Ageing and the burden of diseases in the elderly

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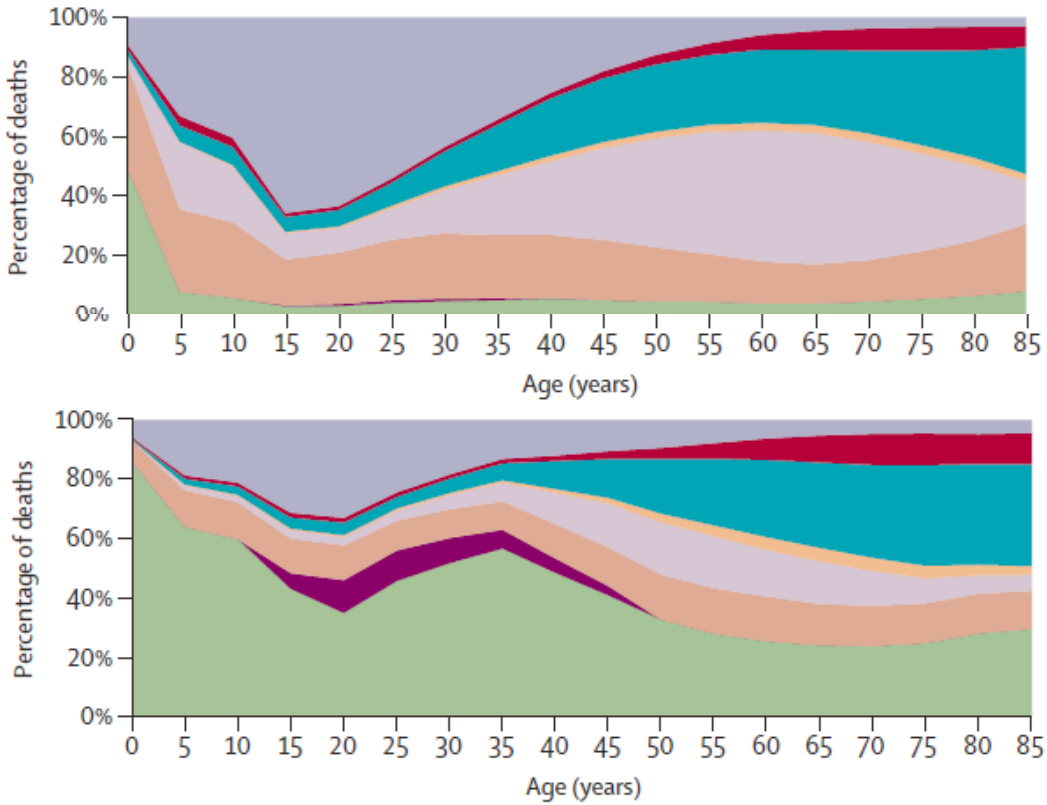
The World report on ageing and health: a policy framework for healthy ageing

John R Beard, Alana Officer, Islene Araujo de Carvalho, Ritu Sadana, Anne Margriet Pot, Jean-Pierre Michel, Peter Lloyd-Sherlock, JoAnne E Epping-Jordan, G M E E (Geeske) Peeters, Wahyu Retno Mahanani, Jotheeswaran Amuthavalli Thiyagarajan, Somnath Chatterji



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S U M M A R Y

In France, although there are 445,000 beds in nursing homes (NHs) for elderly people, no studies on the burden of infections in NHs have been published. We sought to estimate the prevalence of infection among the residents and to assess the extent to which infections were associated with the residents' risk factors. We performed a nationwide, multicentre, cross-sectional, clustered period prevalence survey over five one-month periods. Cases of infection were classified as definite or, in the absence of laboratory confirmation, as probable. A total of 44,869 residents in 578 volunteer facilities were enrolled in the survey. The overall prevalence rate of infections was 11.23% [95% confidence interval (CI): 10.50–11.97] and differed significantly ($P < 0.001$) across survey periods (the time of the year the survey was carried out). The rate of definite cases was 4.60% (95% CI: 4.04–5.54) and the rate of probable cases was 6.63% (95% CI: 5.77–7.98). Respiratory tract infections were the most frequent and accounted for 41% of all infections. Infections were significantly associated with age, length of stay, full disability, urinary device, bedsores and the survey period. Only prevention programmes may reduce the impact of infections on this frail population.

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Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Burden of infections among 44,869 elderly in nursing homes: a cross-sectional cluster nationwide survey

K. Chami [a,b,c,d,*], G. Gavazzi [a,e], F. Carrat [a,b,c,f], B. de Wazières [a,g], B. Lejeune [a,h,i,j], F. Piette [a,b,k], M. Rothan-Tondeur [a,b,c,d]

Symptomatic urinary tract infection	2.64 (2.29–3.00)
Pneumonia	1.28 (1.04–1.53)
Bronchitis or tracheobronchitis	2.49 (2.11–3.02)
Upper respiratory tract infections (sinusitis, rhinitis and pharyngitis)	0.81 (0.60–1.15)
Upper and lower respiratory tract infections combined	4.65 (4.07–5.37)
Gastroenteritis	0.76 (0.46–1.34)
Skin and soft tissue infection	1.05 (0.85–1.34)
Infected wounds and bedsores	0.48 (0.36–0.56)
Infectious conjunctivitis	0.62 (0.51–1.00)
Otitis externa	0.08 (0.06–0.12)
Other infections (herpes zoster, scabies, influenza-like illness, dental or fungal infections, bacteraemia or sepsis etc.)	1.01 (0.88–1.13)
Overall infections	11.23 (10.50–11.97)

Steens *et al. BMC Infectious Diseases* 2014, **14**:57
http://www.biomedcentral.com/1471-2334/14/57

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

What are the most important infectious diseases among those ≥65 years: a comprehensive analysis on notifiable diseases, Norway, 1993–2011

Anneke Steens[1,2*], Hanne-Merete Eriksen[1] and Hans Blystad[1]

- Norwegian Surveillance System for Communicable Diseases (MSIS)
- Clinicians and laboratories are obliged by law to report each case of the 58 notifiable IDs to MSIS.

Table 1 Age-specific average annual frequency and notification rates of IDs in Norway in 2007 to 2011

Notifiable infectious disease*	Average annual frequency		Average annual notification rate (range)/100,000 inhabitants					NRR [7] (range)
	Total	≥65 years	Total	<5 years	5-19 years	20-64 years	≥65 years	65+/20-64
Overall	15870	1792	332 (307–362)	330 (285–407)	330 (276–399)	351 (312–411)	253 (236–280)	0.7 (0.6-0.9)

Steens et al. BMC Infect Dis. 2014 Feb 4;14:57.

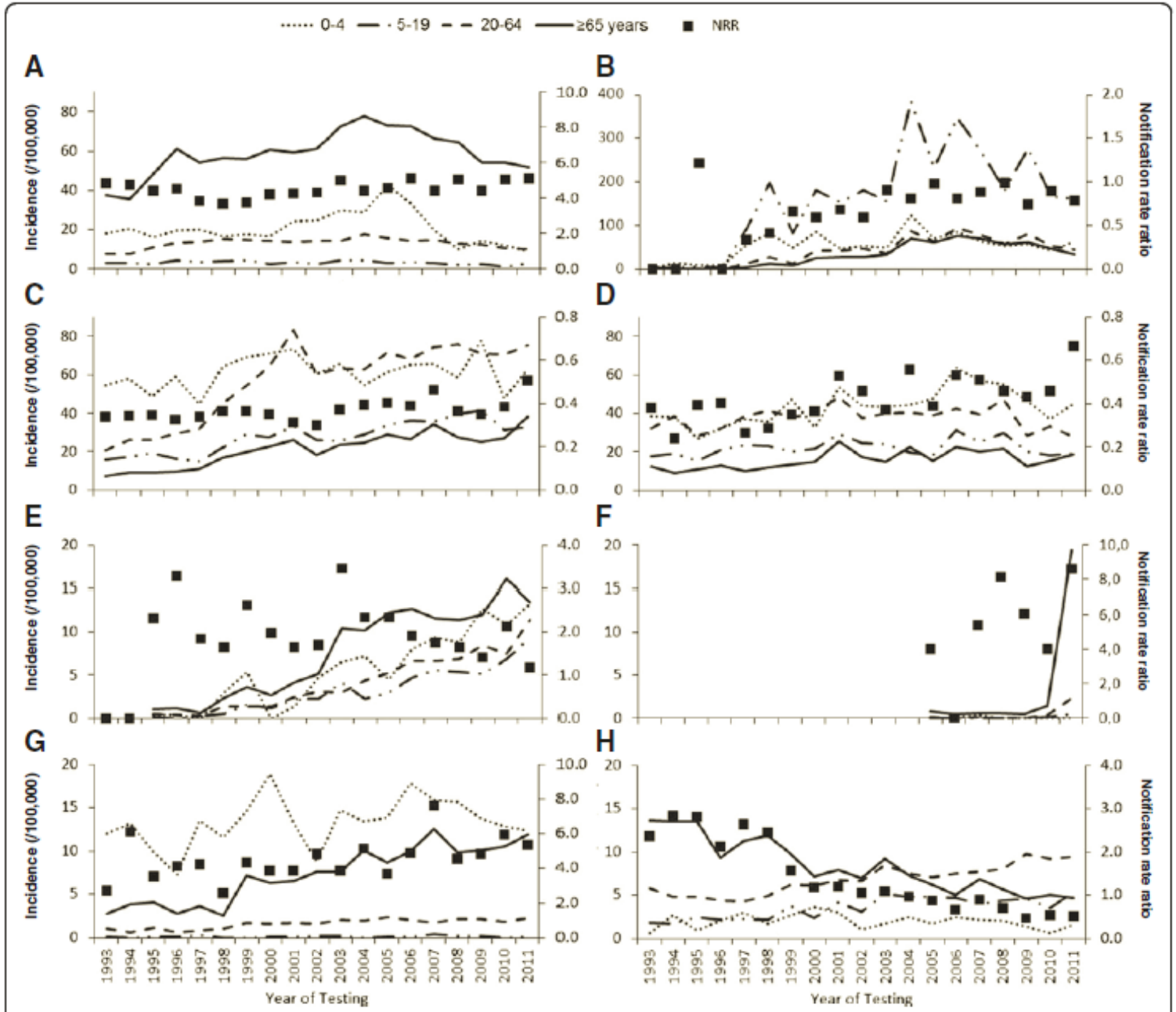


Figure 1 Trends in age-specific annual notification rates (lines) and notification rate ratios (dots) of notified infectious diseases. **A**: invasive pneumococcal disease, **B**: pertussis, **C**: campylobacteriosis, **D**: salmonellosis, **E**: MRSA infections, **F**: VRE*, **G**: invasive group B streptococcal disease (*Streptococcus agalactiae*), **H**: tuberculosis. Note the different Y-scales; both for the notification rates and for the notification rate ratios. *Note that VRE infections and carriage are only notifiable since 2005.

what about Clostridium difficile?

The Epidemiology of Community-Acquired *Clostridium difficile* Infection: A Population-Based Study

Sahil Khanna, MBBS[1], Darrell S. Pardi, MD, MS, FACG[1], Scott L. Aronson, MD[1,2], Patricia P. Kammer, CCRP[1], Robert Orenstein, DO[3], Jennifer L. St Sauver, PhD[4], W. Scott Harmsen, MS[5] and Alan R. Zinsmeister, PhD[5]

Table 1. Comparison of community-acquired and hospital-acquired CDI

Characteristic	Community-acquired (*n*=157)	Hospital-acquired (*n*=192)	*P* value
Age, median (range)	50 (0.1–102)	72 (0.1–99)	<0.001
<18, *n* (%)	21 (13)	8 (4)	
18–65, *n* (%)	87 (55)	63 (33)	
>65, *n* (%)	49 (31)	121 (63)	

***Am J Gastroenterol* 2012; 107:89–95**

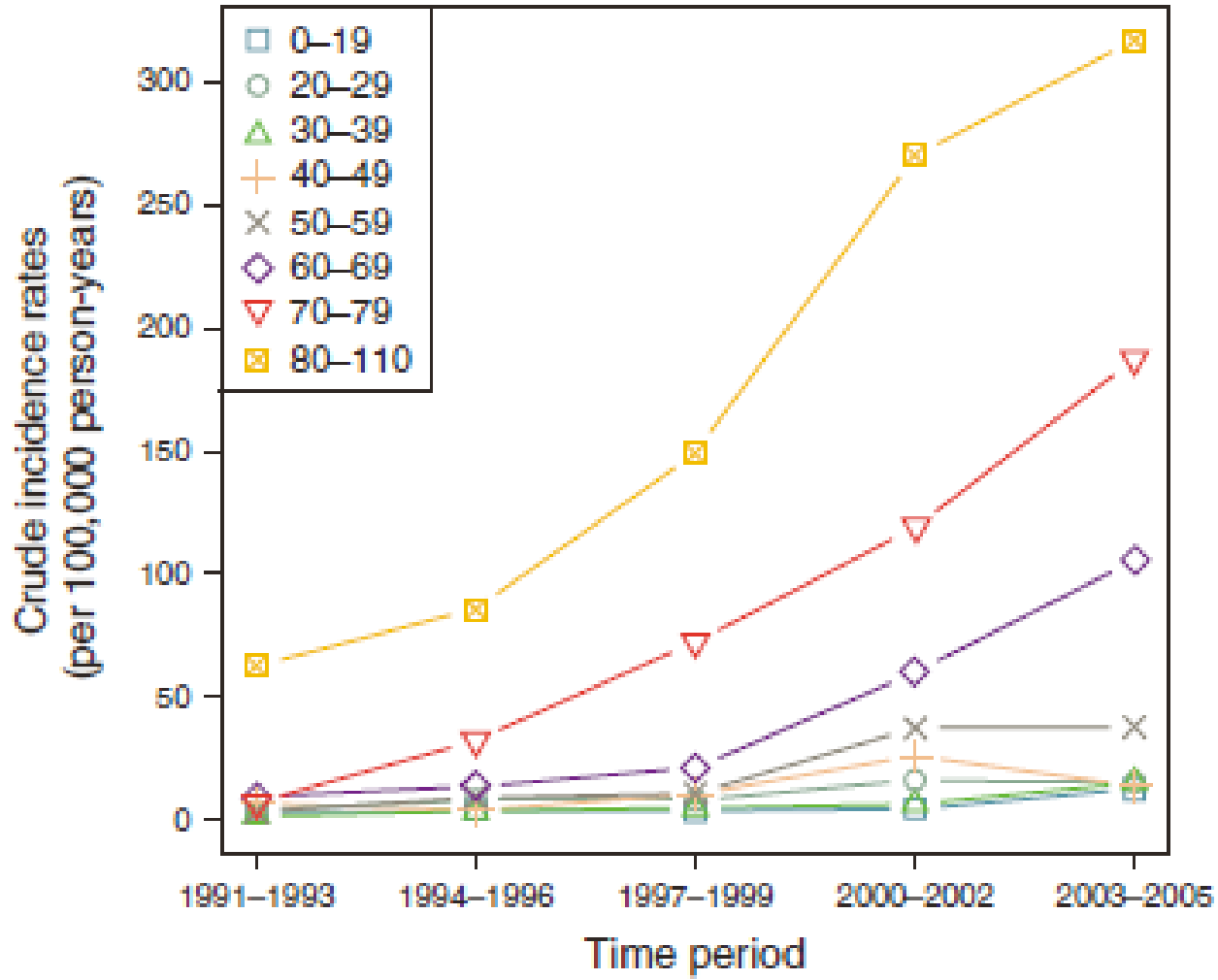


Figure 3. Age-specific incidence rates of *Clostridium difficile* infection (CDI) over time in Olmsted County, Minnesota. The curves depict changes in the incidence of CDI in specific age groups over the duration of the study.

Specific aspects of infections in the elderly?

- increased microbial colonization
- increased frequency of certain infections
- increased severity of certain infections
- altered microbial spectrum for a given infection
- difficulties with the diagnosis
- specific considerations concerning antibiotic treatment
- decreased response to vaccination

Bacterial infections with an increased frequency in the elderly population

- respiratory infections
  - bronchitis
  - pneumonia
- urinary tract infections
  - cystitis
  - pyelonephritis
- skin and soft tissue infections
  - cellulitis
  - diabetic foot infection
- infective endocarditis
- tuberculosis

- digestive tract infections
  - post-antibiotic diarrhea
  - diverticulitis
  - cholecystitis
  - abscesses
- central nervous system
  - listeria meningitis (+pneumococci?)
- foreign body infection
  - endoprothesis
  - indwelling catheters
- influenza

Bacterial infections with an increased severity in the elderly population

Infections	relative mortality rate (as compared to young adults)
pneumonia	3
pyelonephritis	5-10
infective endocarditis	2-3
bacterial meningitis	3
tuberculosis	10
sepsis	3
cholecystitis	2-8
appendicities	15-20

Yoshikawa TT. Perspective: aging and infectious diseases: past, present, and future. J Infect Dis. 1997;176:1053-7.

bacterial meningitis

Dengue fever

Domingo *et al. BMC Infectious Diseases* 2013, **13**:108
http://www.biomedcentral.com/1471-2334/13/108

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

The spectrum of acute bacterial meningitis in elderly patients

Pere Domingo[1*†], Virginia Pomar[1†], Natividad de Benito[1] and Pere Coll[2]

Table 2 Clinical features of patients with acute bacterial meningitis according to age group*

	Group I (non-elderly) N = 427	Group II (elderly) N = 208	RR (95% CI)	P value
Interval symptoms-admission (hrs)	24.0 (24.0–37.0)	27.5 (24.0–37.0)	——	0.3822
Prior antimicrobial therapy (%)	126 (29.5)	77 (37.0)	1.25 (1.00–1.57)	0.0696

Table 3 CSF findings, microbiologic features and etiology of acute bacterial meningitis according to age group

	Group I (non-elderly) N = 427	Group II (elderly) N = 208	RR (95% CI)	P value
Etiology [9]				
Meningococcal (%)	179 (41.9)	24 (11.5)	0.28 (0.19–0.41)	< 0.0001
Pneumococcal (%)	91 (21.3)	59 (28.4)	1.28 (1.01–1.63)	0.0622
Listerial & grampositive bacilli (%)	33 (7.7)	29 (13.9)	1.93 (1.12–2.01)	0.0196
Other Gram-positive cocci (%)	22 (5.1)	13 (6.2)	1.14 (0.73–1.79)	0.7012
Gram-negative bacilli (%)	18 (4.2)	21 (10.1)	1.72 (1.25–2.35)	0.0065
Haemophilus influenzae (%)	9 (2.1)	5 (2.4)	1.09 (0.54–2.23)	0.9685
Mixed (%)	2 (0.5)	2 (1)	1.53 (0.57–4.11)	0.8393
Other	2 (0.5)	1 (0.5)	1.02 (0.20–5.06)	0.5517
Unknown origin (%)	71 (16.5)	54 (25.9)	1.43 (1.12–1.82)	0.0076

Table 4 Evolving features and outcome of acute bacterial meningitis according to age group*

	Group I (non-elderly) N = 427	Group II (elderly) N = 208	RR (95% CI)	P value
Outcome				
Overall mortality rate (%)	50 (11.7)	62 (29.8)	1.98 (1.60–2.46)	< 0.0001
Meningococcal (%)	8 (4.5)	3 (12.5)	2.49 (0.88–7.10)	0.2494
Pneumococcal (%)	14 (15.0)	19 (31.7)	1.68 (1.14–2.48)	0.0259
Listerial & grampositive bacilli (%)	7 (21.2)	9 (31.0)	1.29 (0.75–2.23)	0.5544
Other grampositive cocci (%)	9 (40.9)	6 (46.1)	1.14 (0.48–2.70)	0.9597
Gramnegative bacilli (%)	10 (55.5)	12 (57.1)	1.03 (0.57–1.86)	0.8225
Haemophilus influenzae (%)	1 (11.1)	0 (0.0)	1.50 (0.30–7.43)	0.7320
Mixed (%)	0 (0.0)	0 (0.0)	——	——
Other	0 (0)	0 (0.0)	——	——
Unknown etiology (%)	1 (1.4)	13 (24.1)	2.51 (1.89–3.34)	0.0002
Death attributable to meningitis (%)	42 (9.8)	43 (20.7)	1.67 (1.30–2.13)	0.0004
Post-meningitic sequelae† (%)	42 (11.1)	21 (14.4)	1.22 (0.83–1.78)	0.3945

Challenges in Dengue Fever in the Elderly: Atypical Presentation and Risk of Severe Dengue and Hospita-Acquired Infection

Emily K. Rowe[1,2*], Yee-Sin Leo[1,2], Joshua G. X. Wong[2], Tun-Linn Thein[2], Victor C. Gan[2], Linda K. Lee[2], David C. Lye[1,2,3]

Variable	Patient number (%)		P values
	Adults n = 6694	Elderly n = 295	
Outcome			
ICU	13 (0.2)	2 (0.7)	0.130
Death	3 (0.1)	0 (0)	1

PLoS Negl Trop Dis 8(4): e2777. doi:10.1371/journal.pntd.0002777

Dengue Fever in the Elderly

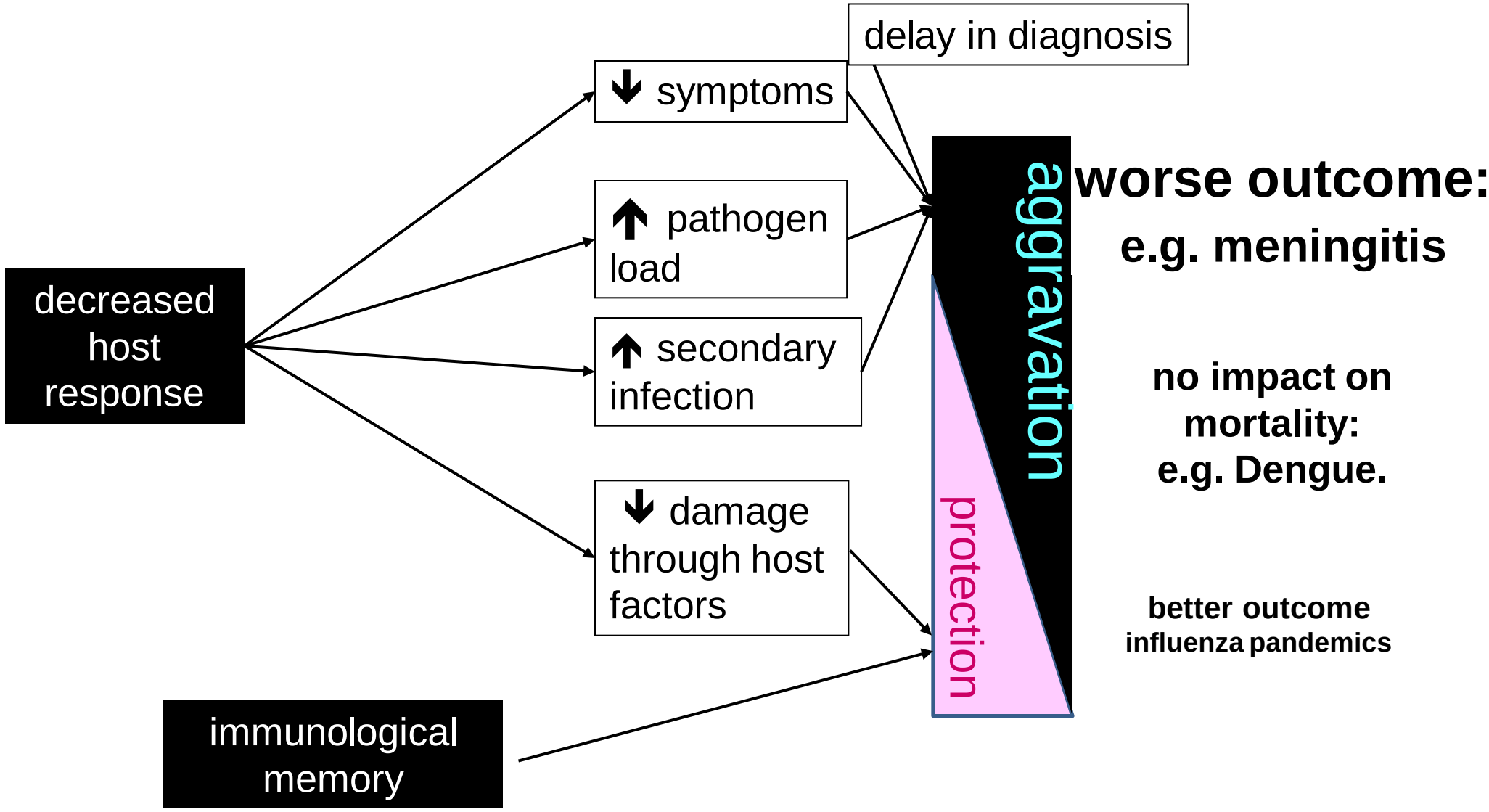
Variable	Patient number (%)		P values
	Adults n = 6694	Elderly n = 295	
Parameters at presentation			
Fever	6287 (93.9)	273 (92.5)	0.335
Malaise, lethargy	1886 (28.2)	100(33.9)	0.033
Rash	3186 (47.6)	108 (36.6)	<0.001
Headache	3287 (49.1)	104 (35.3)	<0.001
Any aches and pains	5495 (82.1)	234 (79.3)	0.226
Nausea	3753 (56.1)	144 (48.8)	0.014
Vomiting	2856 (42.7)	113 (38.3)	0.138
Mucosal bleeding	1620 (24.2)	37 (12.5)	<0.001
Hematuria	44 (0.7)	5 (1.7)	0.054
Melena	4 (1.2)	40 (0.6)	0.128
Leukopenia	5105 (76.3)	188 (63.7)	<0.001

Dengue Fever in the Elderly

Variable	Patient number (%)		P values
	Adults n = 6694	Elderly n = 295	
HAI			
Any HAI	66 (1.2)	13 (4.9)	<0.001
Pneumonia	36 (0.7)	10 (3.8)	<0.001
UTI	17 (0.3)	5 (1.9)	0.003

HAI = hospital acquired infection

Infections in the elderly: a complex story



Infection and ageing: possible strategies to protect the elderly

- improve medical training in the field of geriatric infectious diseases
- vaccination
  - but: those who need vaccines most, do not respond well
- reduce pathogen exposure
  - difficult, but flue vaccination of caretakers is a good example
- reduce immune deficiency of the elderly
  - hitherto no treatments for immunosenescence
  - what about improved nutrition?

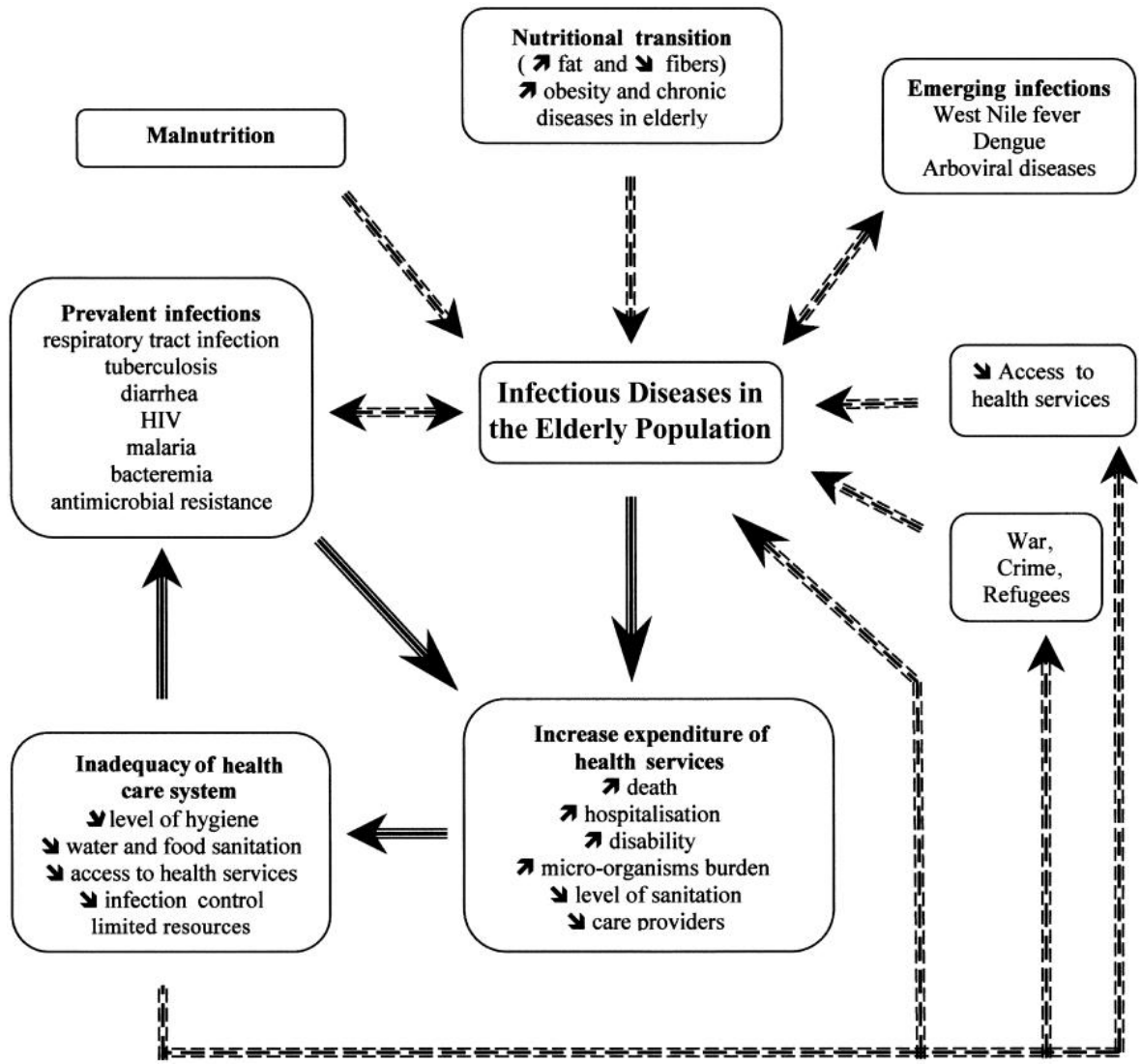


Figure 2. Impact of infectious disease in the elderly population on health care services *(solid arrows)* and factors contributing to an increase in the burden of infectious disease in elderly individuals *(patterned arrows)*. These circumstances create a vicious circle, limiting resources.

Gavazzi G, Herrmann F, Krause KH. Aging and infectious diseases in the developing world. Clin Infect Dis. 2004;39(1):83-91.

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Aging and risk factors

Do risk factors of the younger and middle-aged become protective factors in the elderly?

ELSEVIER
MASSON

Diabetes & Metabolism 35 (2009) 108–114

Original article

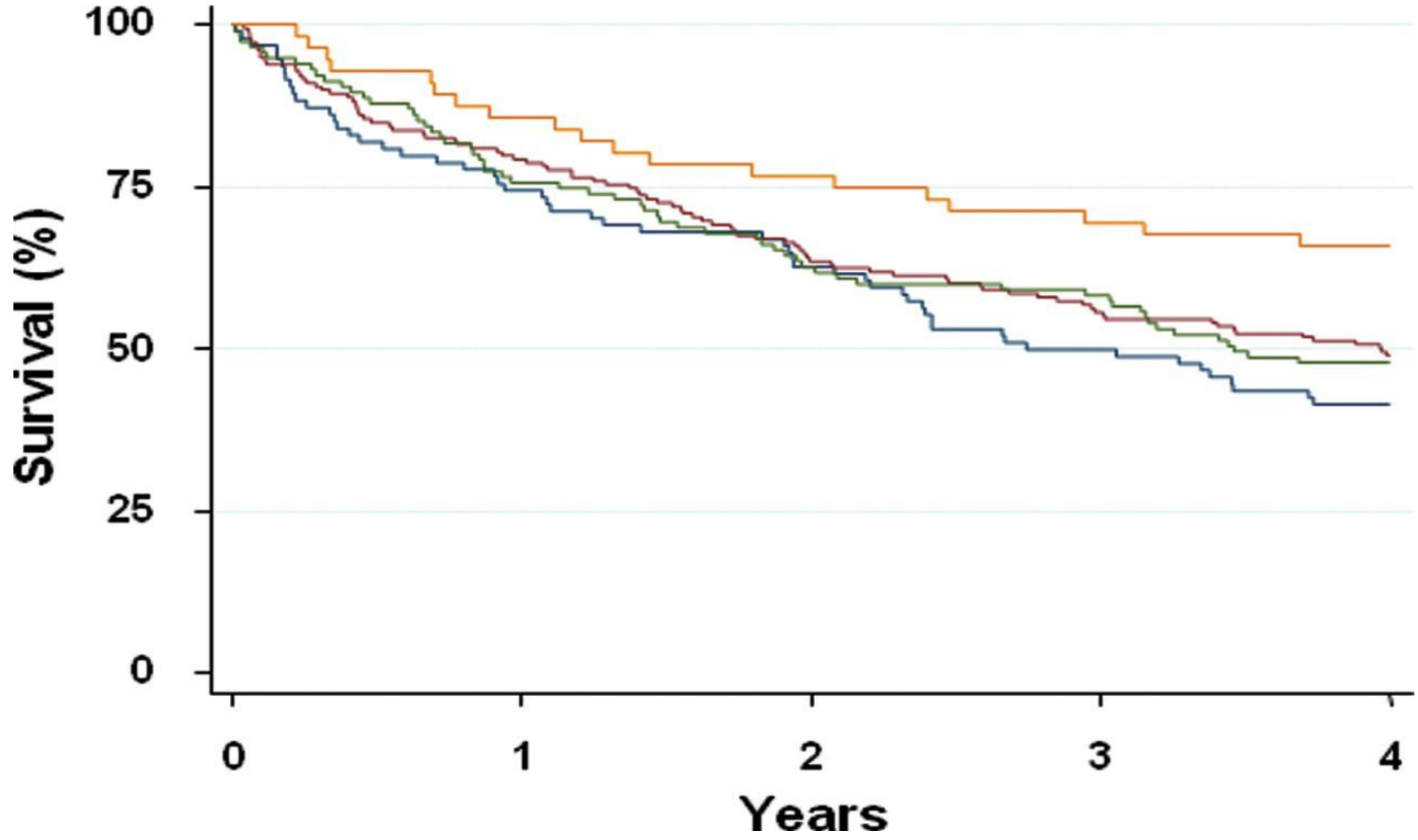
Cardiometabolic determinants of mortality in a geriatric population: Is there a "reverse metabolic syndrome"?

U.M. Vischer [a,*], M.E. Safar [b], H. Safar [b], P. Iaria [b], K. Le Dudal [b], O. Henry [b], F.R. Herrmann [a], P. Ducimetière [c], J. Blacher [b,c]

Conclusion. – In very old patients, low BMI, low DBP, low total and HDL cholesterol, and high insulin sensitivity predict total mortality, indicating a "reverse metabolic syndrome" that is probably attributable to malnutrition and/or chronic disorders. These inverse associations limit

The Association Between the Body Mass Index and 4-Year All-Cause Mortality in Older Hospitalized Patients

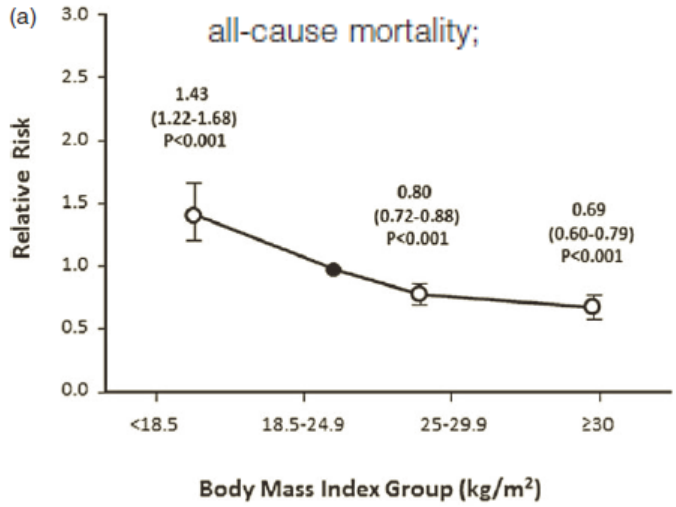
Dina Zekry, François R. Herrmann, and Ulrich M. Vischer†



Kaplan–Meyer survival curves according to body mass index (kg/m2) categories (orange: >30; green: 25–29.9; red: 20–24.9; blue: >20).

Inverse relationship between body mass index and mortality in older nursing home residents: a meta-analysis of 19,538 elderly subjects

N. Veronese **obesity** reviews (2015) **16**, 1001–1015



Infections in the elderly: take home message

- the relative mortality due to infectious diseases is not markedly increased in the elderly, however
  - a clear increase in morbidity due to infections in the elderly
  - infections are potentially preventable cause of disease and death in the elderly
- the infected elderly patient often shows less specific symptoms
  - delay in diagnosis and start of treatment
- elements aging often lead to a worse outcome of infection, but in some instance may also be protective
- few interventions available to protect elderly from infection
  - train doctors in geriatric infectious diseases
  - vaccinate caretakers
  - **feed the elderly well !!!**


Thank you

Reported co-infection deaths are more common in early adulthood and among similar infections

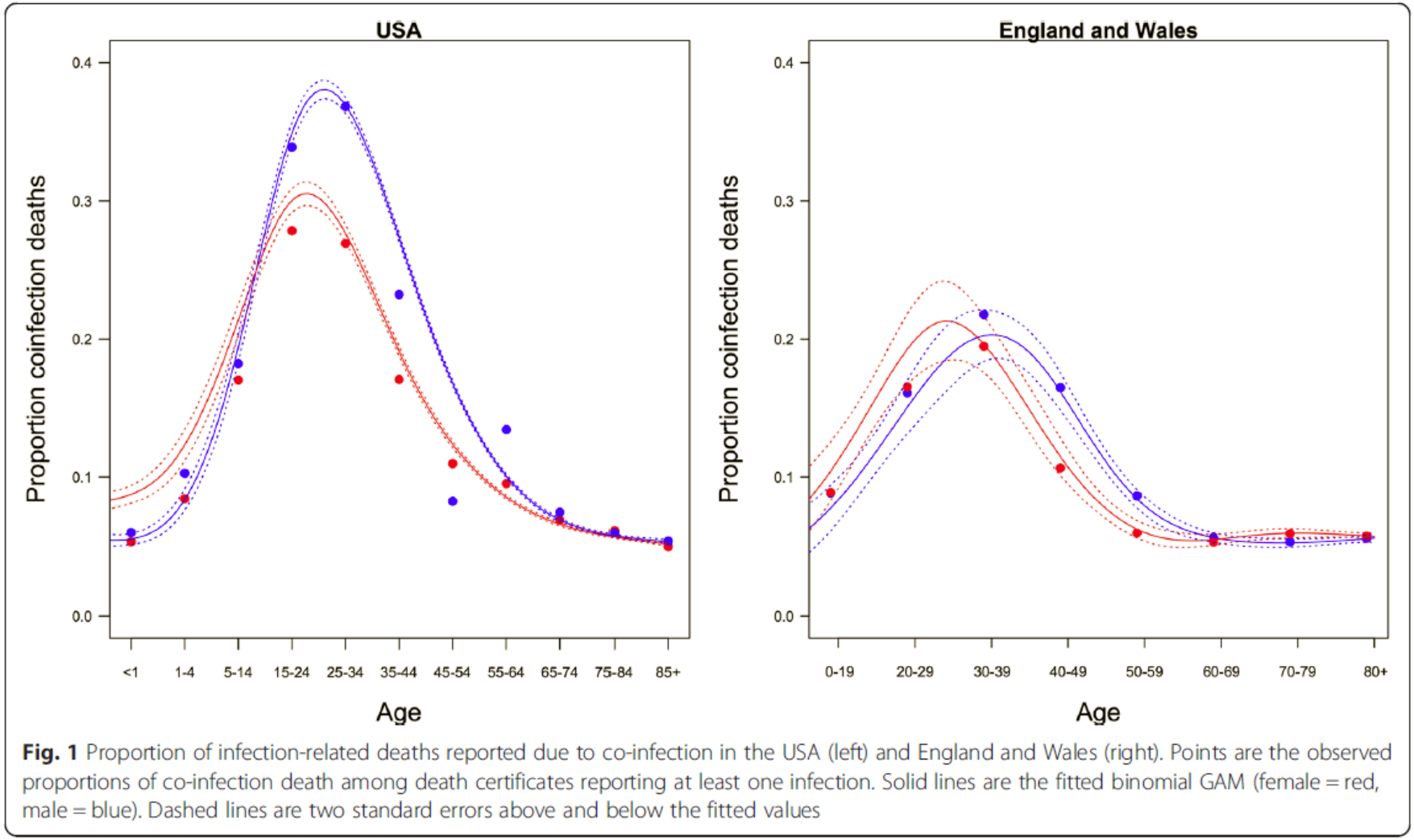


Fig. 1 Proportion of infection-related deaths reported due to co-infection in the USA (left) and England and Wales (right). Points are the observed proportions of co-infection death among death certificates reporting at least one infection. Solid lines are the fitted binomial GAM (female = red, male = blue). Dashed lines are two standard errors above and below the fitted values

Griffiths *et al. BMC Infectious Diseases* (2015) 15:411

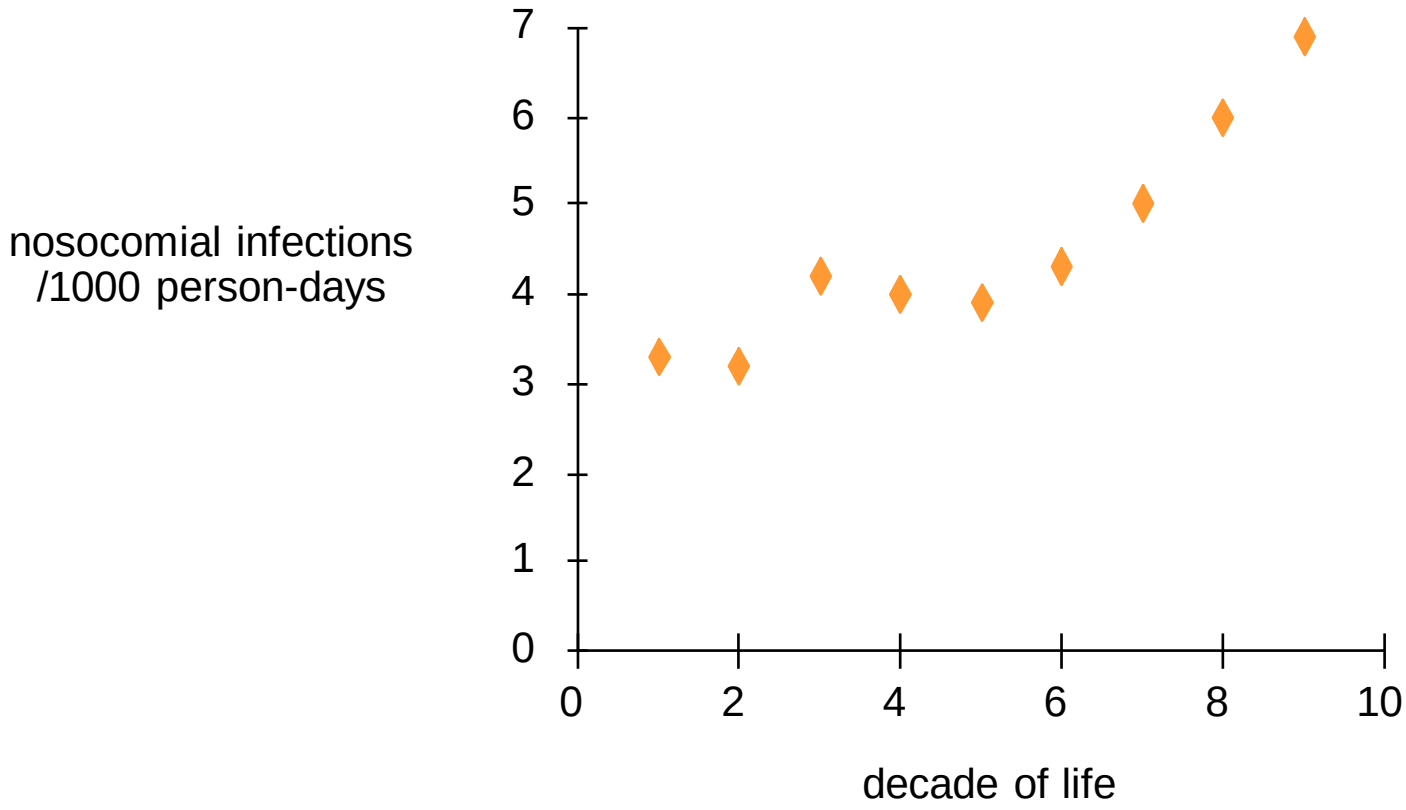
Metabolic changes with ageing and risk factors for malnutrion in the elderly

- Increased protein requirement
  - Decreased protein synthesis
  - Decreased nitrogen retention
- Increased micronutrient requirement
  - Synthesis of vitamin D in the skin declines
  - Decreased renal hydroxylation of vitamin D to dihyroxyvitamin D
  - Atrophic gastritis and decreased stomach acid decreases absorption of Vitamin B 12, calcium, iron, and folate
- Decreased nutrient intake
  - Loss of taste and smell
  - Food avoidance: milk products, limited menu
  - Dental disorders/ ill-fitting dentures
  - Comorbidities (e.g., chronic obstructive pulmonary disease, congestive heart failure, cancer, dépression, dementia)
  - Social isolation/living alone; rarely prepare meals
  - Economic factors: choosing between medications/food/rent
  - Medications: digoxin/other appetite suppressants

Protein-energy malnutrition

- most commonly detected nutritional deficit of elderly subjects
- associated with increased risk of death in the hospital and in the community
- protein-energy malnutrition may be present at hospital admission or develop during the course of the hospitalisation
- problem: mainly observational studies, unable to distinguish whether malnutrition is the cause of the life-threatening disease or whether life-threatening disease is the cause of malnutrition.

Nosocomal infections in the elderly



from: Saviteer SM, et al. Nosocomial infections in the elderly. Increased risk per hospital day. Am J Med. 1988 Apr;84(4):661-6.

Infectious disease in the elderly: distinct features in the resource-limited countries

- distinct spectrum of infections in the elderly
- greater overall relevance.
- tropical diseases have a specific presentation and epidemiology in elderly patients.
- infectious diseases with a worldwide distribution impact elderly patients in the developing world in a specific manner
- malnutrition contributes in a major way to the immunodeficiency of elderly patients in the developing world.
- poorly controlled use of antimicrobial drugs leads to multidrug-resistant microorganisms
- limited resources available for drug treatment

What is specific about infectious diseases in the elderly in resource-limited countries

INVITED ARTICLE AGING AND INFECTIOUS DISEASES

Kevin P. High, Section Editor

Aging and Infectious Diseases in the Developing World

Gaëtan Gavazzi, Francois Herrmann, and Karl-Heinz Krause

Department of Rehabilitation and Geriatrics, Geneva University Hospitals, Switzerland

Although demographic aging does not remain restricted to industrialized countries, the medical challenge arising from the aging population will be distinct in the developing world. This is particularly true with respect to infectious diseases, which have a distinct spectrum in the elderly population, as well as a greater overall relevance in the developing world. Tropical diseases have a specific presentation and epidemiology in elderly patients. Infectious diseases with a worldwide distribution impact elderly patients in the developing world in a specific manner, which is most obvious with respect to human immunodeficiency virus and tuberculosis but is also true with respect to "trivial" manifestations of infection, such as diarrhea and pneumonia. Malnutrition contributes in a major way to the immunodeficiency of elderly patients in the developing world. Poorly controlled use of antimicrobial drugs leads to multidrug-resistant microorganisms, which, together with the limited resources available for drug treatment, makes appropriate treatment of infections in elderly patients in developing countries very difficult. Infections in elderly patients will have an increasing impact on the public health and economy of developing countries.

Steens et al. BMC Infect
Dis. 2014 Feb 4;14:57.