

# **The hygiene hypothesis misnomer and inflammatory diseases – and its implications for hygiene**

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# Why should we be concerned?

- Hygiene hypothesis is a misleading misnomer for a concept which is essentially correct
  - “hygiene” not the root cause
- hindering efforts to develop public understanding of hygiene - at a time when hygiene is becoming more important

# The original hygiene hypothesis

- 1989 Strachan proposed - a cause of rising allergic diseases was lower incidence of infection in early childhood
- Suggested smaller families provided insufficient “infection” exposure through person-to-person spread
- but also because of “*improved household amenities and higher standards of personal cleanliness*”
- Named “Hygiene hypothesis”
- From this - notion “we have become too clean for our own good” has arisen.

Are we too clean for our own good ?

Clean home  
could give a  
tot asthma

Too clean for our own good?

Hygiene  
is killing  
us, says  
Conran

Is our cleanliness  
zeal making us ill?

Childhood  
is poisoned  
by the  
germ of fear

Clean children  
run a higher  
risk of asthma

SOME DIRT EVERY DAY  
KEEPS DOCTOR AWAY

Dirt could be good for you

**How dirt can protect  
you against cancer**

# Revised hypothesis

- Most experts now agree that the hygiene hypothesis is a misnomer
- Epidemiological studies confirm that childhood infections do not protect against allergy.
- But the media have not noticed!

# The Old Friends Mechanism 2003

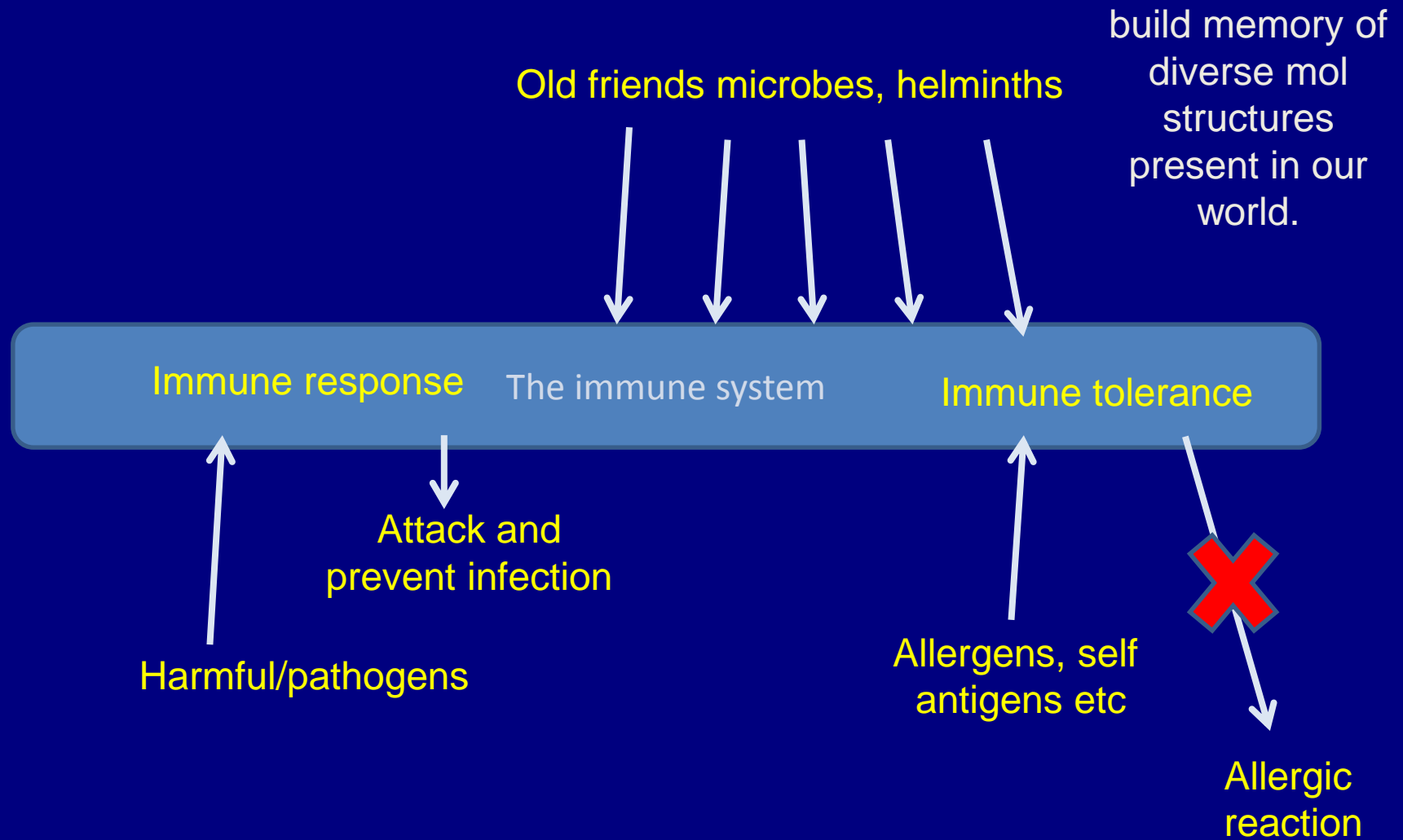
## Old Friends Mechanism (Rook in 2003)

- microbial exposures not infectious diseases – which evolved only “recently” in human evolution
- But the largely non harmful species, spp need to be tolerated
- Co-evolved role in devt and regulation of immune system

## Concept extends to other immune disorders

- Allergies, autoimmune disease (MS, Rheumatoid arthritis), type 1 diabetes, IBD.
- May also contribute to e.g depression/reduced stress resilience.

# Rook likens immune system to a computer programme



**What are the likely causes of our loss  
of exposure to OF microbes?**



# What has changed in past 2 centuries to deprive us of requisite microbial exposures?

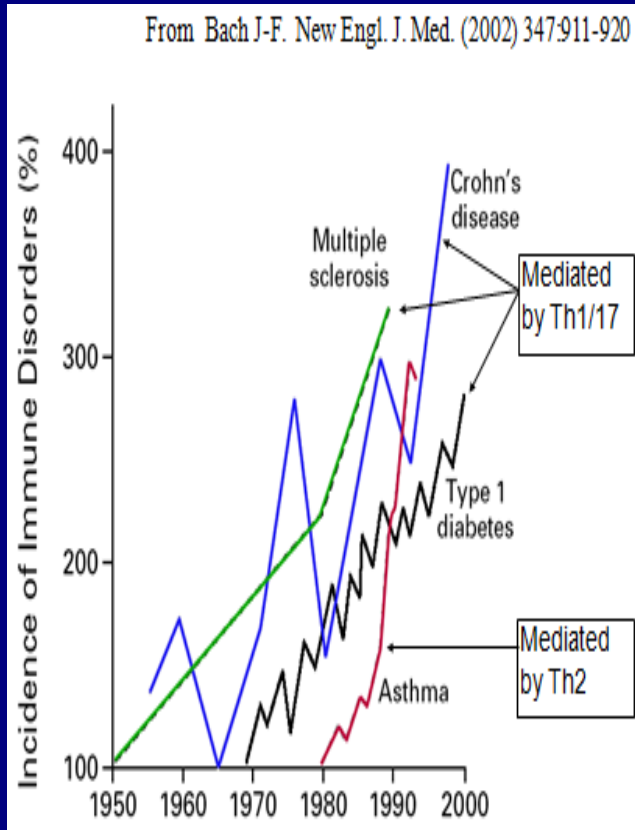
Allergies etc - largely diseases of last 200y - obvious answer is  
sanitary revolution

- improved water quality, sanitation, environment
- reduced human/animal waste in city streets.

altered diet/foods

- Microbial quality assurance
- Vital protection from ID, but inadvertently reduced exposure to “OFs”

# Most rapid rise in allergies etc has occurred in last 50 years



Unclear which might be the most important

• Most likely cause/s are lifestyle changes which have occurred during last 50 yrs which have been linked to rises in inflam/y diseases through epidem studies:

- C-section – reduced exposure during delivery (25% C-S in UK)
- fewer siblings - reduced microbiota sharing,
- Less exposure to natural environment/outdoor activity
  - farm living protects against asthma
- Urbanisation – homes less exposed to the natural environment.
  - Spend up to 80% of our time indoors

# The human microbiome and health

We also need to understand the role of the human microbiome (microbes in our intestines, skin, respiratory tract etc)

- Diversity of microbiome is key
- mediates interaction between OFs and immune system
- **antibiotic use** and **altered diet** affect the microbes in our body in a way that can increase inflammatory disease risks
- **Antibiotics – studies show**
  - antibiotics alter and reduce diversity of gut microbiota
  - excessive AB during pregnancy/neonatal – associated w. Increase in inflammatory disease risk
- **Diet – studies show**
  - Breast feeding, dietary fibre help build/maintain “healthy” gut microbiome

# Are we too clean for our own good?

- Role of home and personal hygiene small relative to other factors.
  - Clean-looking homes full of bacteria, viruses, fungi, etc.
  - Routine weekly cleaning - no sustained effect on microbe levels
- Microbes constantly replaced via dust, air, body flora, pets, contaminated foods – all impact on domestic microbiome

Key point may be:

- Microbial content of homes now DIFFERENT - but not because of “increased” cleanliness
  - e.g modern urban homes – interact c different environment cf rural homes prior 1800s
  - Homes inhabited by fewer people – who may have altered microbiome
  - Presence of pets increases microbial diversity

# What about personal hygiene?

- Strachan suggested “*higher standards of personal cleanliness*” could be an underlying cause
- Temporal correlation - increased bathing/showering, shampooing/bathing baby since 1950s
- Bathing and showering remove microbes from skin but rapidly replaced
- Evidence that skin microbiota are OF microbes – studies with mice
- Lack of data:
  - Does “obsessive” personal hygiene affect skin microbiome?
  - If so – is this linked to immune dysregulation/allergies?

# Does cleanliness matter?

- From a 2015 study 399 German families, Von Mutius et al concluded
- Development of allergies and asthma not related to increased cleaning activities (personal cleanliness (e.g. HWWS) and home cleanliness)

# Microbial exposure is not the only factor ?

- Lifestyle changes apply to all of us – why do we not all suffer from immune diseases?
- Increased risk of allergies/CIDs also depends on other factors :
  - diet (vitamin D deficiency), pollution, less physical activity, obesity,
  - socio-economic factors and stress,
- Genetic predisposition - key risk factor.

# Where have we got to?

- **Can we reverse trends in allergies and other CIDs through restoring microbial exposure and immune tolerance?**
  - Lifestyle changes, probiotics, therapeutic interventions
  - Rook: “The work is progressing very fast, but it has a long way to go”
- **Controlling infectious diseases through hygiene**
  - Good news! - allergies/CIDs not the price we have to pay for protection against infectious diseases



# Addressing the issues

- Fundamental question is “How can we reintroduce beneficial microbes whilst at the same time promoting good hygiene practice to protect from infectious disease”
- Answer lies in targeted hygiene

**The urgent need to change  
perceptions about the so-called  
hygiene hypothesis -  
and restore public confidence in  
hygiene**



# Current situation

- Researchers generally agree re “OF mechanism” and underlying “lifestyle” changes as a fundamental cause

Problem is:

- “too clean/hygienic” idea still rooted public mind
- (and media, health professionals, opinion formers, policy makers etc.)

Why?

Number of factors contribute:

- Researchers – scientific and clinical – don’t care
- Consumer media – won’t let go of a good story
- Microbiomists and nutritionists – new kids on the block!

# Clinical and scientific researchers view

Agree:

Reduced exposure to OfS  
and reduced diversity of  
human microbiome

Linked to:  
Allergic, autoimmune etc  
diseases

-Likely causes are

- Clean Water,
- Sanitation,
- food quality,
- C-section,
- breastfeeding,
- social contact,
- urban living ,
- antibiotic use
- Diet

They cannot decide  
on a new name so  
still call it the  
Hygiene  
Hypothesis

# What do experts tell us via the media?

Extract from PNAS article by Scudellari:

- “The call to experts to abandon the original “hygiene” hypothesis term has fallen on deaf ears. Several researchers interviewed for this article said the issue was semantics - they didn’t care what name is used”
- i.e. their impact on public - who see “hygiene” as personal and home cleanliness is not their concern



<http://www.pnas.org/content/114/7/1433.full.pdf>

# What do the Consumer media tell us?

<b>Report new studies showing likely causes of allergies etc as:</b>	c-section, antibiotics, diet, less outdoor activity etc
<b>But still report solution as:</b>	Being less clean! Why?
feel bound to explain the HH - “less infections – due to too much hygiene - increased risk of allergies”	

Example of misleading messages - Daily Telegraph, 2016

**Don't wash your hands! A bit of dirt is good for you: Experts say cleaning less often would protect against allergies by allowing helpful bacteria into the body**

# What do microbiome experts now tell us (via the media?)

- The Times: health supplement Nov 3<sup>rd</sup> 2015
- Microbiome vital for health
- Why is the human gut microbiome depleted? – 3 main culprits
  - Antibiotics
  - Sterility of modern life and diet
  - C-sections

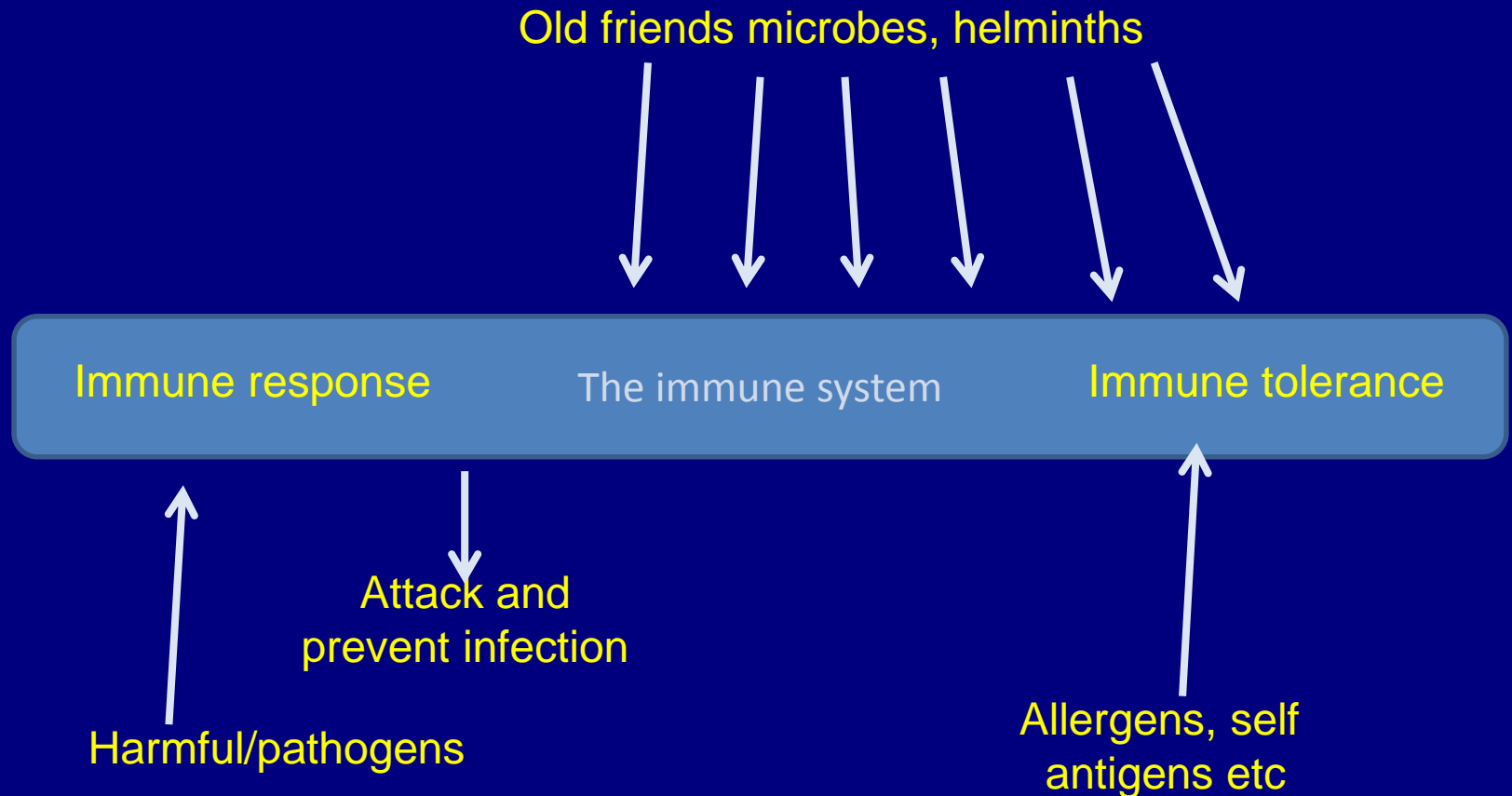


Nutrition Expert: "The idea that children should wash their hands before eating. I don't think we should be washing our hands before a meal now.

If you think about the number of food poisoning infections in the home- they are incredibly rare

we are over-cleaning enough, our sterility is causing us problems"

# What does the public think - what do they say?



- I encourage my children not to worry about **being dirty**, e.g If we are on a picnic I don't bother to get them to wash their hands because they need **plenty of exposure to germs to keep their immune system strong**

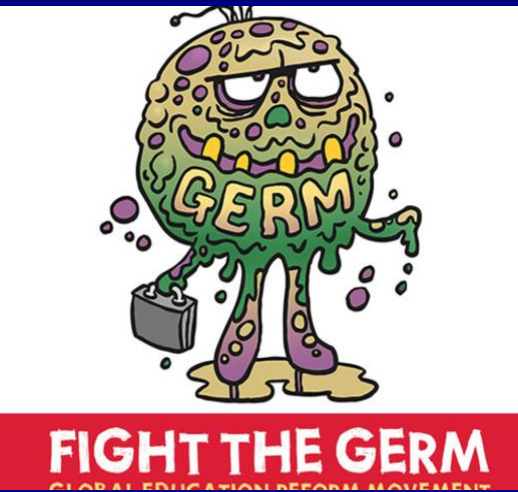


# What does the public think - what do they say?

- My daughter is the only one in her class who washes her hands before school lunch - and often the only one not to catch stomach bugs and colds. But many in her class have allergies - so poor hygiene evidently doesn't guard against allergies.

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**What do we actually understand about  
“hygiene”?**

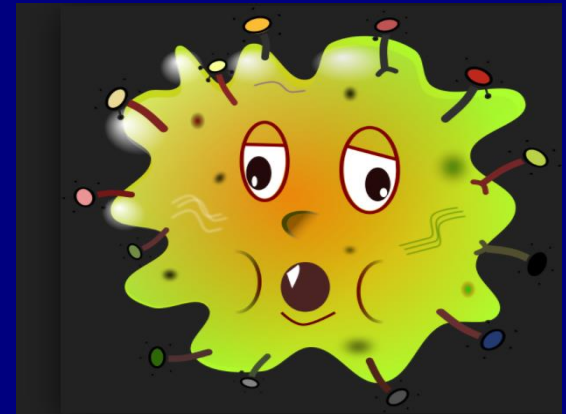


# What are germs?

- Yuck!, Uurgh!
- Nasty dirty germs
- Poo – smelly!
- Don't touch!
- Make you sick
- disgusting



- We are brainwashed as children with Germophobia



# So “Tell me where are the germiest places in my home ?”

- Where do germs lurk?
- Where are the dirtiest places in my home?
- The 5 second rule – is food dropped on the floor (perceived as the dirtiest place in the home) still safe to eat
- Hmn – actually it’s the people, animals and food in your home which are the germiest places!

# But now they have a paradox

Bad  
Germs



Good  
germs



Now we are all totally confused!

OED – germs = microbes, particularly those  
that cause disease, ----

# So you think your bathroom is clean?

## Daily Mail – 10<sup>th</sup> April 2017

“Bathroom is a haven for bacteria, breeding in places you believe are sparkling clean”



“Here’s a map to help identify where germs love to lurk and help you to banish the bugs”



# **“How do I get rid of germs from these dirty places so that my family is safe?”**

- By getting rid of dirt?

Assuming:

- If a surface is dirt free it is also germ free
- If surfaces / my hands look clean they are free of germs
- If my home is clean – its hygienic – germ safe

# Pilot study

- 117 people were asked - What do YOU understand by terms clean & hygienic – and what's the difference?

**Clean**

**Hygienic**

**In this group,  
41% saw a discriminator: hygiene is more rigorous  
cleaning - “more clean, clean enough, safe for  
purpose”,  
BUT  
that left 59% who did not make this distinction – “if  
it's clean – it's also hygienic”,**

**water**

**disinfectant**



# IFH online elearning resource

## [www.ifh-homehygiene.org](http://www.ifh-homehygiene.org)

### A simple guide to healthy living in a germy world



An 'Interactive Guide' that explains our current understanding of the so-called hygiene hypothesis, how and why reduced interaction with our microbial world is linked to rising levels of allergies and other chronic inflammatory diseases.

The guide also looks at how we can develop hygiene habits which will protect us against infectious diseases whilst at the same time maintaining exposure to the microbes which are important for our health.



For more information or to view this document online visit [www.ifh-homehygiene.org](http://www.ifh-homehygiene.org)

Explains so called hygiene hypothesis and implications for hygiene in simple language

# Conclusions

- Hygiene hypothesis is dangerous misnomer - but is only the tip of iceberg
  - Microbe/good germ:bad germ misunderstanding is endemic
  - As is dirty/clean/hygienic
- Not just consumers! – endemic misunderstanding extends to health professionals, opinion formers, public health policy makers etc

# Conclusions

- In future we are going to have to view our microbial world very differently ?
- Restoring public confidence in hygiene/changing behaviour is vital
- We will have limited success in change hygiene behaviour through hygiene promotion
- **Unless and until** we resolve public misunderstandings about our microbial world and its relationship to health and disease