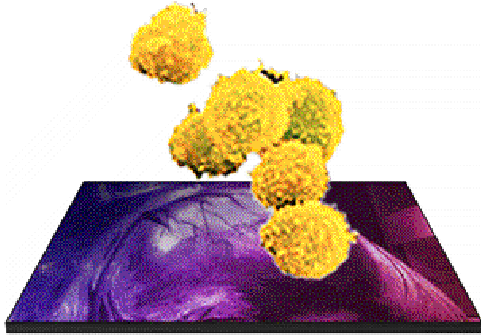
Campylobacter issue – case numbers!



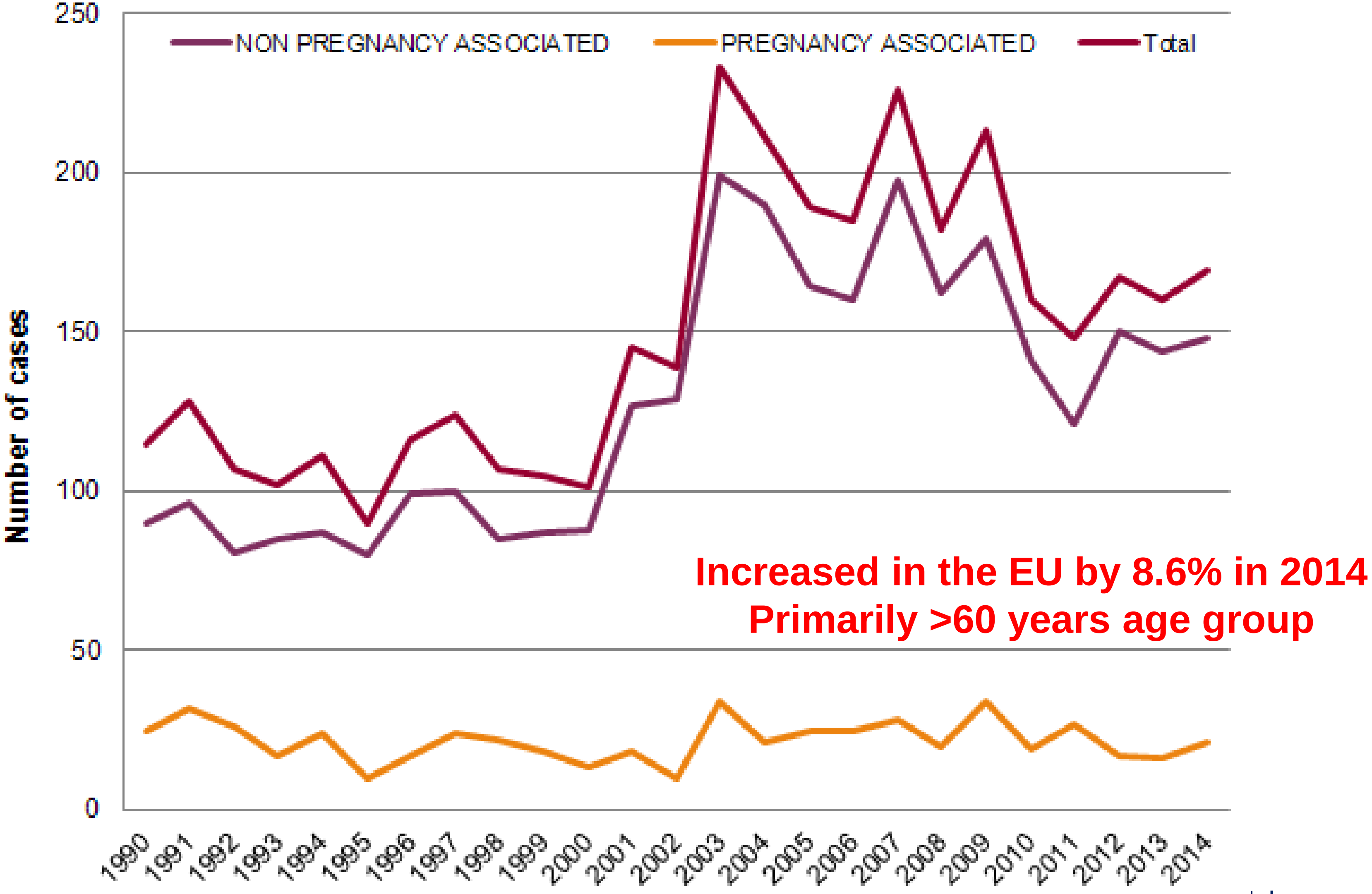
FSA and EFSA surveys show high UK prevalence (65-85%, 6th highest in EU)

Listeria pathogenicity

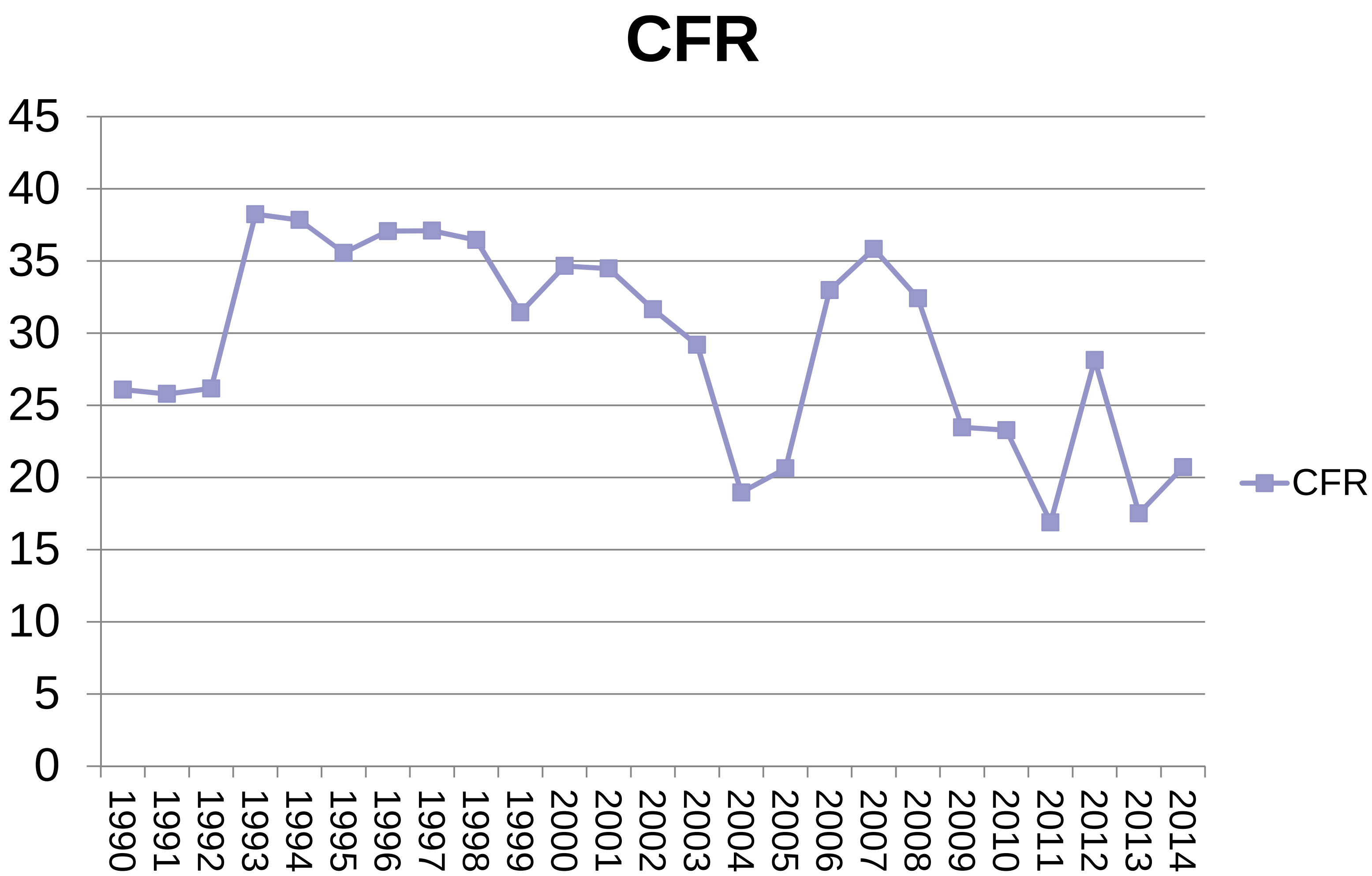
- *Listeria monocytogenes*
- Gram positive, non-sporing short rod
- Isolated from Soil, vegetation, sewage, silage - farm animals
- Mild flu-like illness (pregnant women), miscarriage, still births
- Meningitis (children and adults), endocarditis, peritonitis, conjunctivitis, septicaemia, local abscess formation, cutaneous nodules (farmers and veterinarians)
- High rate of hospitalisation ~80%



UK listeriosis cases 1990-2014



Listeria issue case - fatality rate



Campylobacter growth characteristics

- Strictly microaerophilic
- Growth range: 30 - 45°C (optimum 42°C, no growth at 25°C)
- Limiting Aw for growth is 0.98
- Growth >3%<10-15% O_2. >5%CO_2
- Growth unlikely in the environment
- Survival?
- Environmentally sensitive
- No known resistance to common disinfectants

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Listeria growth characteristics

- Facultative anaerobe
- Temp:- -0.4^{o}C to 43^{o}C
- pH:- 4.39(30^{o}C),5.0(5^{o}C) to 9.6
- NaCl:- grows to10%(a_w0.94), survives 25%(a_w0.84)
- Resistance – not resistant to:-
  - Process temperatures
  - Disinfection
- Human carriage
  - Estimated that 10% of healthy adults carry in gut/(hands)

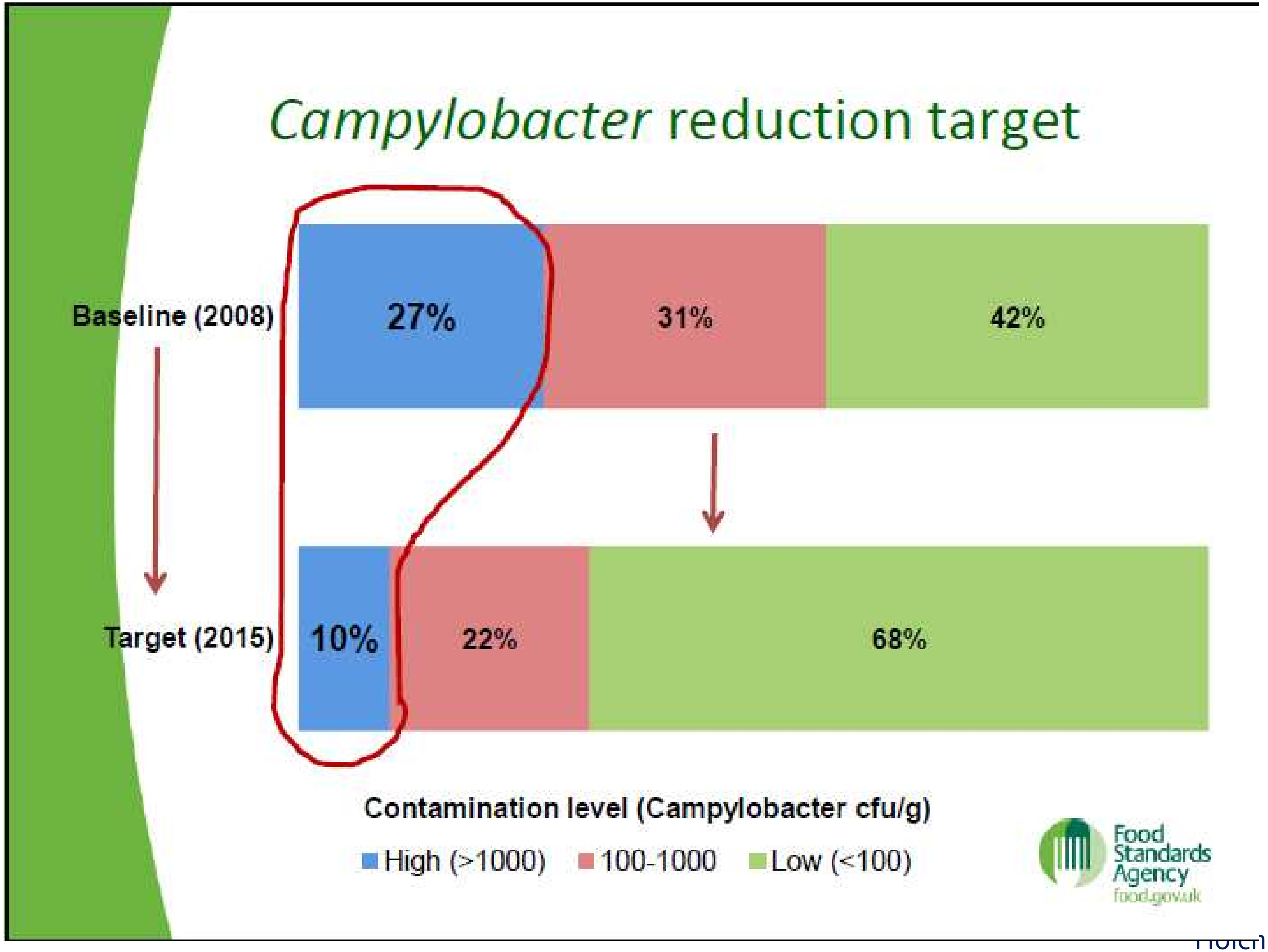
Campden BRI MIG, FSA, February

Likely areas for action 2015-2020

- Continued focus on reducing campylobacter
- Refreshed focus on listeria reduction
- Tackling food fraud – establishing the Food Crime Unit
- Ensuring effective regulation in a time of reducing resources

Food Standards Agency
food.gov.uk

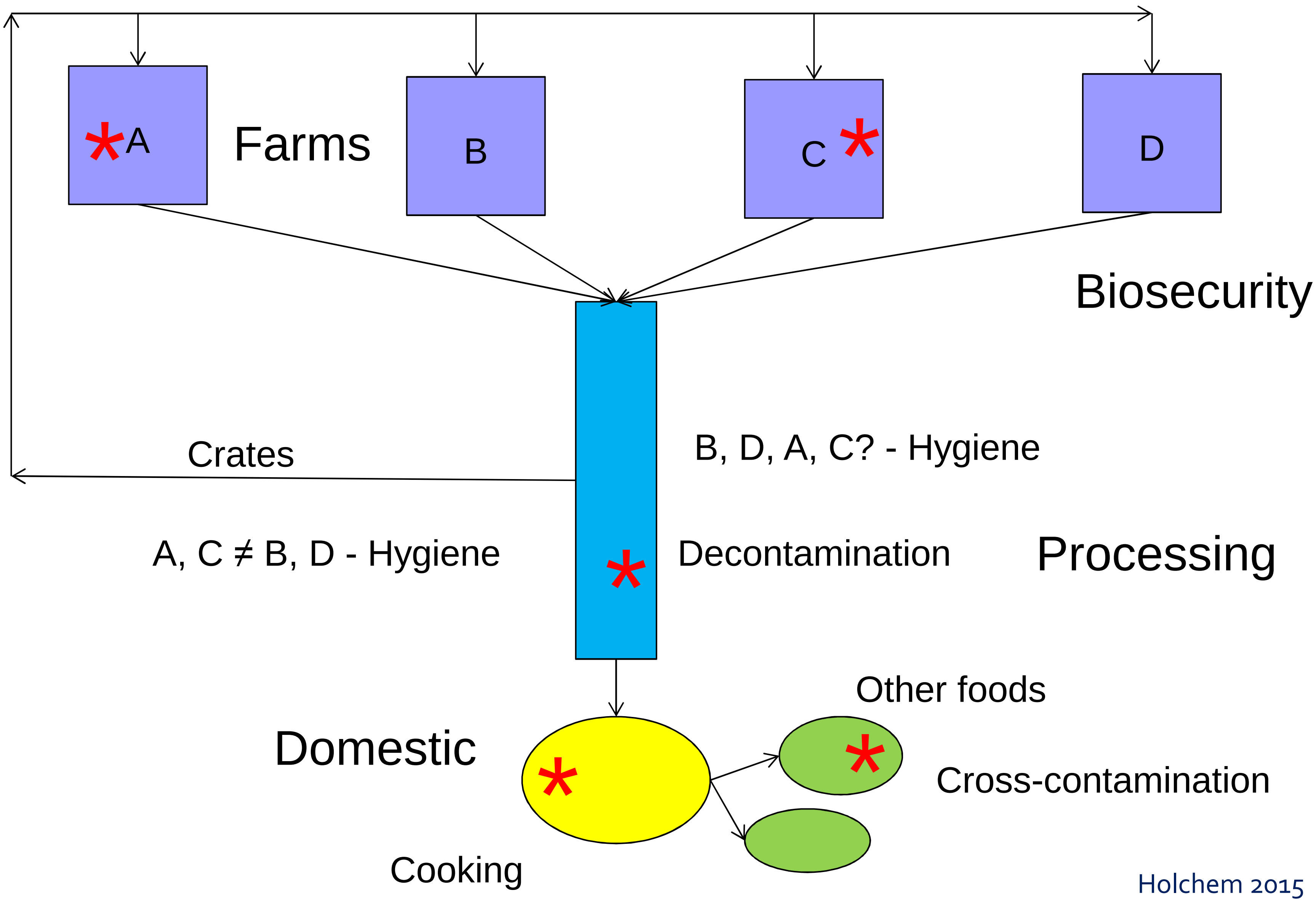
Campylobacter requirements



Listeria monocytogenes requirement

Essentially zero in ready-to-eat foods

Campylobacter control options



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Reality!

Mm, chicken bug. Great with roasties

Terrifying news arrives that almost all supermarket chickens are affected by the food-poisoning bug campylobacter, which is Latin for "short, homosexual bacteria", I think.

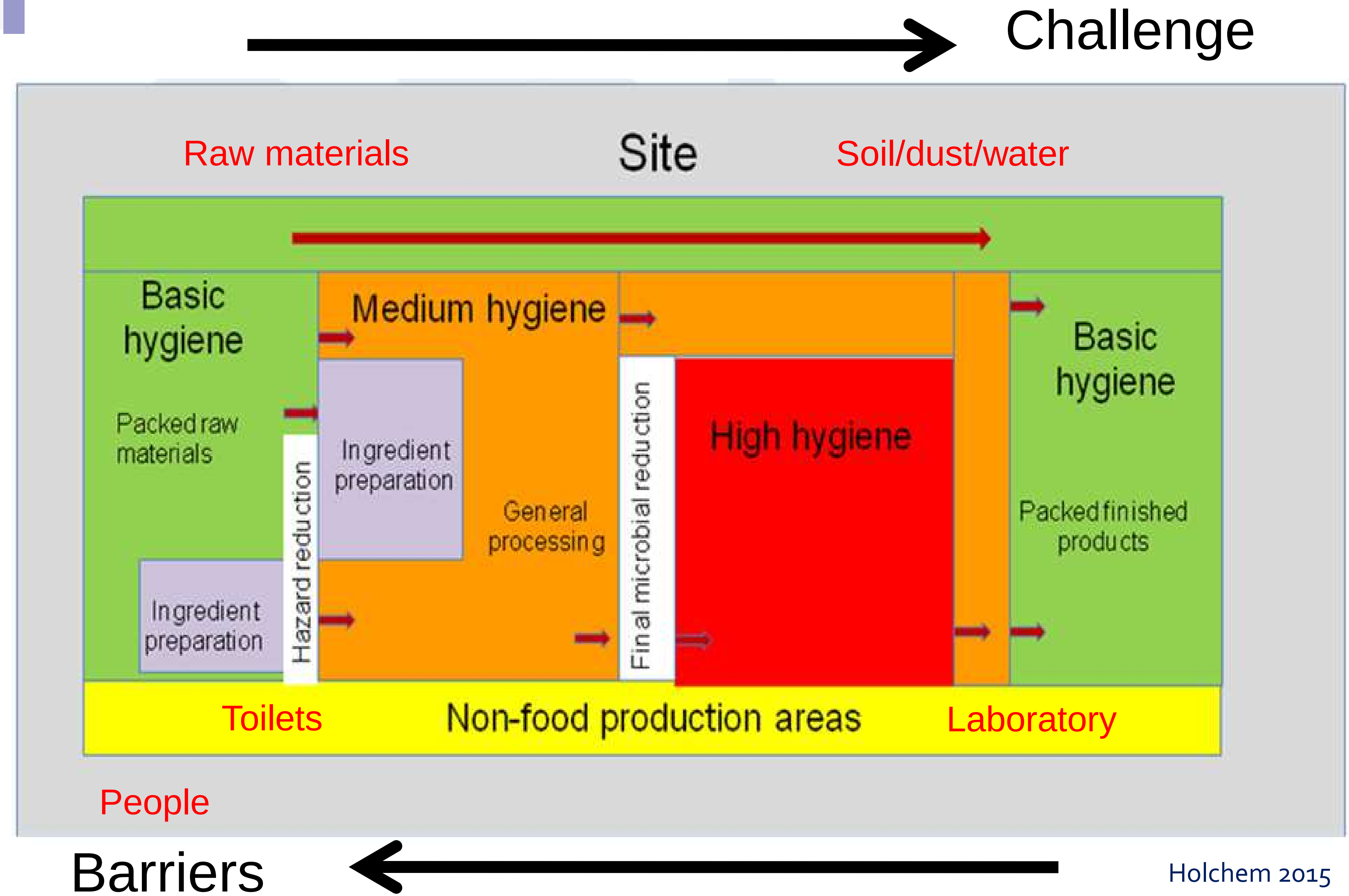
There are demands from the left, as a consequence, to boycott all supermarket chicken, occupy Wall Street and destroy capitalism, and also to shout urgent revolutionary slogans at live chickens when they are encountered on a day-to-day basis. Good.

A simpler approach might be to cook your chicken before eating it, as this destroys every last colony of these evil, camp bacteria. A radical idea, I know, but hell — desperate times call for desperate measures.

Actually 'curved rod'

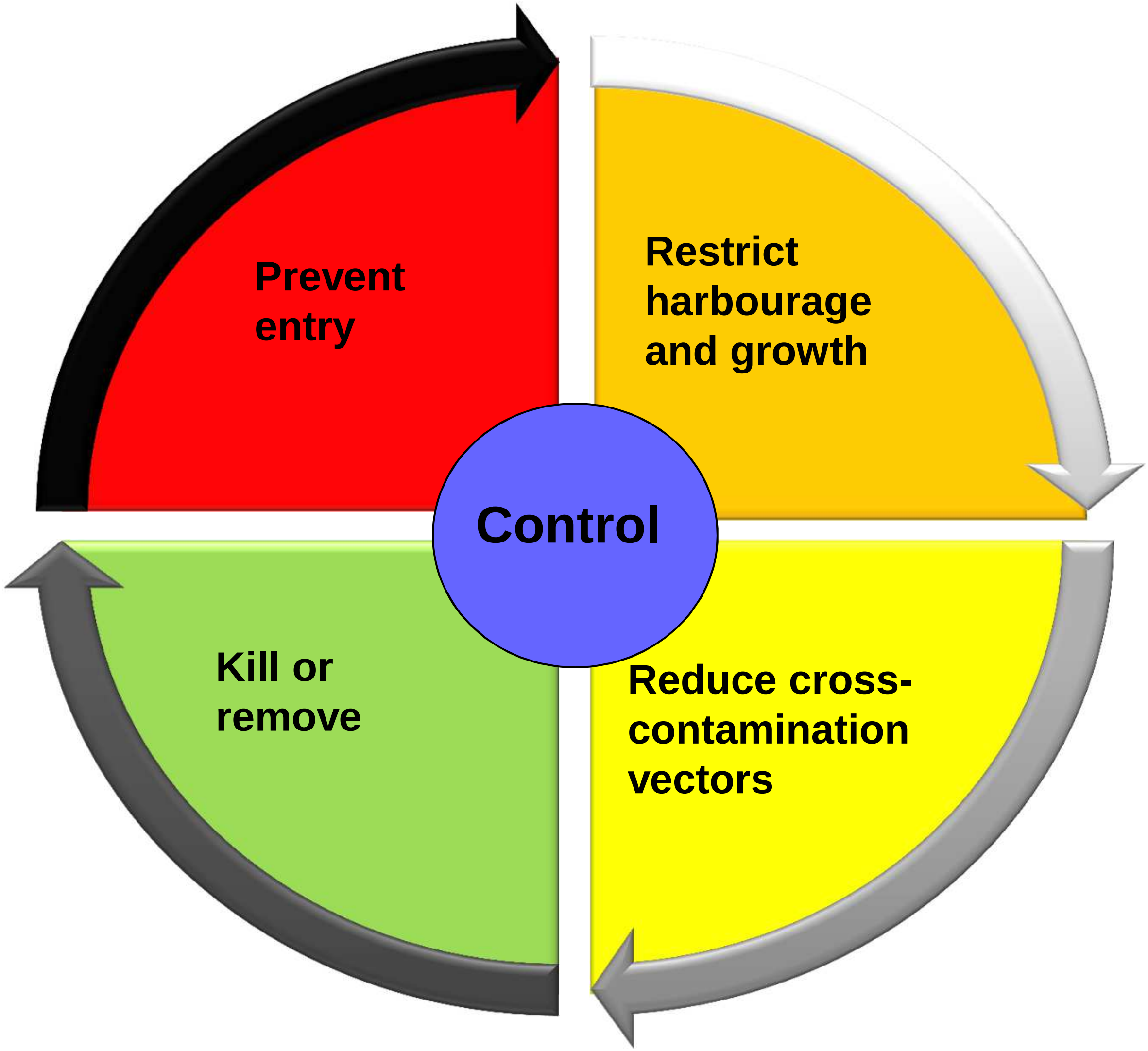
Rod Liddle
Sunday Times 30.11.14

Listeria sources, barriers and GMPs



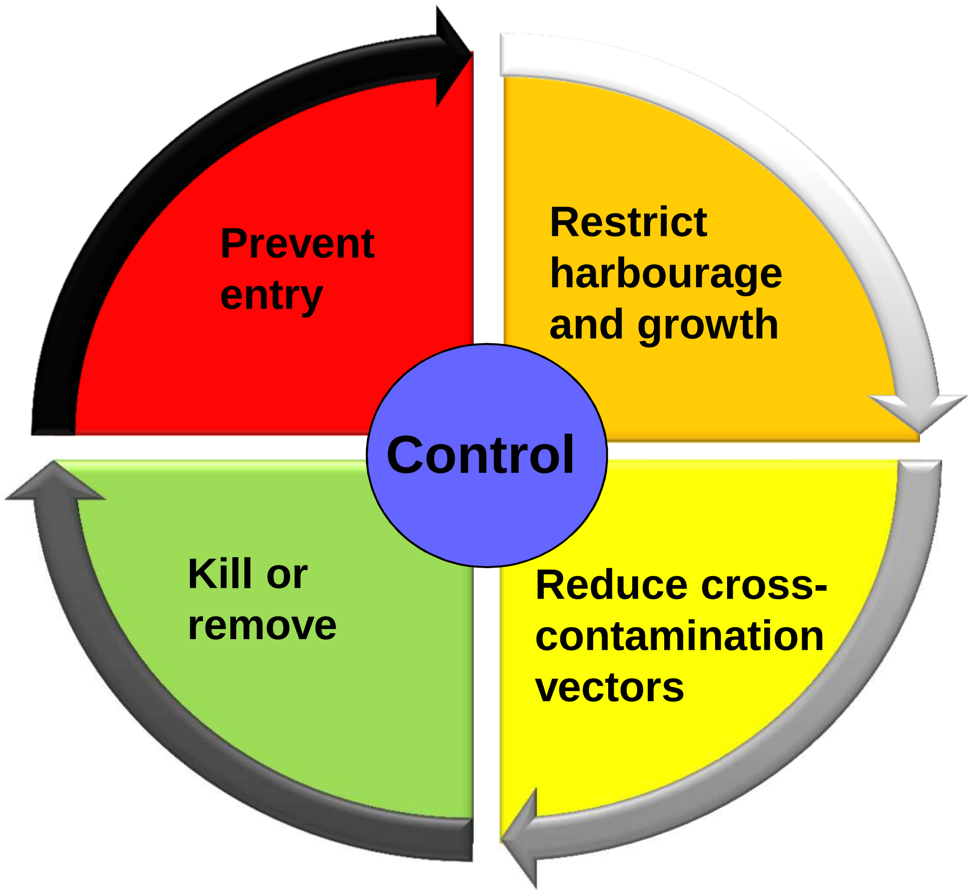
Pathogen Control model: 5 Point Plan

Campden BRI
Land O'Lakes
Pepsico
Holchem

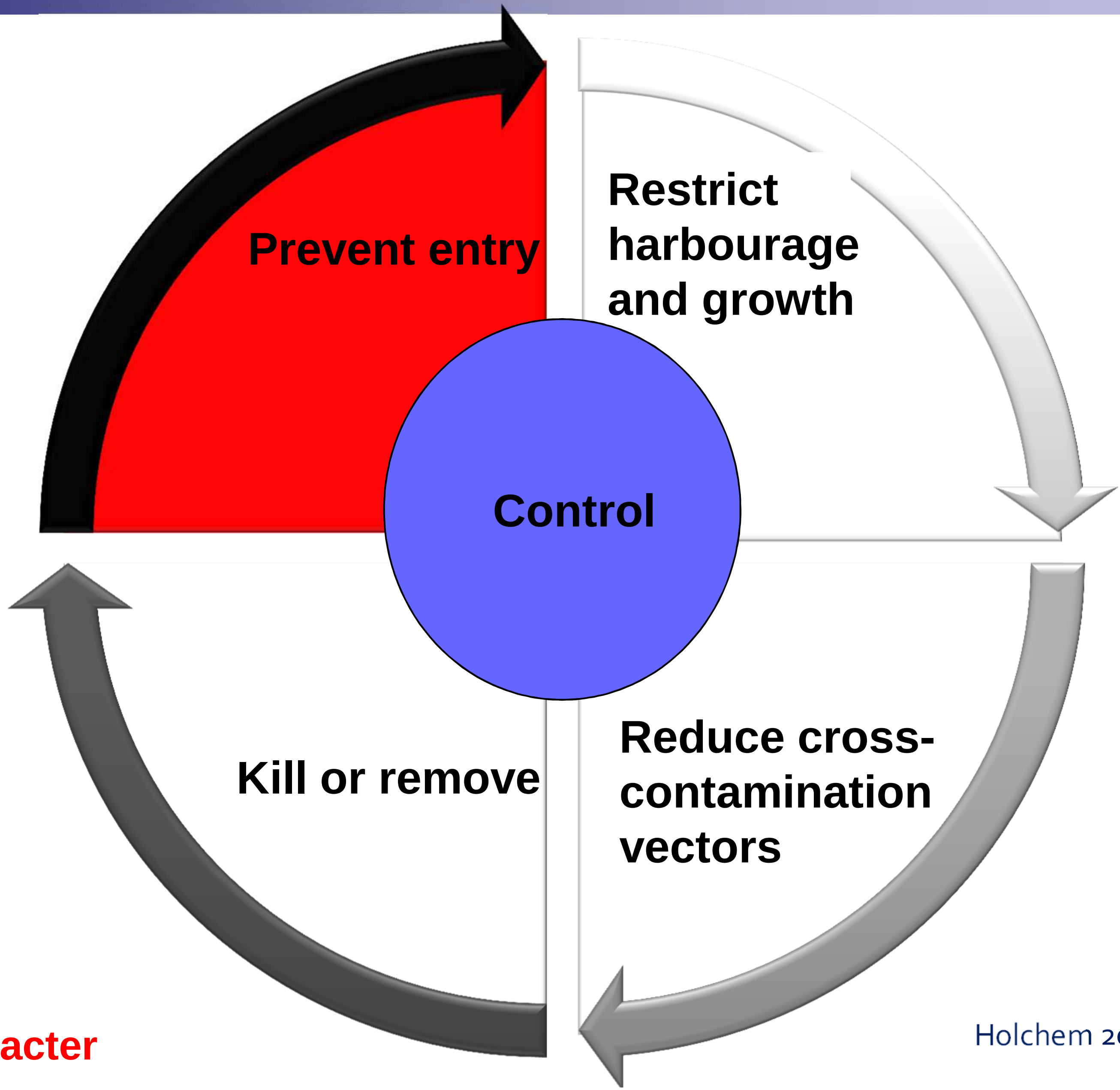


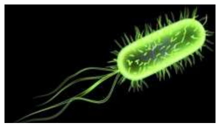
Pathogen Control model: 5 Point Plan

Listeria control is more than disinfection!



There is no silver bullet!





Listeria

Campylobacter

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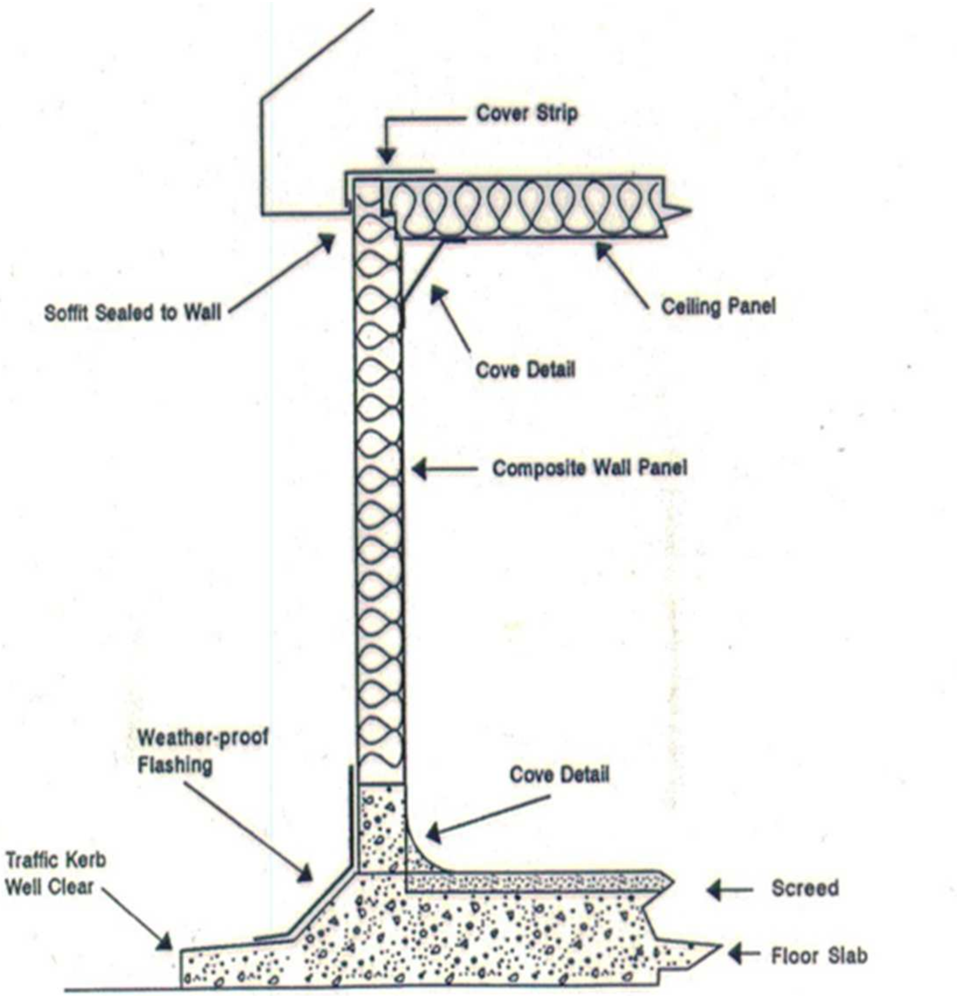
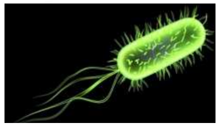
Campylobacter

- No campy barriers – comes in with the flock or cross-contamination in transport
- Rapid detection of Campy to allow positive flocks to be processed last?

Factory barrier

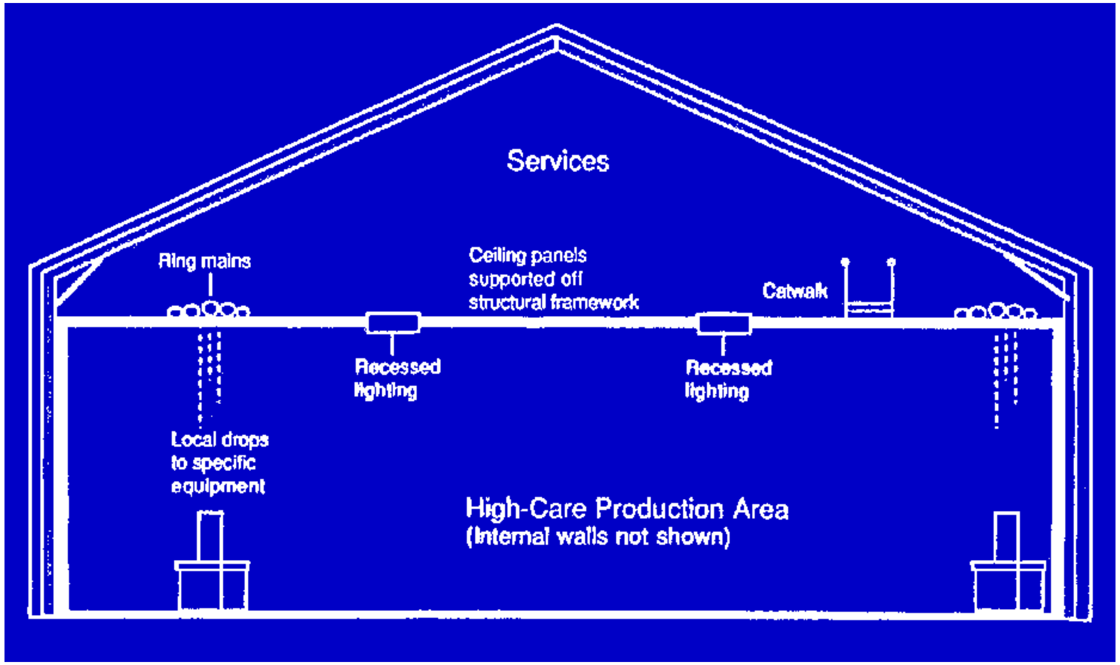


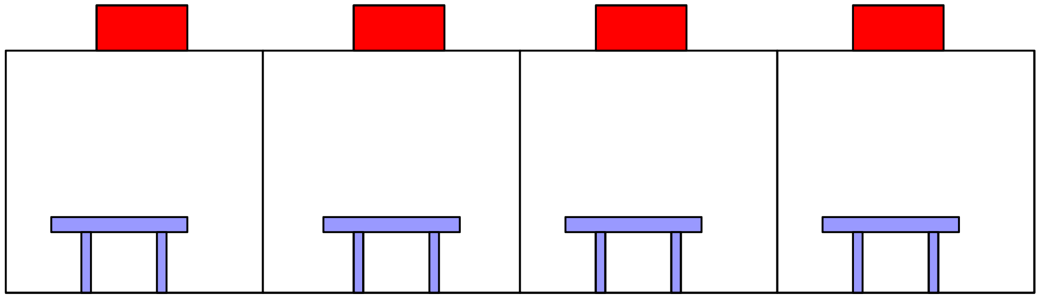
Load Bearing Composite Panel Wall Arrangement

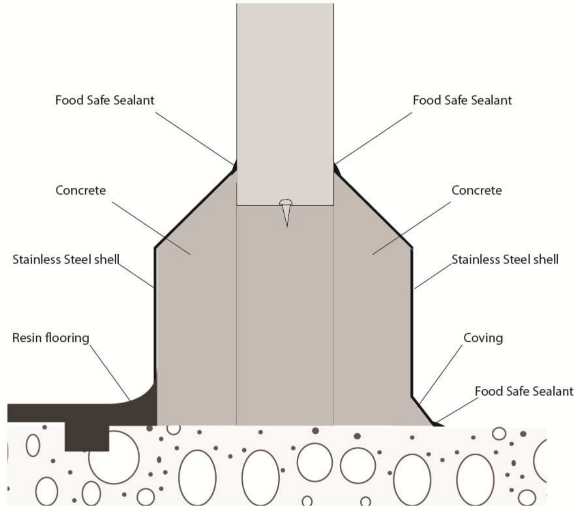


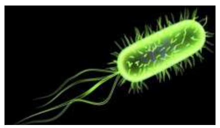
A box within a box

- External services
- Product, packaging, equipment, personnel only
- Small as possible
- Fewest, controlled entrances



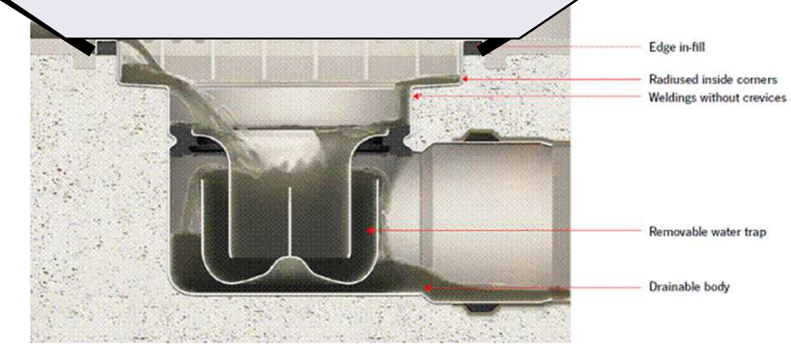


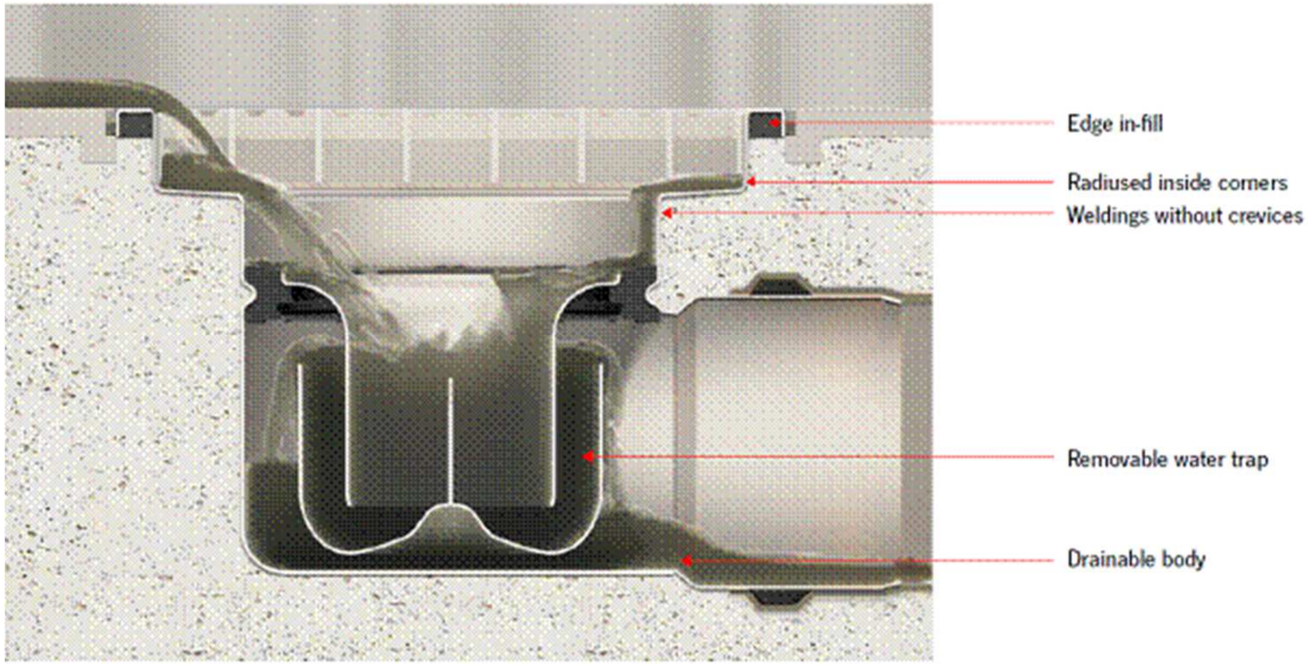


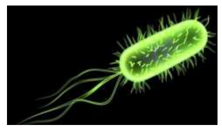


Drain design

High risk floor direct to sewer







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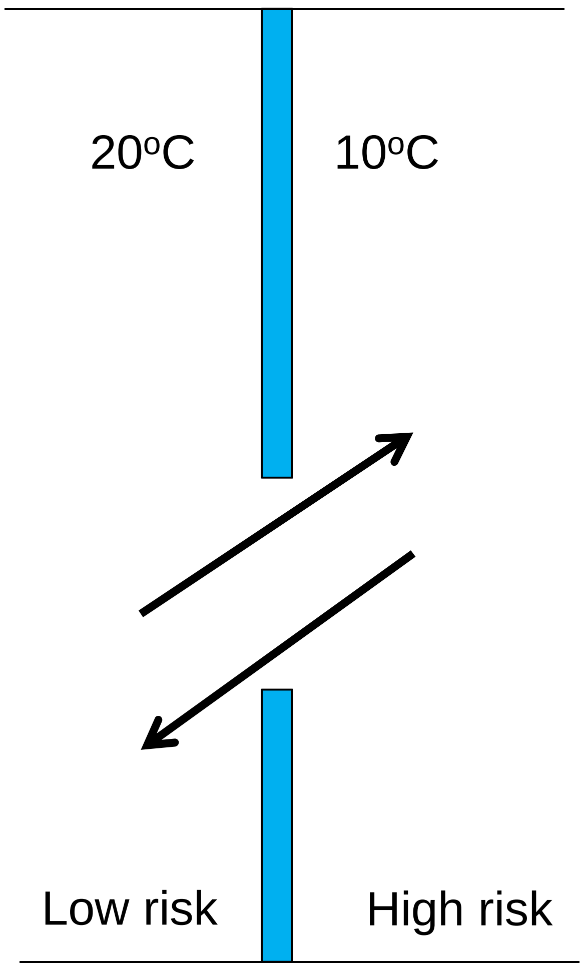
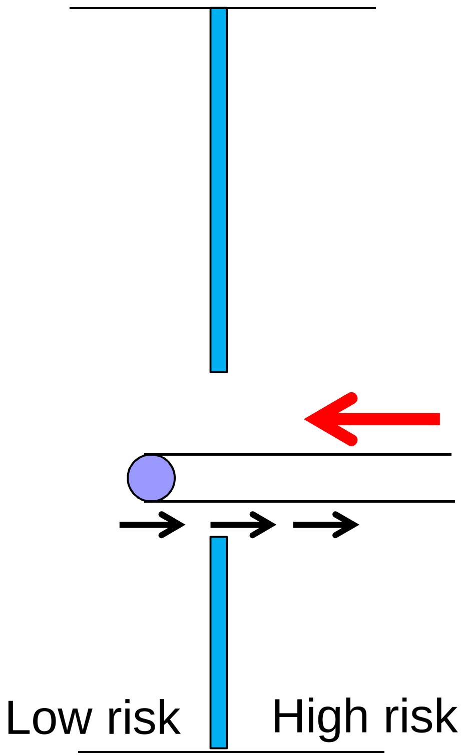
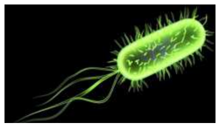
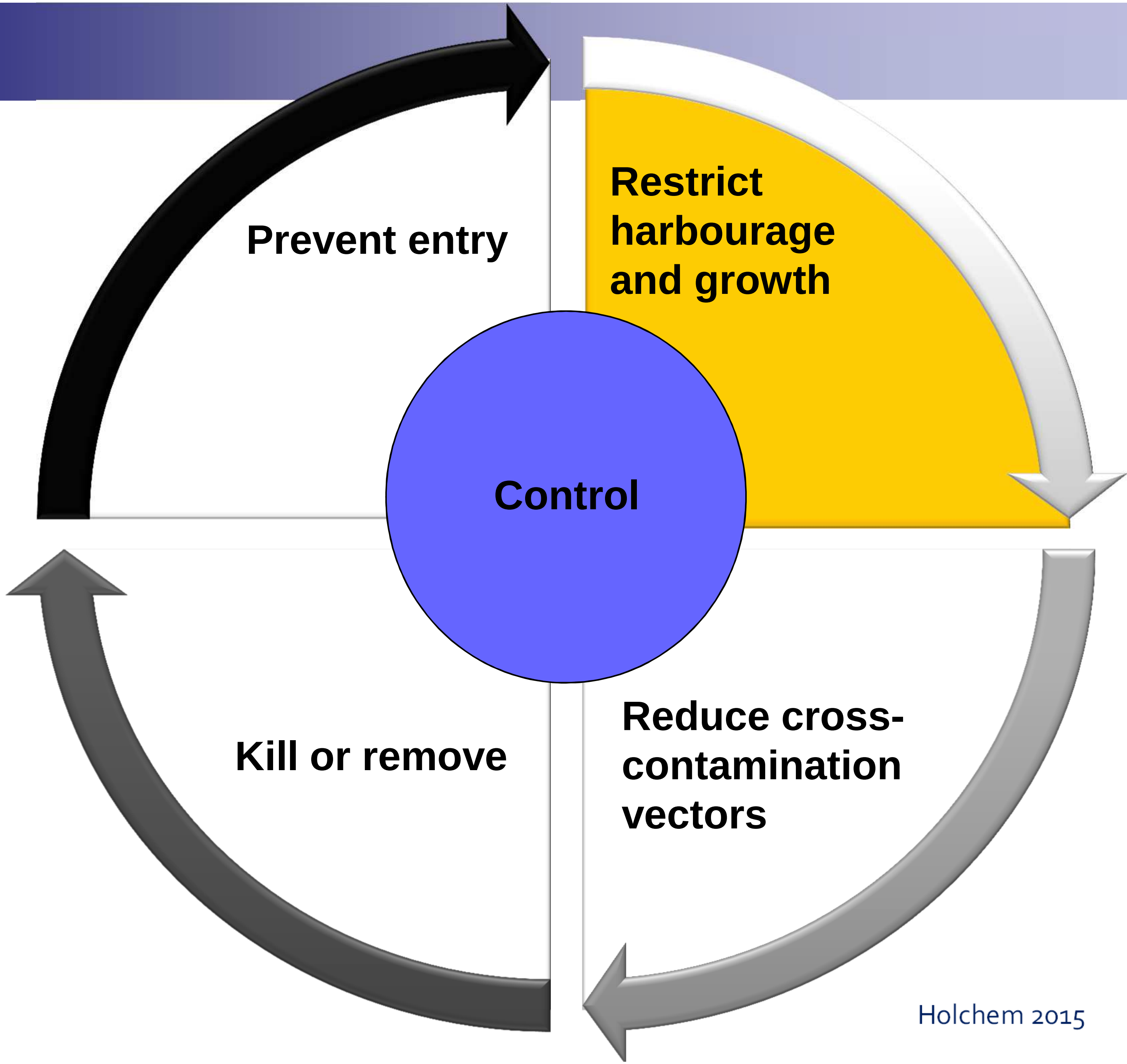
Air movements between high and low risk





Positive pressure is required, typically 2-5 Pascals /air velocity>3m/s





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Restrict harbourage and growth

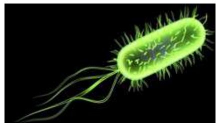
- Definitions – sources/niches
  - A permanent site from which a pathogen can travel via a cross-contamination vector
  - Source permits survival and protection from controls
  - Niche also allows microbial growth
- Source
  - Hygienic design – environment/equipment
- Niche
  - Water/nutrients/temperature/oxygen/time
  - Persistence

Campylobacter sources

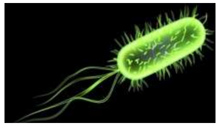
- Unknown environmental survival
- Biofilms?

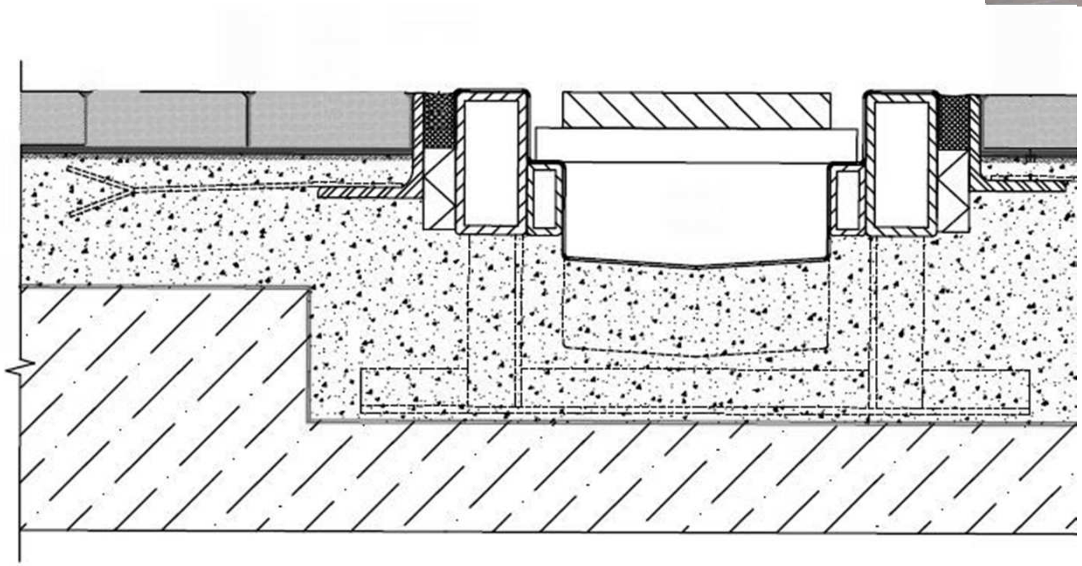
Condensate

- Drainage – no full trays
- U bend – air lock
- Condensate to drain – in low risk – via air gap?
- Giros, freezers, N_2 tunnels etc



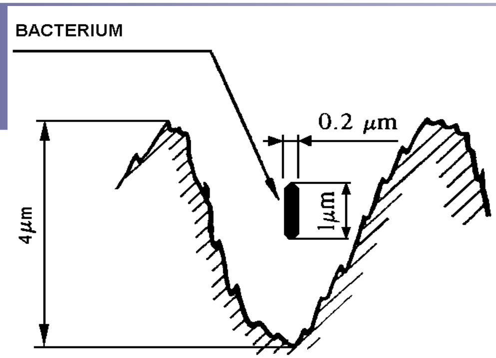
Drain/ sub-floor interfaces?





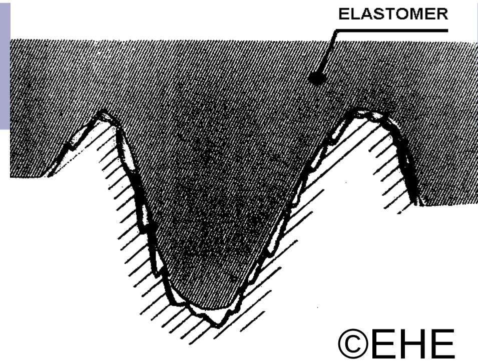
EHEDG Building design 2014

Joints



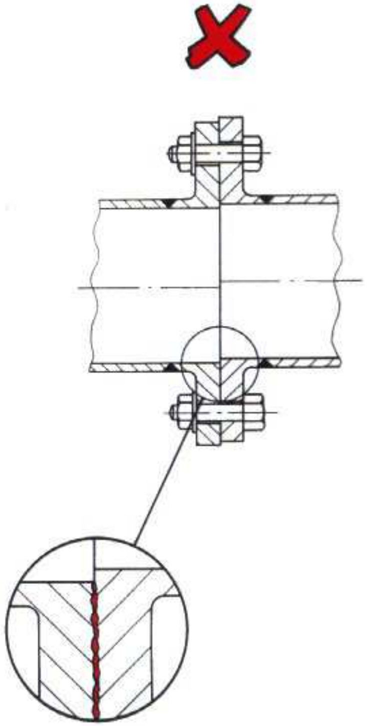
Typical representation of a surface profile of 0.8 µm. Ra (32µinch RMS) roughness achieved by 180-240 grit mechanical polish.

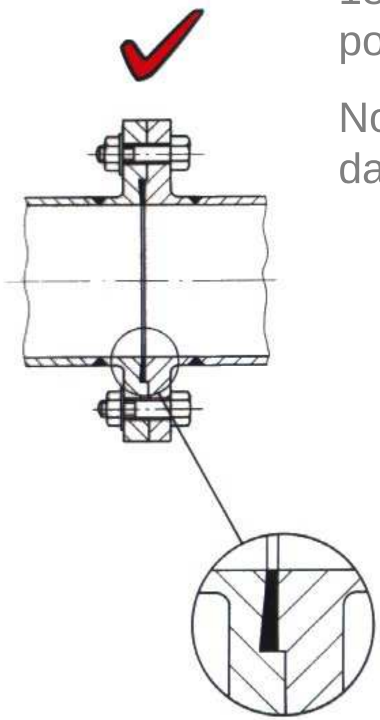
No surface defects or damage.

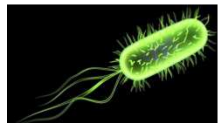


©EHEDG

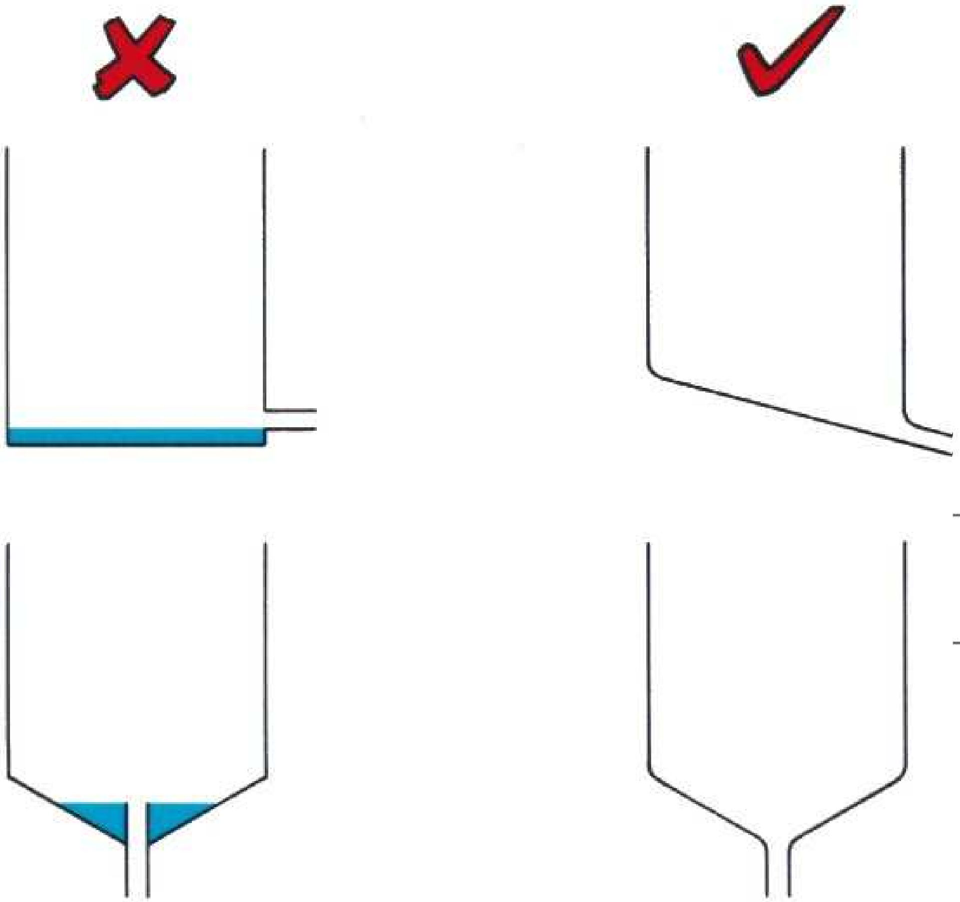
1.5 N/mm² contact pressure required using 70º Shore A hardness elastomer achieved with 15 per cent compression of original thickness.

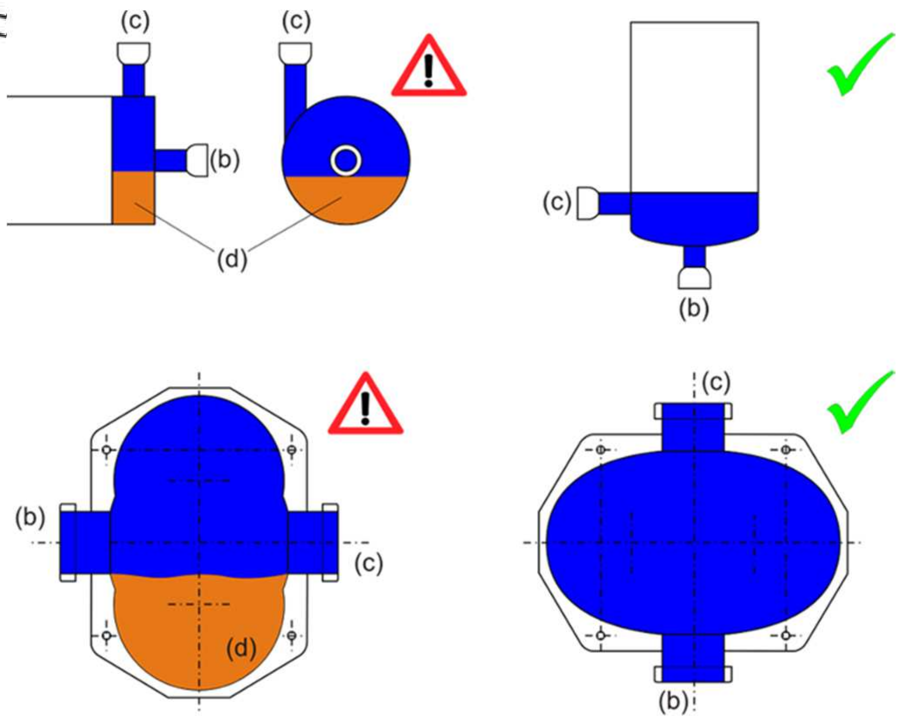




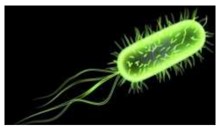


Drainage

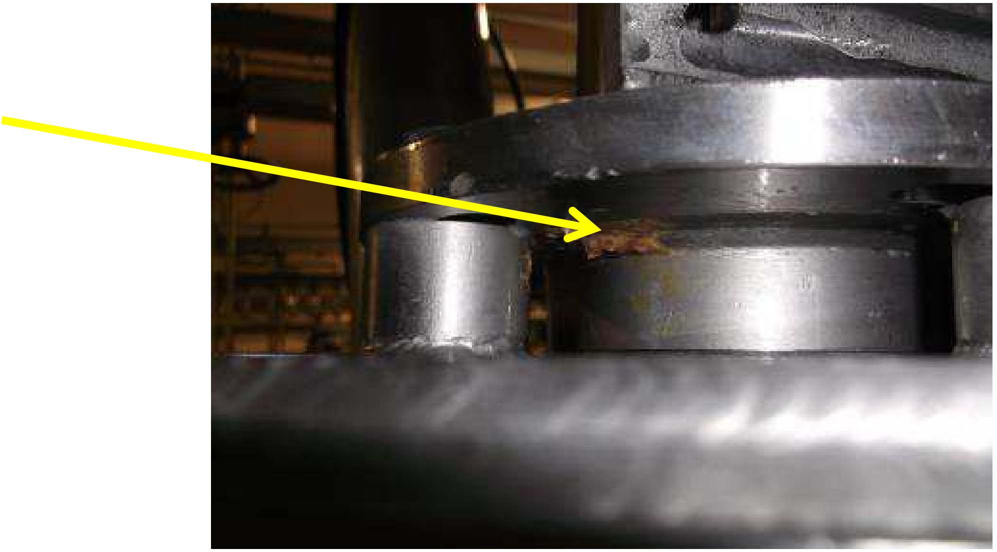




Microbial growth requirements
•Temperature
•Nutrients
•Oxygen
•Water



Dead areas: Poultry processing equipment



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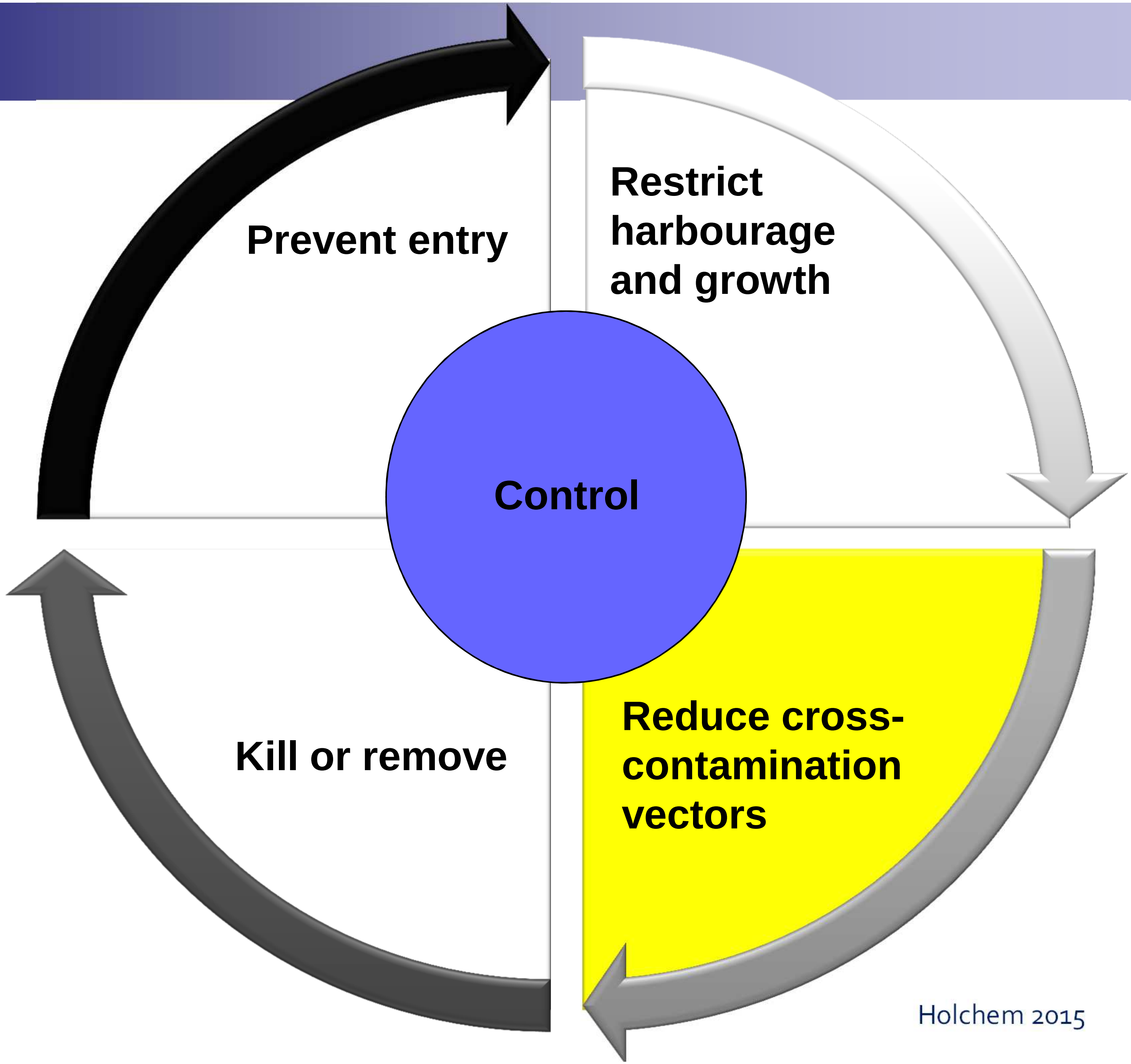

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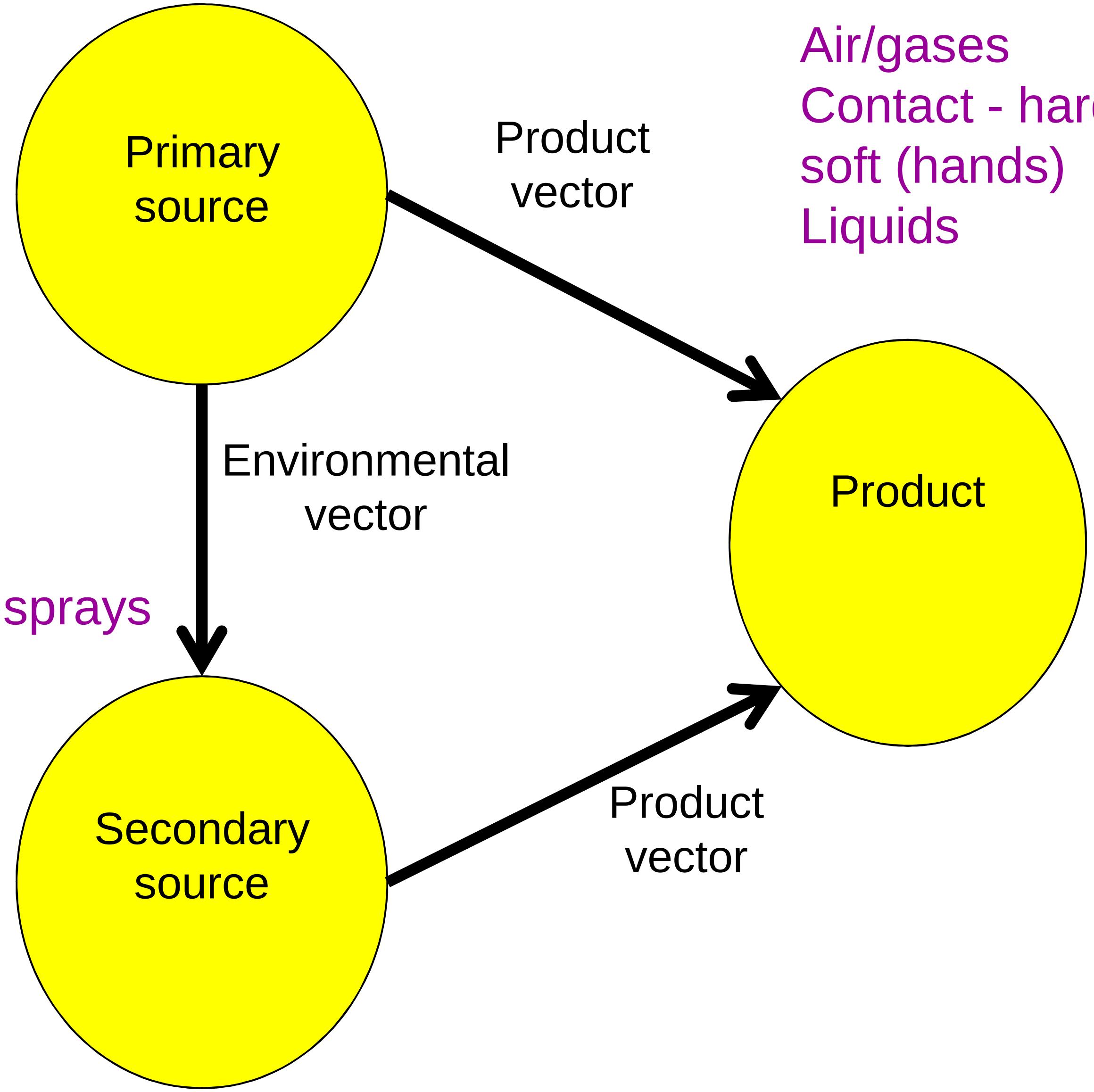
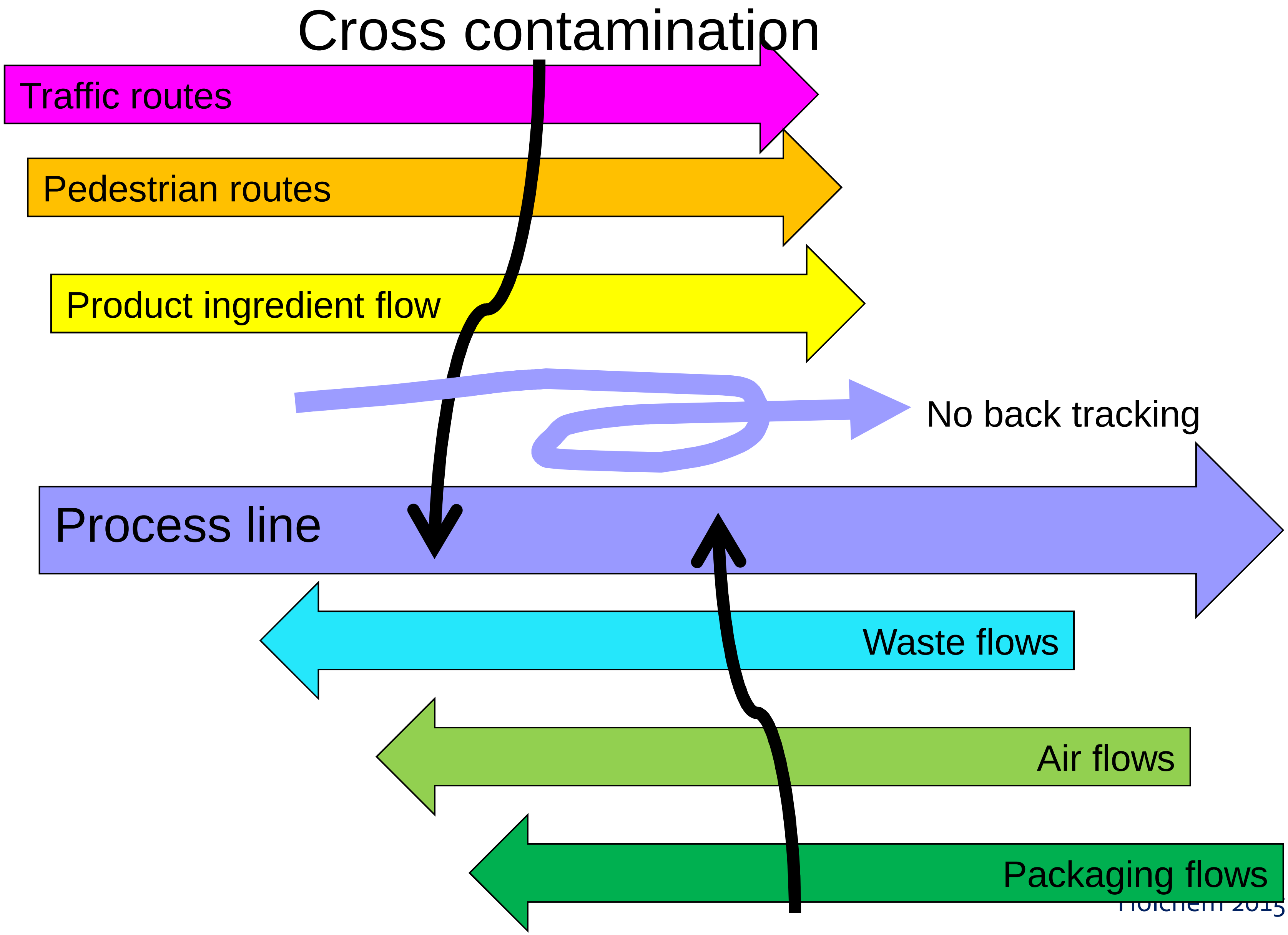
Reduce cross-contamination vectors

Air/gases
Contact - hard (conveyor), soft (hands)
Liquids

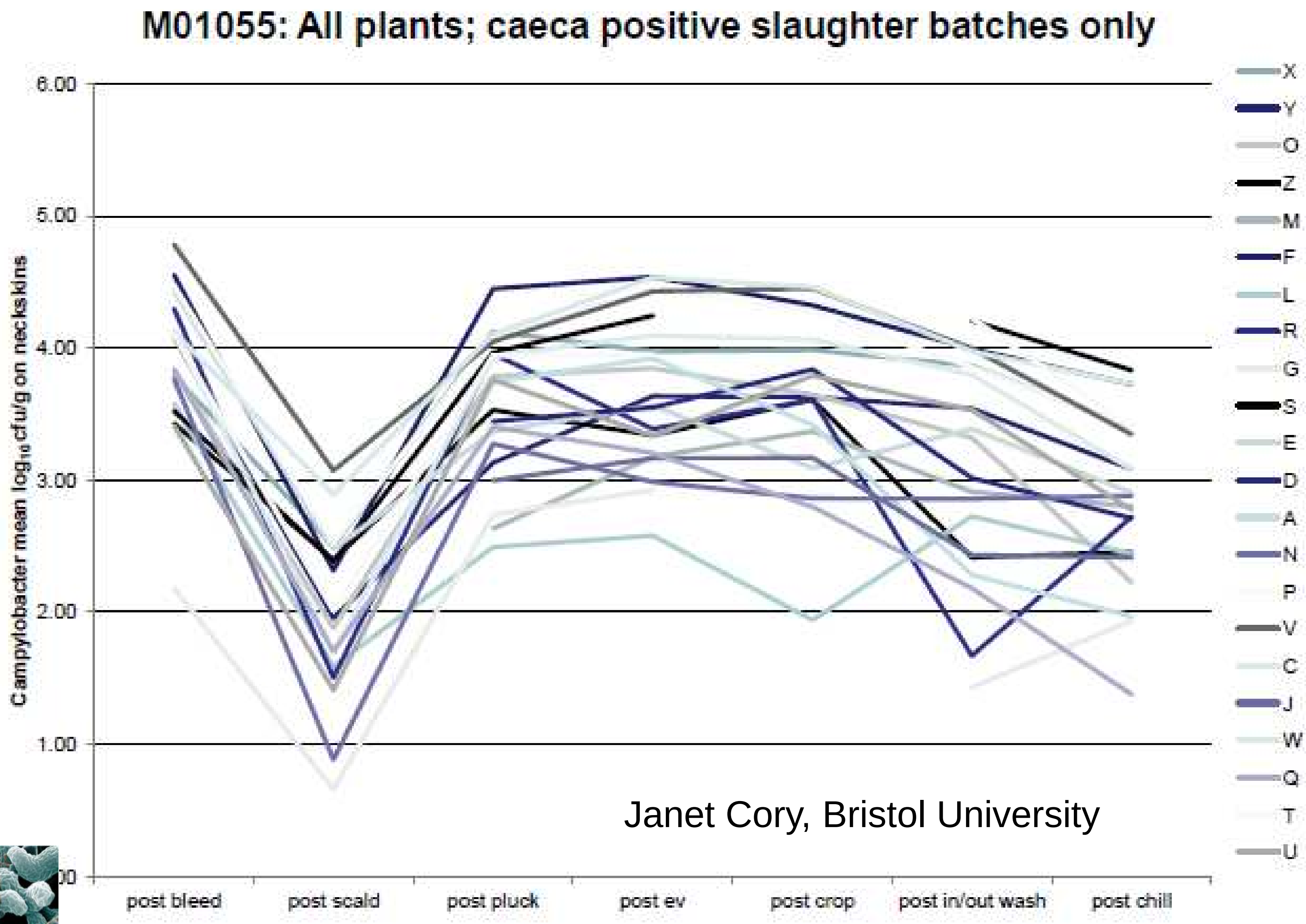


Wheels
Feet
Leaks
Cleaning sprays
Etc.

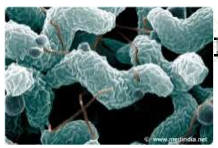
Vectors


Cross contamination
Traffic routes
Pedestrian routes
Product ingredient flow
No back tracking
Process line
Waste flows
Air flows
Packaging flows

Campylobacter levels through processing,



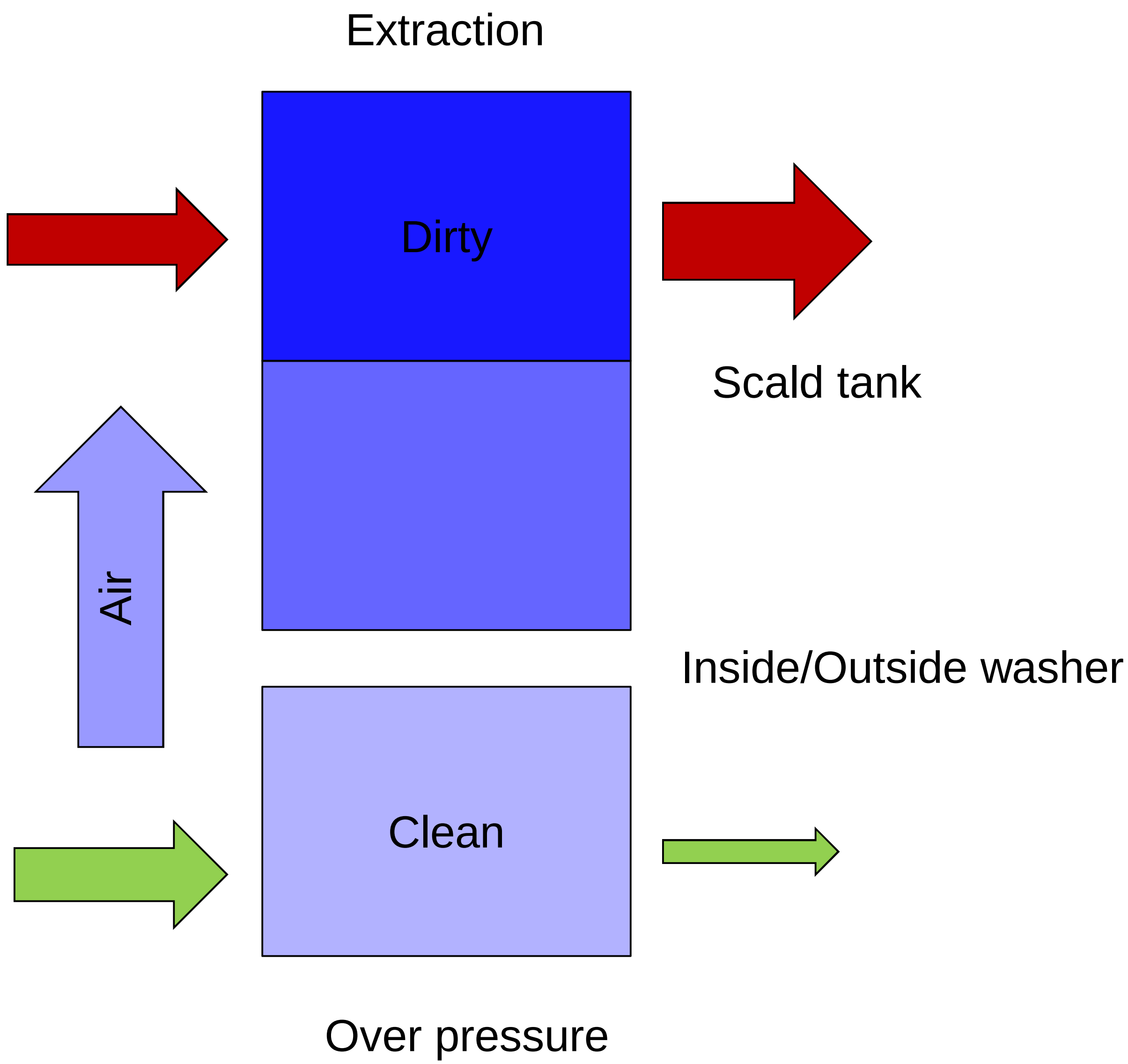
Janet Cory, Bristol University

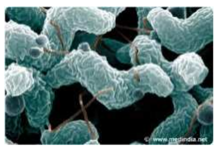


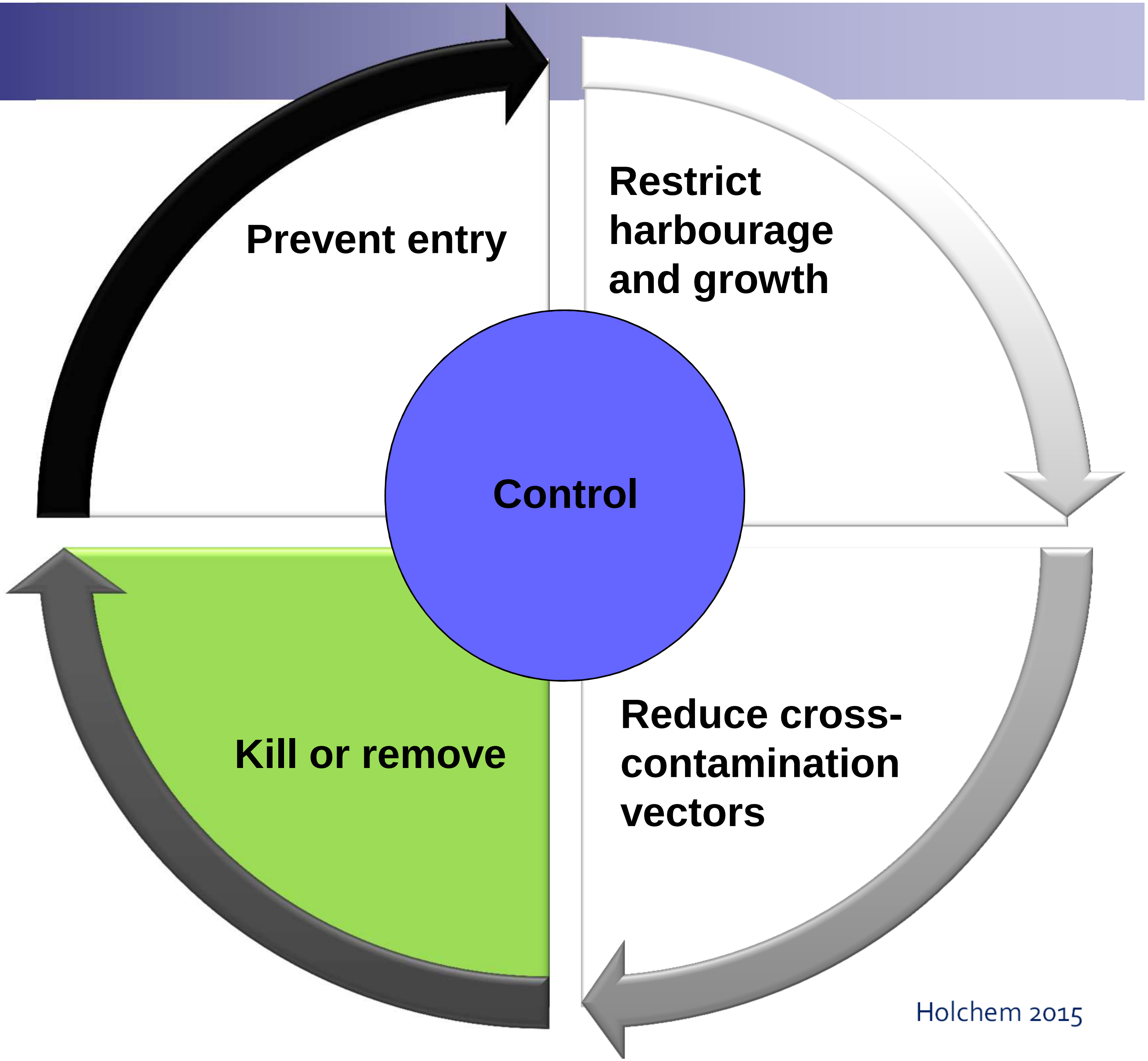
Scald and pluck

Air

- Site layout







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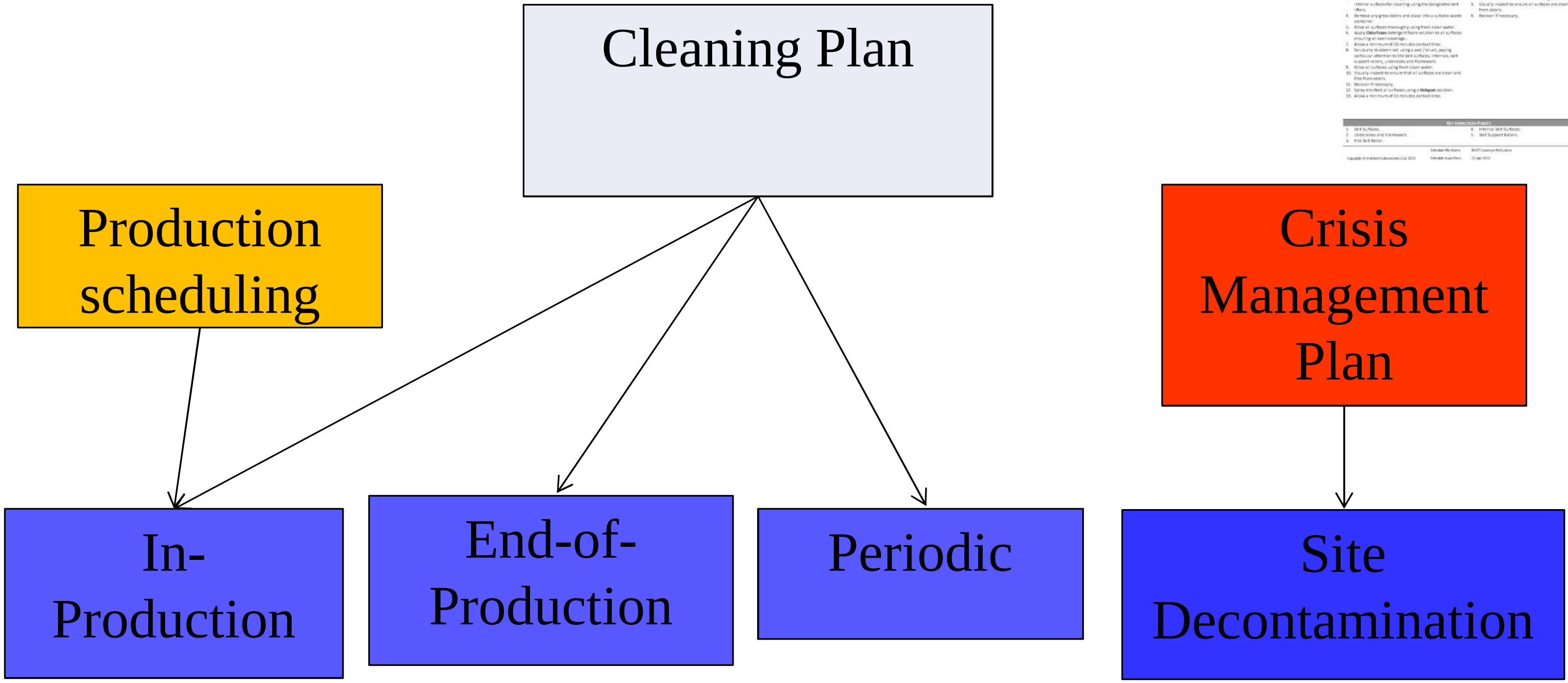
Cleaning schedule overview



General housekeeping SOP
Hazard/objective SOP CIC
Handover SOP

Strategy SOP CIC

Engineering support CIC

Decontamination SOP (Periodic) CIC
Wholeroom SOP

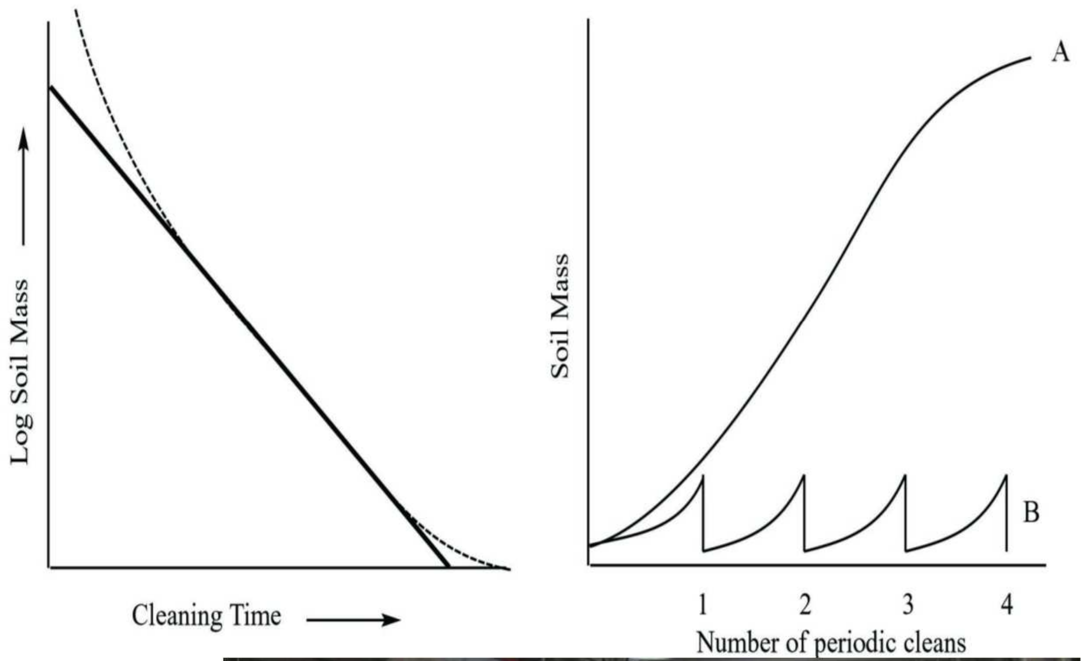
Strategy

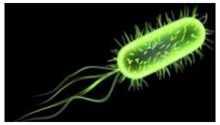
A sequence of events designed to maximise the removal of micro-organisms from the processing area and to leave the food contact surfaces as free of micro-organisms/allergens as possible for subsequent food production.

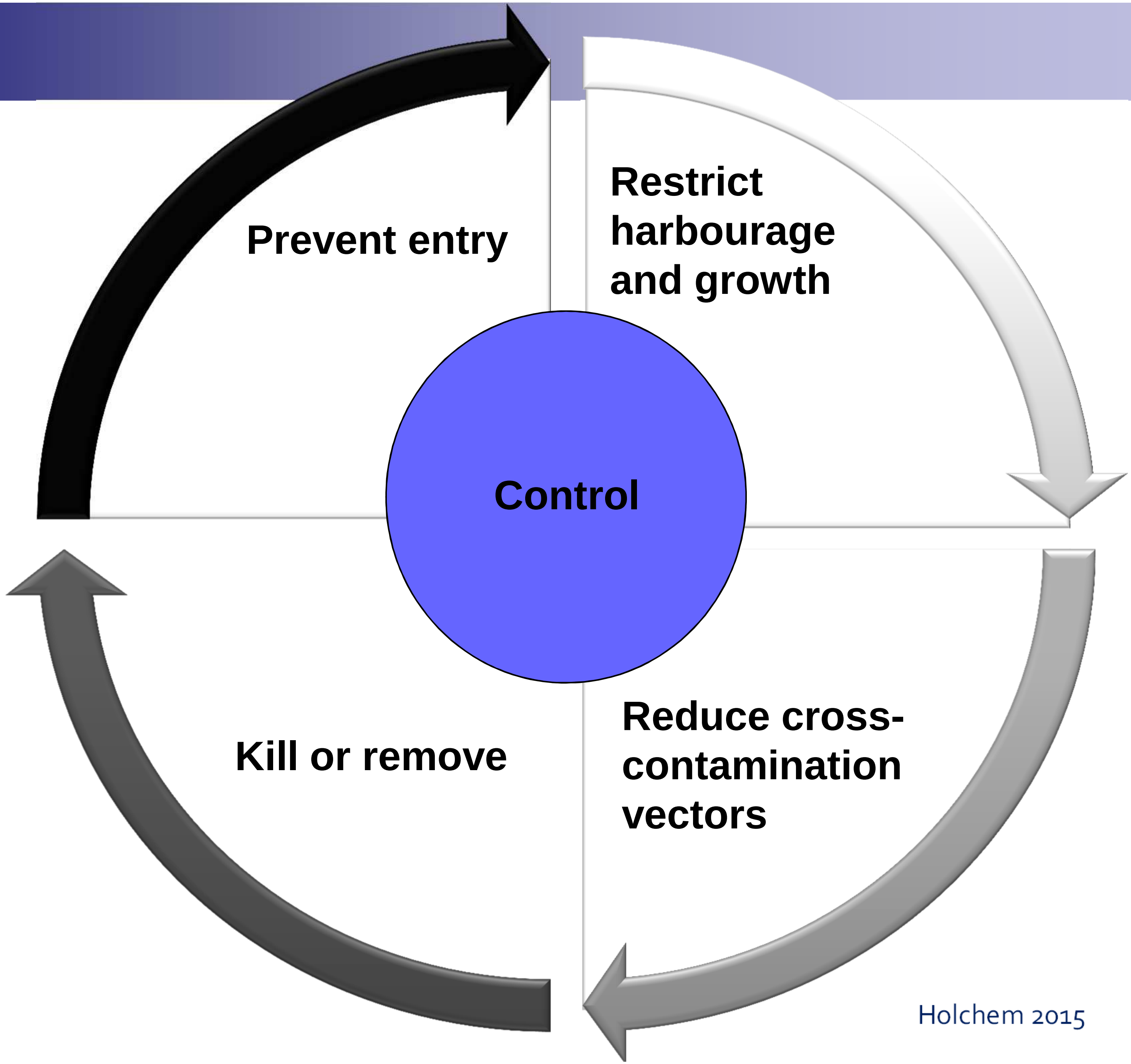
- Product/packaging removal
- Gross solids removal
- Rinse from top to bottom
- Clean drains, floors, walls
- Rinse
- Clean equipment (all together now)
- Rinse
- Disinfect equipment
- (Rinse)

Periodic cleaning

- Cleaning is not 100% efficient so soil will accumulate with time
- Periodic cleans are required
  - Additional energy
  - Additional strip down
  - Alternative chemicals e.g. scale removal (acid clean)
- Certain items cleaned on a weekly or monthly basis







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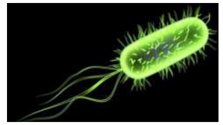
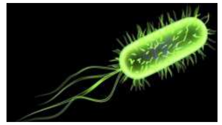
Sampling strategy



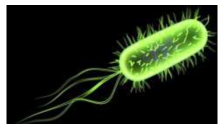
1 Provide barriers against entry

- Sample around barriers during the day e.g. personnel changing, product entry tunnels, air supply and verify performance

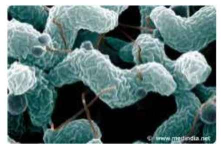


2 Stop spread/growth during production

- During production on source/transfer vectors – are they in control?
- During production at collector points e.g. footwear, tote wheels, cleaning equipment, drains – is there any evidence of the presence of a pathogen?
- Investigative studies if yes



3 Remove at end of production using cleaning and disinfection programmes



- Verify performance (freedom of pathogen)

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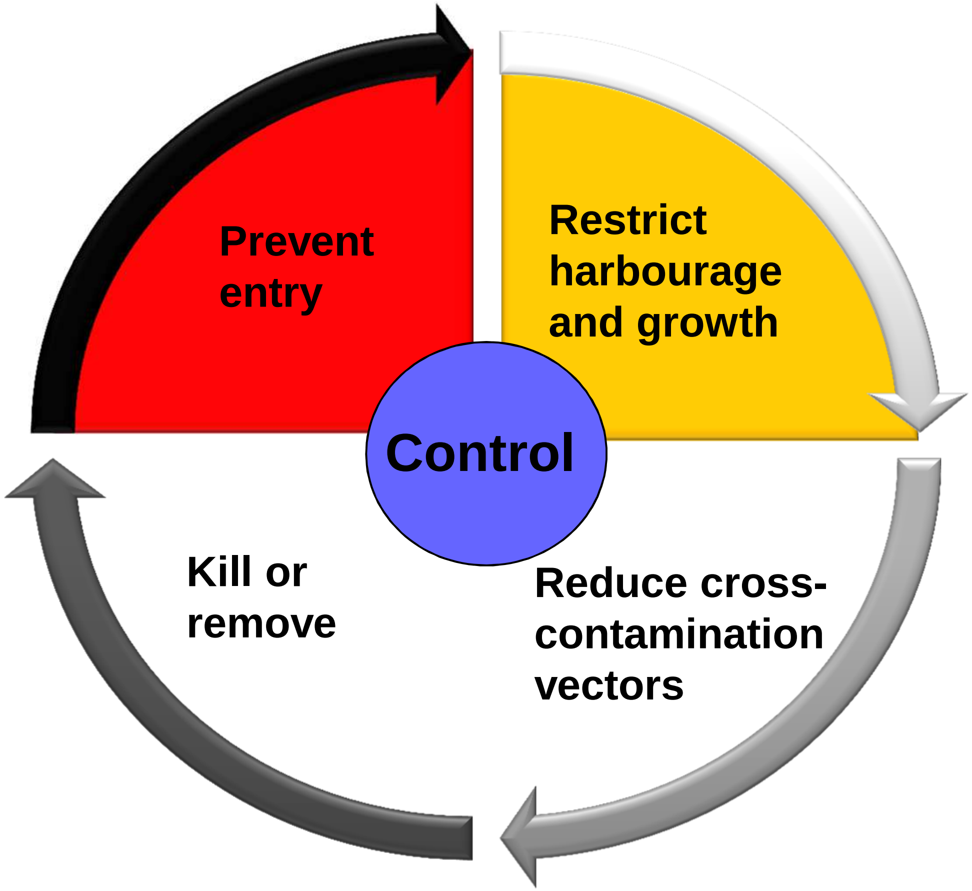
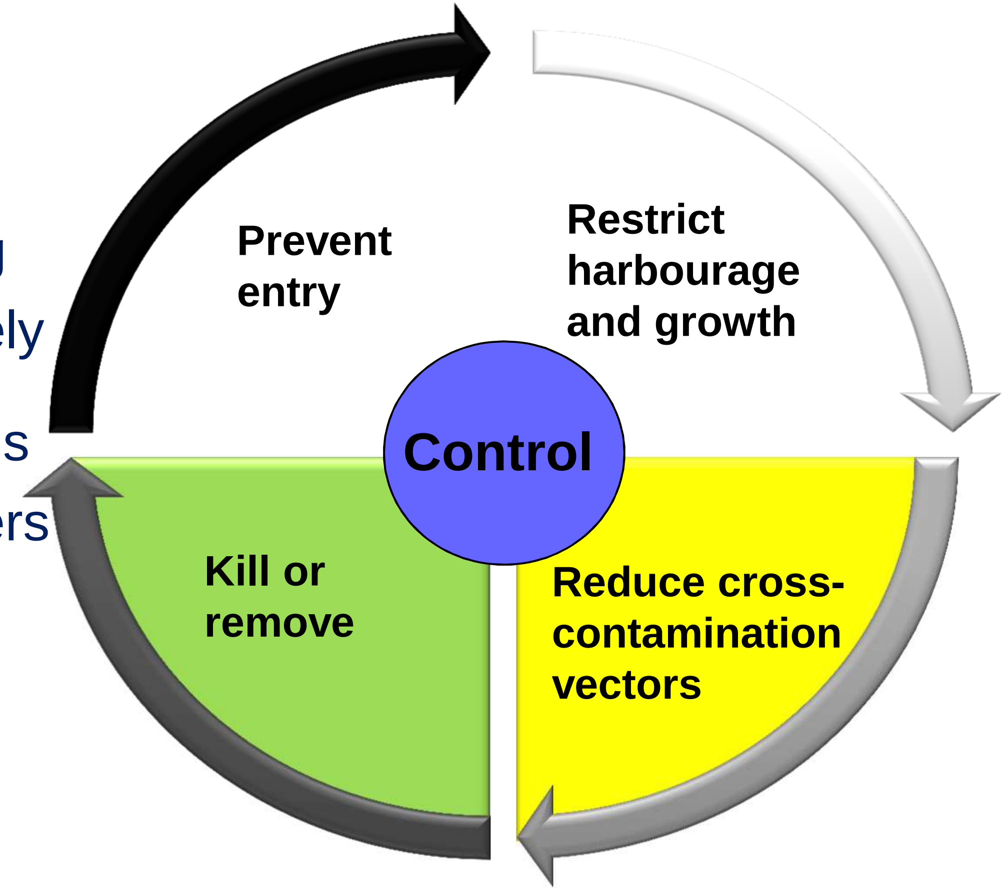
Listeria control

- Absence in food, manage single organisms
- Environmental tolerance and potential persitence
- Prevent entry
- Prevent harbourage and growth
- Vectors are minimised
- Kill or remove difficult on sources



Campylobacter control

- Relatively high infective dose
- Cannot prevent entry
- Growth and survival of Campylobacter in food processing environments unknown and unlikely
- Large quantities of microorganisms to cross-contaminate large numbers of birds during consistent cross-contamination events
- Schedule Campy +ve flocks
- Target frequent deep cleans



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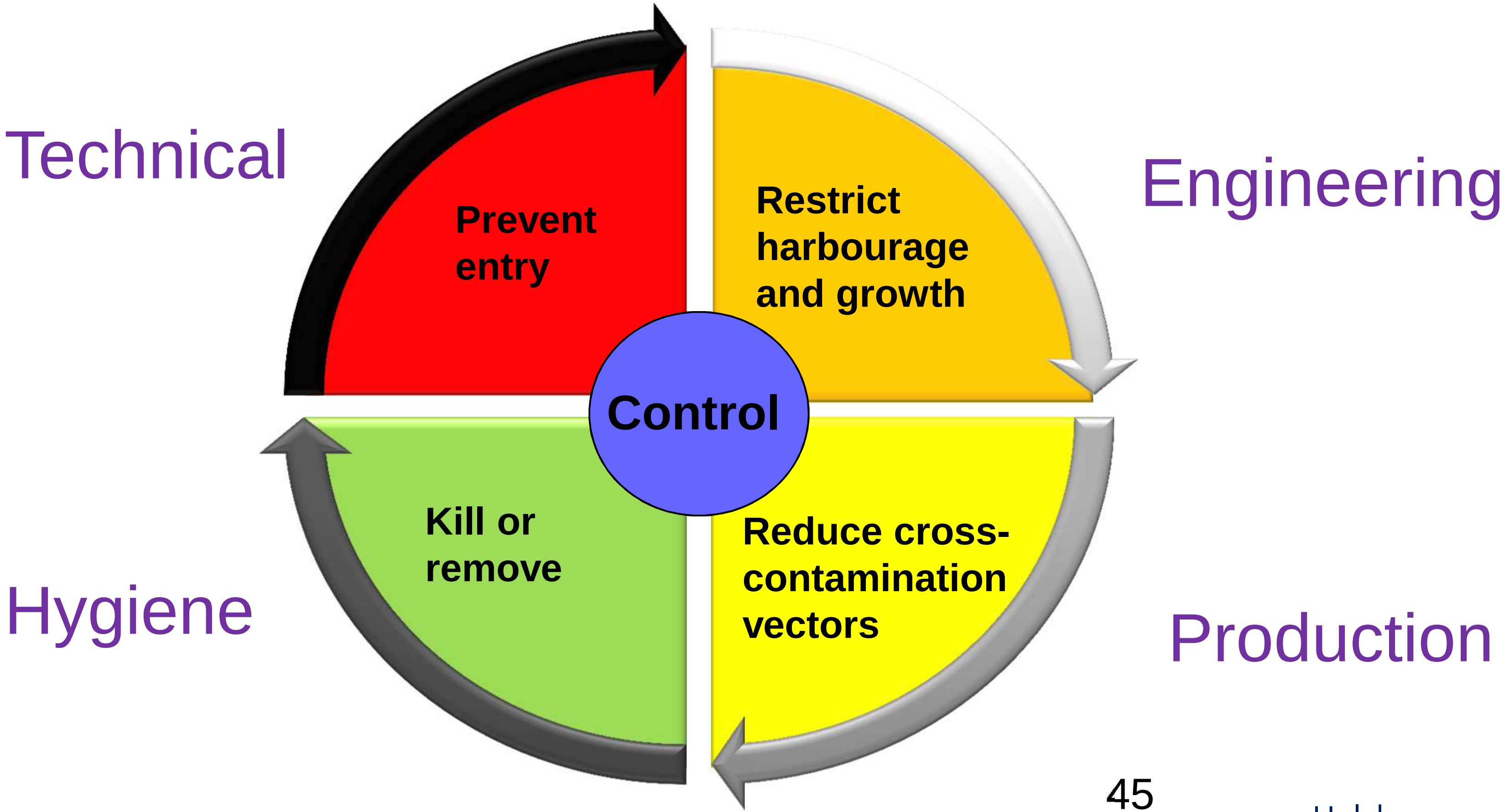
Pathogen control plan

Senior Management Support



Questions