
# Healthcare tendencies and their potential impact on insurances

Jochen Maas

# Which are the interesting areas?

- Medical progress with social impact:  The aging population

- Medical progress with open questions: Personalized medicine

- Scientific facts influencing healthcare: The climate change

# The aging population: Why are we getting older and older?

## Family planning

- Natural methods
- Pills
- Devices
- Combinations

## Attitudes changing

- Single lifestyle
- Later marriages
- Fewer children
- Career
- Economy

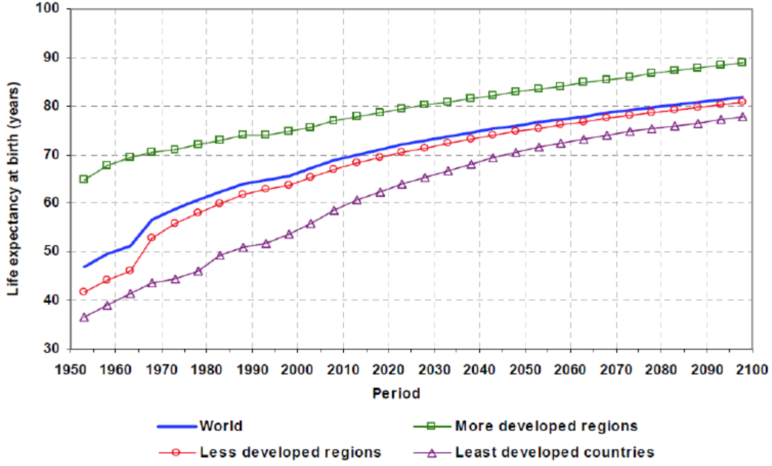
## Increased longevity

- Healthier environment
- Improved health care
- Technology advances
- Devices

Lower fertility rates

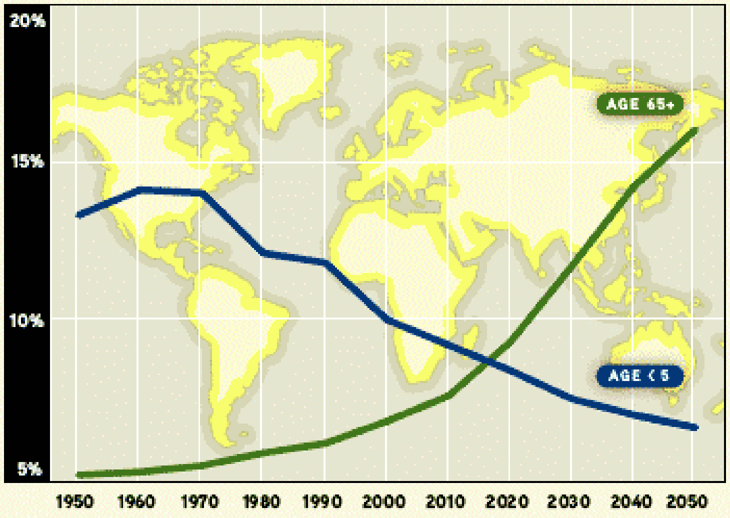
Lower mortality rates

Aging population



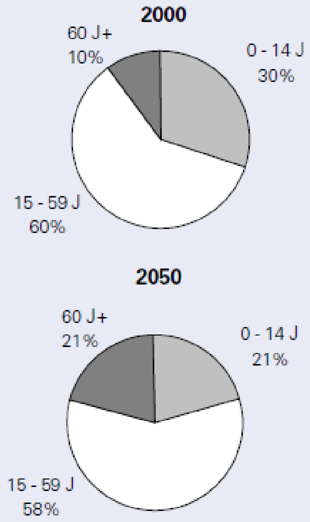
# The aging population: Switch of populations

YOUNG CHILDREN AND OLDER PEOPLE AS A PERCENTAGE OF GLOBAL POPULATION




Source: United Nations Department of Economic and Social Affairs, Population Division. *World Population Prospects. The 2004 Revision.* New York: United Nations, 2005.

**Struktur der Weltbevölkerung nach Altersgruppen**




Quellen: UN, DB Research

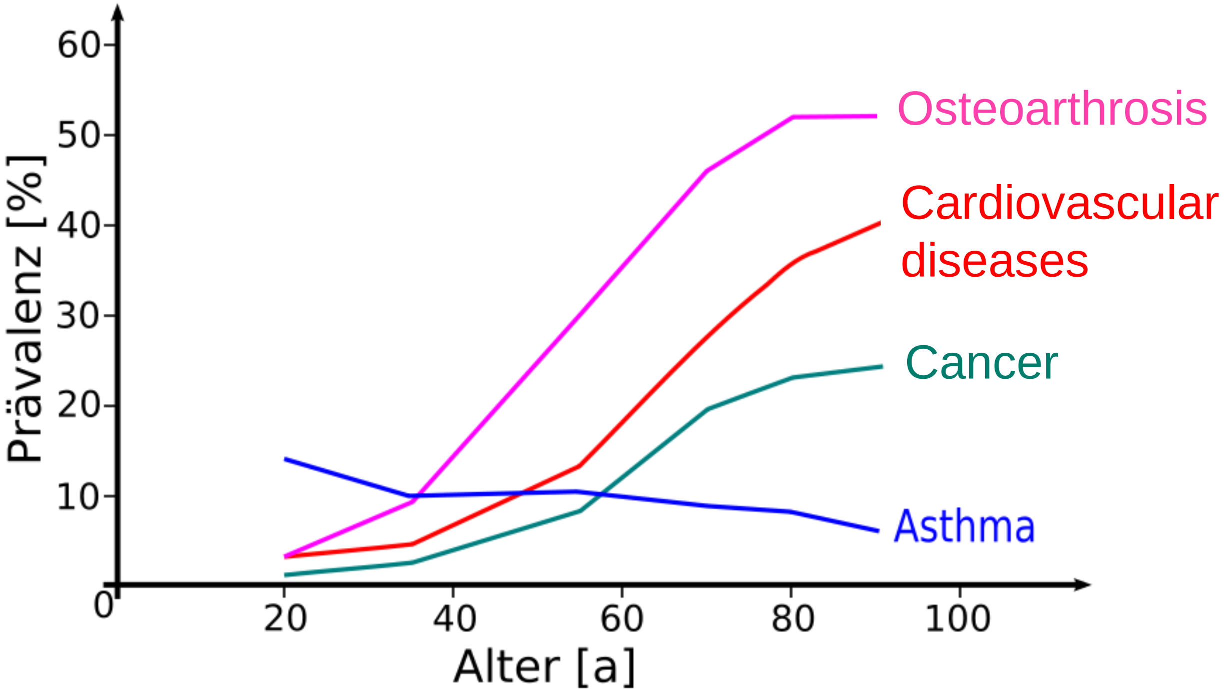
## Jugend- und Altenquotient 1998-2100

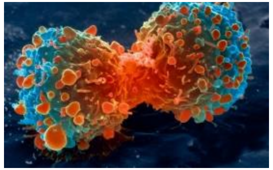
| | *Jugend-quotient* [1] | *Alten-quotient* [2] | *Unterstützungs-quotient* [3] |
|---|---|---|---|
| *1998* | *38,0* | *38,6* | *76,6* |
| *2000* | *38,1* | *42,8* | *80,9* |
| *2010* | *33,2* | *48,3* | *81,5* |
| *2020* | *31,3* | *59,9* | *91,2* |
| *2030* | *33,1* | *81,3* | *114,4* |
| *2040* | *32,1* | *85,9* | *118,0* |
| *2050* | *31,9* | *91,4* | *123,3* |
| *2060* | *32,7* | *92,6* | *125,3* |
| *2070* | *33,1* | *93,0* | *126,1* |
| *2080* | *33,2* | *92,2* | *125,4* |
| *2090* | *34,0* | *90,9* | *124,9* |
| *2100* | *34,5* | *88,7* | *123,2* |

*1 Unter 20-Jährige auf 100 Menschen im Alter von 20 bis unter 60*
*2 Über 60-Jährige auf 100 Menschen im Alter von 20 bis 60*
*3 Summe aus Jugend- und Altenquotient*

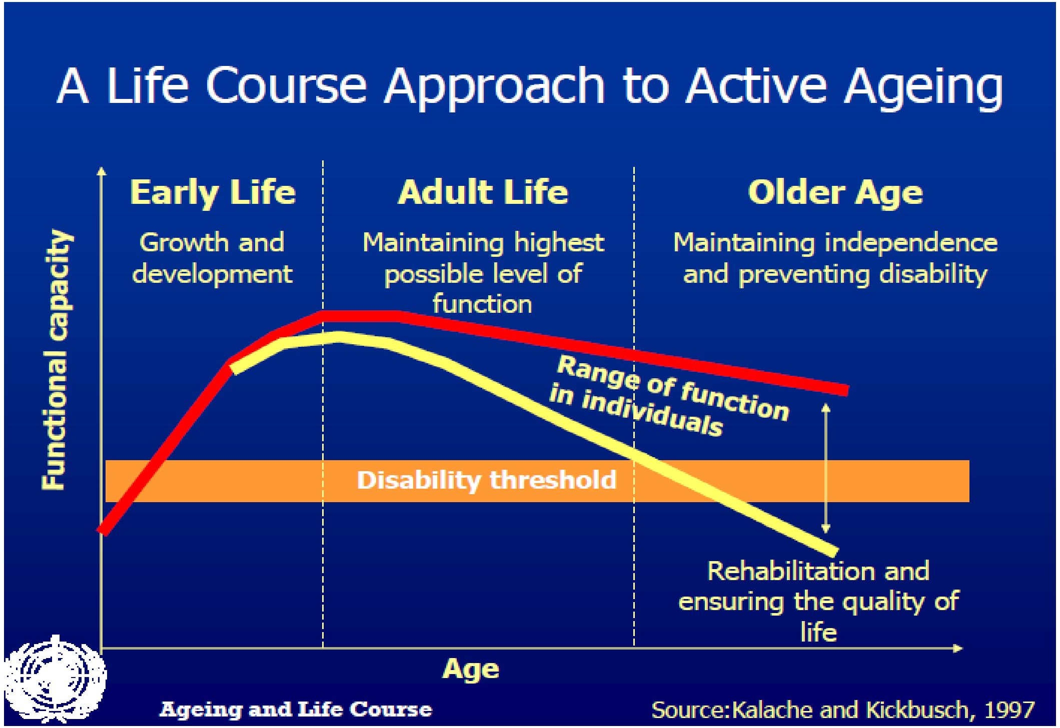
*Herwig Birg, Die ausgefallene Generation, 2. Aufl., München 2006, S. 130*

# The aging population: Age dependency of specific diseases



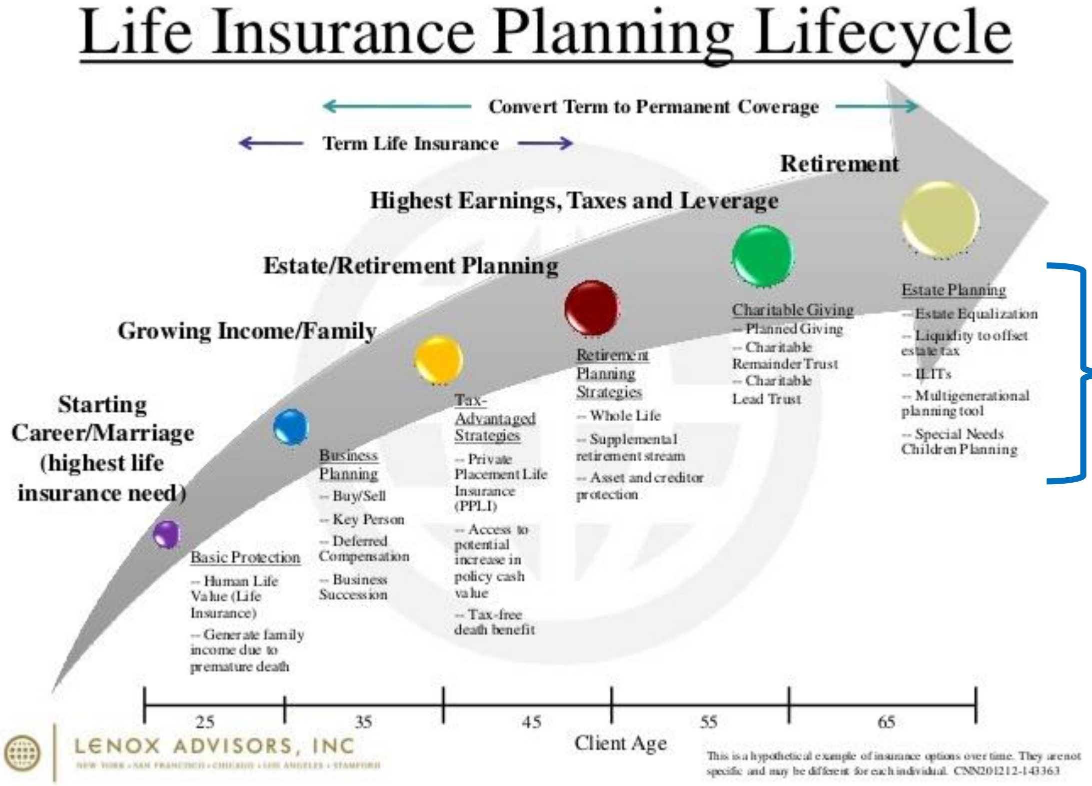
# The aging population: Objective is “delay” of aging




Is there an impact of (*health*) insurance systems?

*Prevention* Incentives for
- Patients
- Physicians
- Companies

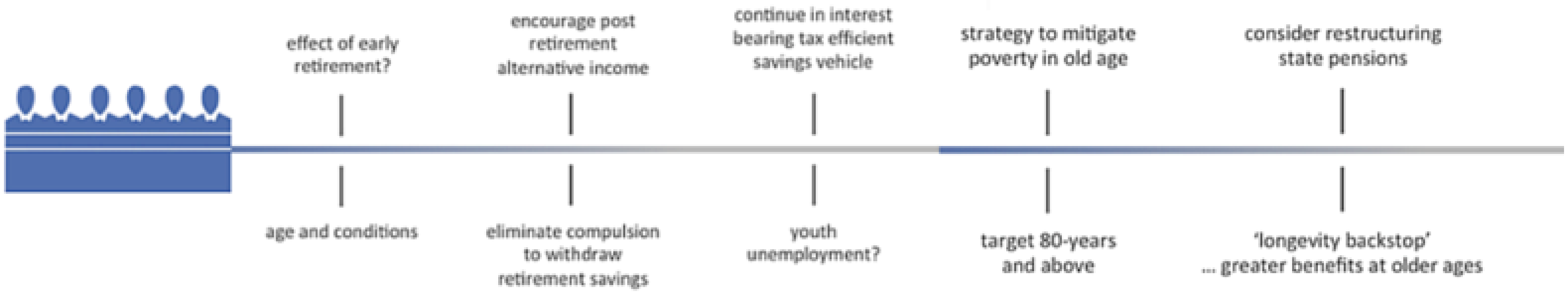
# The aging population: Influence on *life* insurances




Increasing focus ?

# The aging population: Influence on *social* insurances

## Impact on annuities and pensions




Restructuring required – based on political circumstances

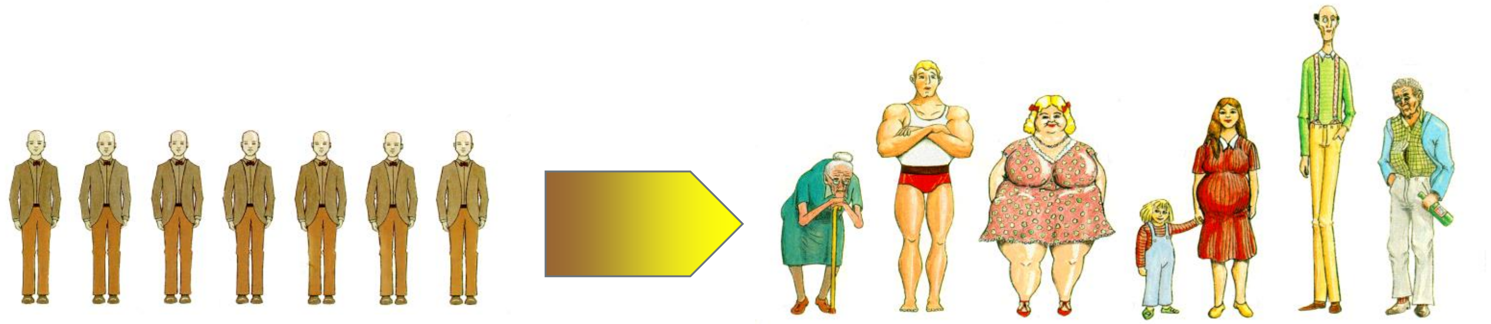
# Prerequisites to get older and to maintain quality of life


Progress in healthcare

- New drugs
- New treatments
- New devices
- New approaches based on new technologies

- **personalized medicine**

# Personalized Medicine – what is it?



**Personalized medicine** is a medical model emphasizing in general the customization of healthcare, with all decisions and practices being tailored to individualized patients in whatever ways possible. Recently, this has mainly involved the systematic use of genetic or other information about an individual patient to select or optimize that patient's preventative and therapeutic care[1]

- … to improve the **efficacy** of a medication
- … to improve the **safety** of a medication
- … to improve the **dose regimen** of a medication

# Personalized Medicine – what is it not (yet)?



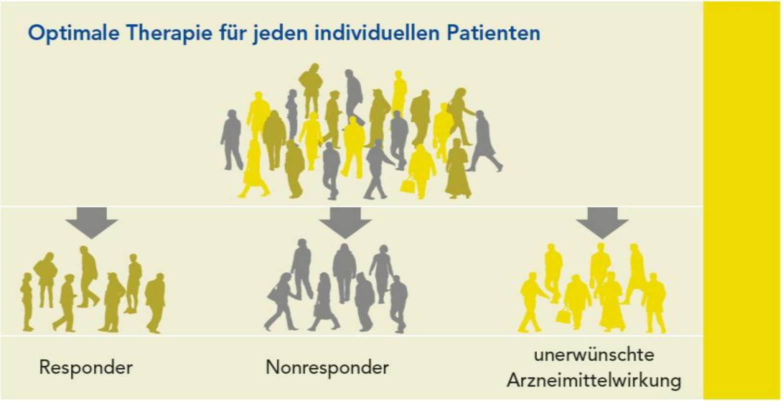

Where we come from….
*(and where we still are –*
*at least in some areas)*

… achieved until 2018
*(but only in some areas)*

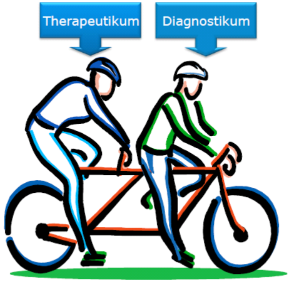
Where we want to be
*(but haven‘t reached it)*

# Objectives and prerequisites of personalized approaches

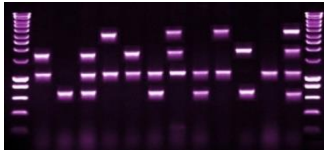
O: Patient stratification – Optimized therapy for each individual patient

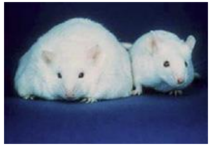



Quelle: Johann Wolfgang Goethe-Universität, Frankfurt am Main




P: Diagnosis: Genotyping and Phenotyping





Diagnostics can be Imaging as well!!!

# *The* challenge for the future….

*What the public came to expect of PHC are truly individualized therapies – something science and industry may not be able to deliver for some time*

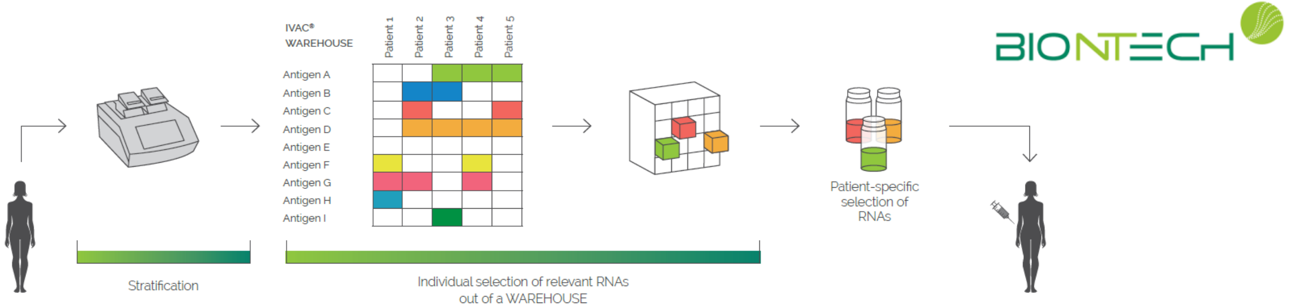
This statement has to be more and more modified !!!!

Real individualisation is coming

# One of the first examples….

## mRNA‘s – A personalized concept to fight cancer

- RNA based vaccines that targeting shared tumor-associated antigenes
  - Tumor profiled by RT-qPCR for specific antigen expression profile
  - Patient receive individual combination of RNAs from warehouse that corresponding to antigen-expression profile




- RNA based vaccines targeting unique antigens that result from tumor-specific mutations
  - Tumor-specific mutations determined, patient-individual immune status investigated
  - Sequences in healthy and cancerous tissue compared to determine patient specific tumor mutanome
  - Patient receive truly personalized combination of RNAs produced de novo based on mutation profile

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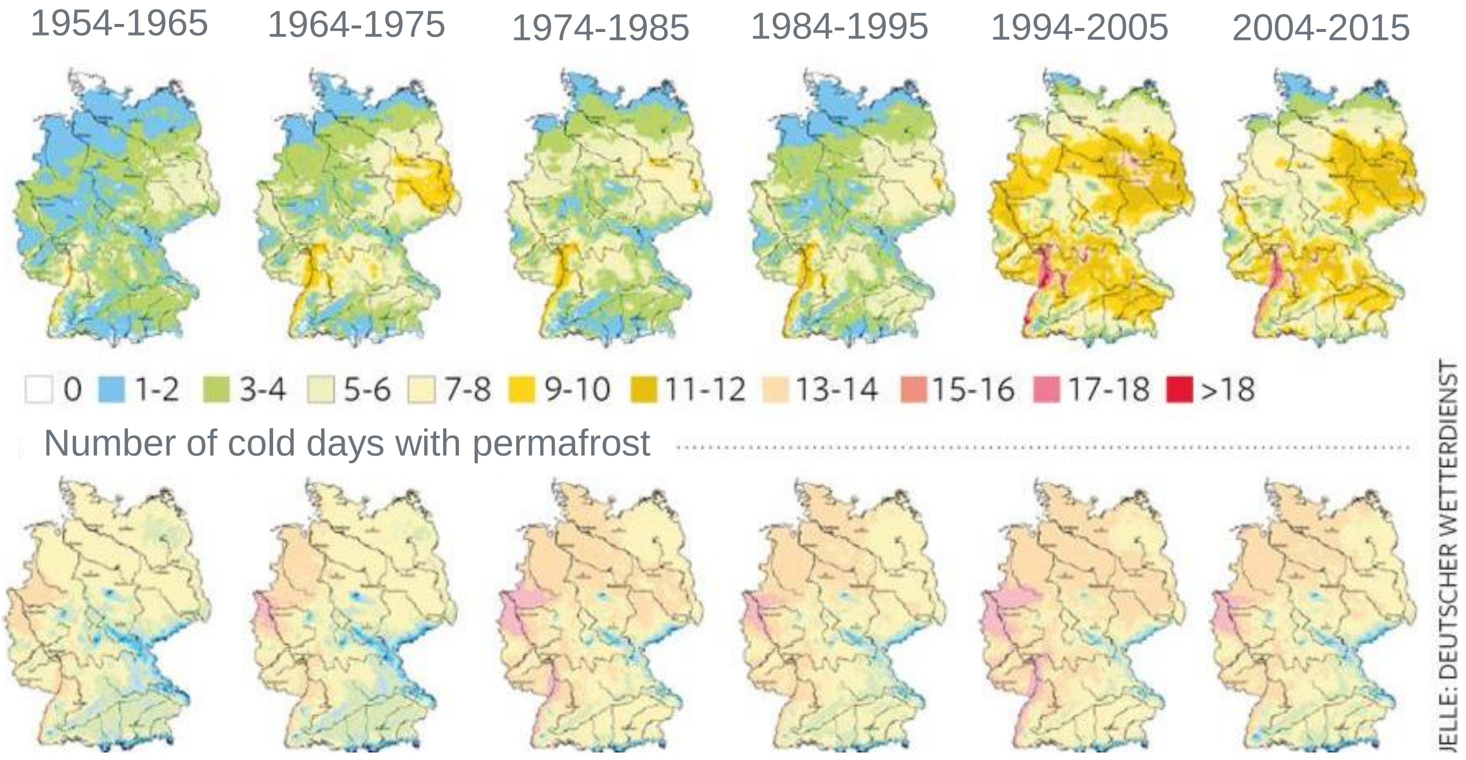
# Challenges – two specific for health insurance considerations

- Costs, costs, costs….
- Ad hoc: Generation of data which are not fully understood today
- How to transfer basic research results into the clinical situation?
- Do we have the right skillsets for an individualized treatment?
- Do we have the „health competency“ in patients to use personalized medicine? In the whole society?
- Do we stop at an „personalized“ level or do we move to an „individual“ level
- Is there another influence on health insurance? Do we cancel the principle of solidarity?
- What is the impact on the business plans of the pharmaceutical industry?
- Can gene sequences be patented?

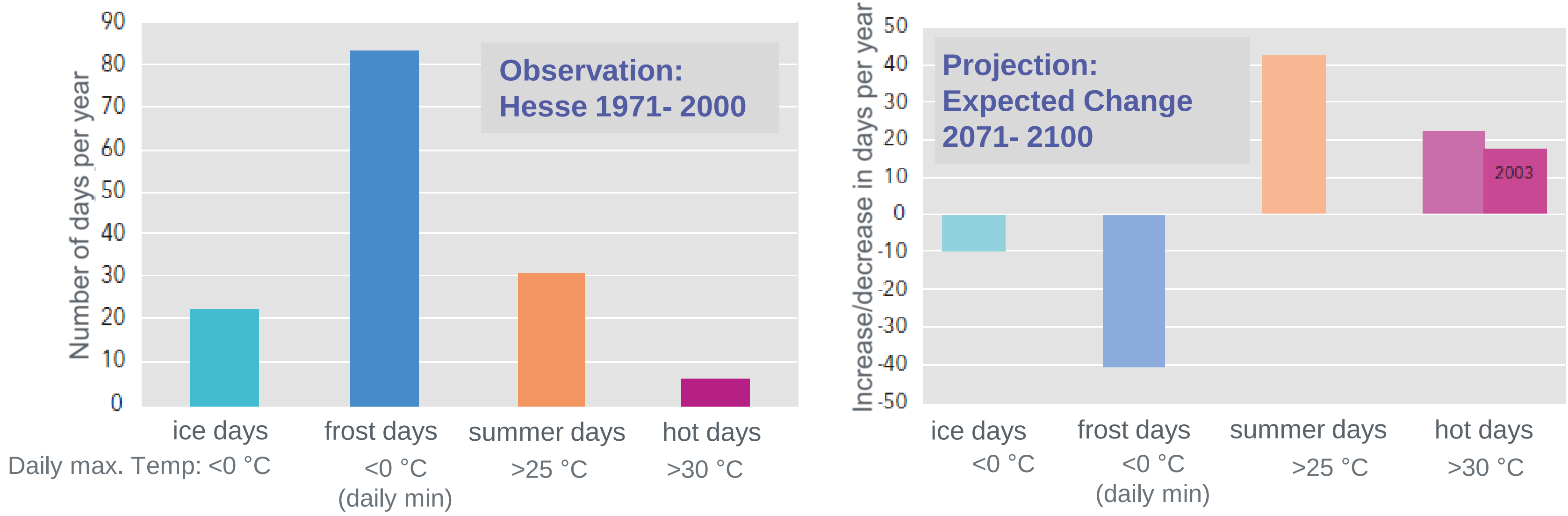
# Climate change: Number of hot days increased….




Quelle: Infografik Die Welt

# …and the trend continuous

## Average temperature expected to increase by at least 0.6 – 1.8°C in next 50 years




- Higher maximum Temperatures, more hot days and heat waves
  - More very hot days resulting in higher thermal stress
  - Strong heat stress at temperature >38°C

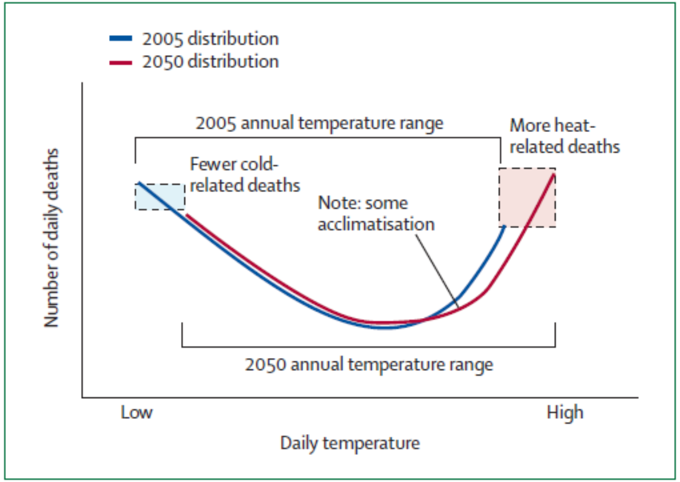
Klimawandel in Hessen, Hessisches Landesamt für Umwelt und Geologie, Fachzentrum Klimawandel Hessen, **2015**

# Climate change: *Direct* health threats

## Direct Consequences

**Climate change: Temperature, precipitation, Weather pattern**

| Cause | Impact on health |
|---|---|
| Thermal stress through high ambient temperatures (heat waves) | Increased risk for CV, kidney and respiratory disease, heat stroke, higher morbidity and mortality |
| Higher UV-exposure by ozone depletion and lower cloud cover | Elevated risk for erythema, skin cancer, cataract and weakening of the immune system |
| Frequency and severity of extreme weather events (storm, flooding) | Deaths, injured, psychological stress, depression, increasing the risk of cholera and diarrhea |
| Sea-level rise, coastal flooding, salination of coastal land & freshwater, | Impaired crop, livestock, fisheries resulting in malnutrition, population displacement, mental health |




Increase in average annual temperature will affect temperature-related deaths, e.g. heat wave 2003: up to 35.000 additional deaths in western Europa

**…but also positive effects through more Mediterranean climate**

- e.g. higher vitamin D status, less accidents through icy conditions, less depression?, eating habits?

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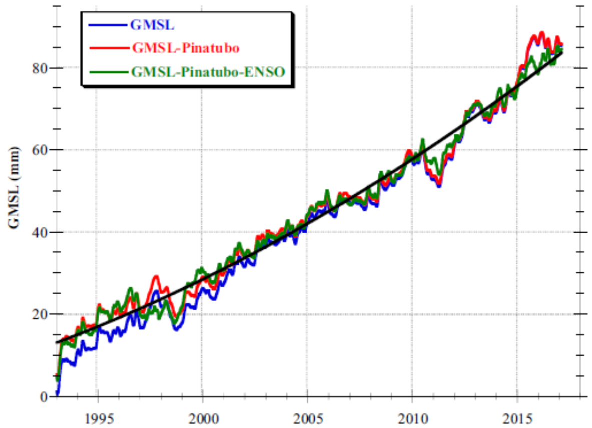
Klimawandel in Hessen, Hessisches Landesamt für Umwelt und Geologie, Fachzentrum Klimawandel Hessen, **2015**
D. Eis, D. Helm, D. Laußmann, K. Stark, *Klimawandel und Gesundheit Ein Sachstandsbericht,* Robert Koch-Institut, Berlin **2010**
A.J. McMichael, R. E Woodruff, S.Hales, *Lancet* **2006**, *367*, 859–69

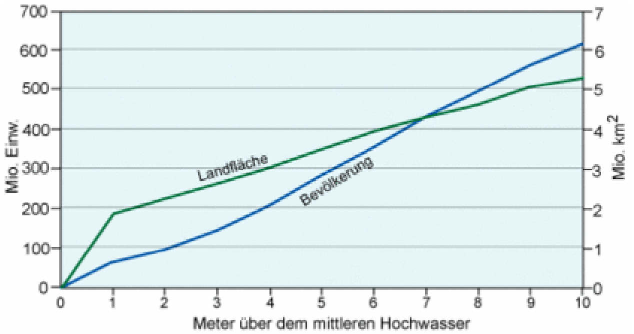
# Climate change: Global mean sea level increase

## *Indirect* Consequences on health

- **Sea level increase so far**
  - Approx. 25 cm between 1880 to 2009 (1.8 mm/year)
  - Since 1993 raising at rate of 3,2 mm/year, rate accelerating at 0.08 mm/y
- **Projection**
  - Stronger increase as expected so far
  - New calculations based on satellite altimetry suggest a global mean sea level increase by 65 cm until 2100, in more pessimistic scenario >1m possible
  - 60 Mio people live on land area <1 m, 275 Mio <5 m above sea level
  - 8 of the 10 biggest cities in the world in coastal area
- **Consequences**
  - *Ecological* consequences: e.g. strong risk for coast regions, coral reefs, mangroves, river delta, biodiversity etc.
  - *Economic* consequences: e.g. salination of coastal land & aquifer, storm surges, impaired crop, livestock, fisheries etc.
  - *Socio-political* consequences: e.g. loss of livelihoods, population displacement, malnutrition, poverty etc.
- **Significant extension of coastal protection measures necessary**



Global mean sea level, Nerema *PNAS*



Distribution of global land areas and population



R.S. Nerema,1, B.D. Beckleyb, J.T. Fasulloc, B.D. Hamlingtond, D. Mastersa, G.T. *PNAS*, *2018*, Mitchume https://doi.org/10.1073/pnas.1717312115

# Climate Change: *Indirect* Consequences

## Vector-born infectious diseases

- Climatic change has a direct influence on epidemiology of vector-borne disease
- Higher temperatures and increased humidity improves living conditions of most vector species
  - Increased vectorial capacity
  - Higher reproduction rates
  - Faster and more frequent blood digestion
  - Increased transmission intensity
  - Reduced extrinsic incubation period
- Changed geographical distribution and seasonal incidence of vector-born pathogens
  - Climatic dependency and vector competence of many vectors not well understood

| Infektionserreger | Überträger/Vektor | Verbreitung | Kompetente Vektoren in Deutschland | Importierte Infektionserreger | Abschätzung des Risikos für die Ausbreitung beziehungsweise einen Ausbruch |
|---|---|---|---|---|---|
| Frühsommer Meningo-Enzephalitis-Virus* | Zecken (Ixodes ssp, I. ricinus) | Mittel- Nordeuropa, Russland, nördliches Asien | Vorhanden | Infizierte Haus- und Wildtiere | Möglich |
| Hantavirus | Nager | Mittel- Nordeuropa, Russland, Amerika, Asien | Vorhanden | Infizierte Haus- und Wildtiere | Möglich |
| Tollwut-Virus* | Haus-, Wildtiere | Europa, Asien, Amerika | Vorhanden | Infizierte Haus- und Wildtiere | Gering |
| Sandfliegenfieber-Virus | Sandfliegen | Südeuropa, Mittelmeerländer | Lokal vorhanden, Rheingraben | Infizierte Personen, infizierte Vögel | Möglich |
| West-Nile-Virus | Mücken (Culex u. Aedes ssp.) | Südfrankreich, Balkan | Vorhanden | Infizierte Personen | Möglich |
| Lymphozytäres Choriomeningitis-Virus | Nager, Hamster | Europa | Vorhanden | Infizierte Nager | Möglich |
| Krim Kongo Hämorragisches Fieber | Zecken (Hyalomma ssp.) | Afrika, Mittlerer Osten, Balkan, Türkei | | Infizierte Personen | Gering |
| Chikungunya-Virus | Mücken (Aedes ssp.) | Afrika, Asien, Oberitalien | Lokal vorhanden | Infizierte Personen | Möglich |
| Dengue-Virus | Mücken (Aedes ssp., A. aegypti) | Südamerika, Asien, Afrika | Lokal vorhanden | Infizierte Personen, Warenimport | Möglich |
| Gelbfieber-Virus* | Mücken (Aedes ssp.) | Afrika, Südamerika | Lokal vorhanden | Warenimport, infizierte Personen | Möglich |
| Japanisches Enzephalitis-Virus* | Mücken (Culex ssp.) | Asien | Lokal vorhanden | Warenimport, infizierte Personen | Gering |
| Rift-Tal-Fieber-Virus | Mücken (Culex u. Aedes ssp.) | Afrika, Mittlerer Osten | Lokal vorhanden | Warenimport, infizierte Personen | Gering |

K. Stark, N. Niedrig, W. Biederbick, H. Merckert, J. Hacker, Die Auswirkunegn des Klimawandels, Bundesgesundheitsbl. **2009**



Becker, P. u.a. Gesundheitsrisiken durch Klimawandel, in: *promet* **2007**, 33, 148-56
http://wiki.bildungsserver.de/klimawandel/index.php/Indirekte_Auswirkungen_des_Klimawandels_auf_die_Gesundheit

# Climate change: An example for vector-born infectious diseases

## *Indirect* Consequences

- Invasion and territorial expansion of previously non-endemic  vector species in Germany
- Aedes japonicus
  - Unclear vector potential of local population
  - Considered as active vector for Japanese encephalitis and West Nile Virus
- Tiger mosquito (Aedes albopictus)
  - Epidemiologically important vector for transmission of many viral pathogens such as the yellow fever virus, dengue fever, and Chikungunya fever
  - Introduced to Italy in 1990s by import of used tires
  - Today established in the whole Mediterranean area and in parts of Switzerland
  - Since 2011 also in the South of Germany, first successful overwinter survival proven (2015/2016 in Heidelberg)

*Aedes japonicus* © James Gathany, CDC

*Tiger mosquito  (Aedes albopictus)* © James Gathany, CDC

Klimawandel in Hessen, Hessisches Landesamt für Umwelt und Geologie, Fachzentrum Klimawandel Hessen, **2015**

# Climate change: Another example vector-born infectious diseases

## *Indirect* Consequences

- Expansion of domestic vector species. e.g. ticks
  - Principal vector of  Lyme-borreliosis and tick-born encephalitis
  - Climatic change results in higher population density and expansion to northern latitudes
- Lyme-Disease
  - Most important vector-born  infectious disease in Central Europe approx. 90.000 infections per year in Germany
  - Climate induced higher transmission rates
- Tick-born encephalitis (TBE)
  - Viral infectious disease involving the central nervous system, most often manifests as meningitis, encephalitis, or meningoencephalitis
  - No specific drug therapy available but effective vaccination, mortality 1-2%, in Siberian or Asia even 20-40%
  - Increasing number of reported cases in the south of Germany but northwards movement
  - Approx. 0.1 to 5% of tick population infected

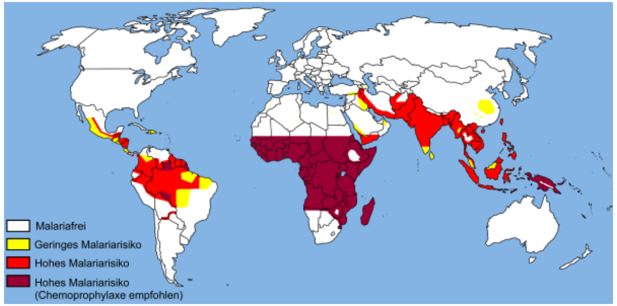
Deer tick (Ixodes ricinus) © Richard Bartz, Munich, endemic in Central Europe

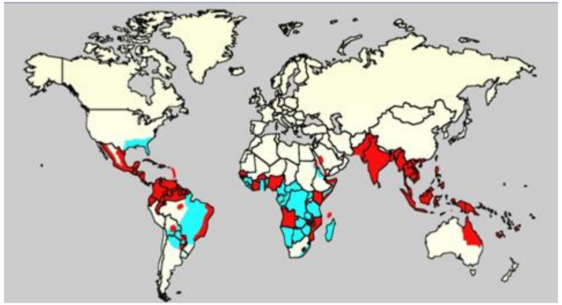
O. Kahl, H. Dautel, Zur Biologie und Ökologie von Zecken und ihre Ausbreitung nach Norden in: Lozán, J.L. (Hg.): Warnsignal Klima. Gesundheitsrisiken. Gefahren für Pflanzen, Tiere und Menschen. Hamburg, Freiburg, Bonn, List/Sylt **2008**

# Climate change: Vector-born infectious diseases

## *Indirect* Consequences

- ➢ Worldwide increasing risks for higher incidences of tropical diseases, e.g.




Malaria

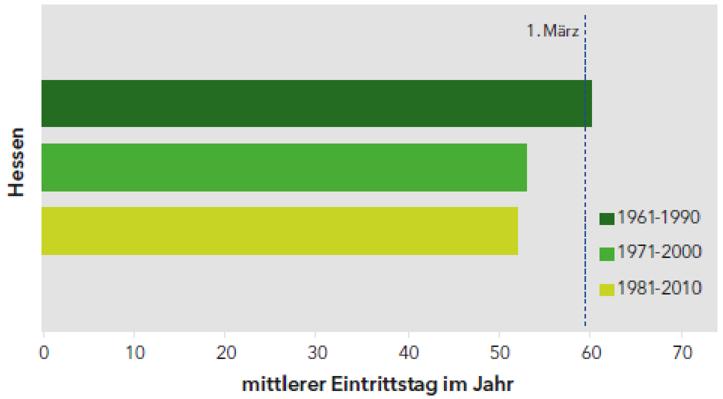
Dengue

Leishmaniosis

# Climate change: Change in allergen exposition

## *Indirect* Consequences

- Significant increase of allergies und asthma
  - Approx. 20-30% of Germans suffer from allergies today
  - Significant increase expected (new allergens!)
- Longer and more intense allergen exposition
  - Climate induced extension of pollen season
  - Temperature increase results in earlier vegetation growth and longer flowering season
  - Increased $CO_2$ concentration results in significant higher pollen emission
- Increasing pollution levels in air induces enhanced allergen exposition
  - Allergen aerosol formation through absorption on fine dust particles




Hazelnut: Significant earlier beginning of flowering in last years
Airborne pollen already in January not unusual

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http://wiki.bildungsserver.de/klimawandel/index.php/Indirekte_Auswirkungen_des_Klimawandels_auf_die_Gesundheit
Klimawandel in Hessen, Hessisches Landesamt für Umwelt und Geologie, Fachzentrum Klimawandel Hessen, **2015**

# Climate change: “New” airborne pollen and allergies

## *Indirect* Consequences

- Invasion of non-native species – Neophytes
  - Example: common ragweed (Ambrosia artemisiifolia)
  - Highly allergenic, causing Bronchitis and skin allergies
  - Late flowering early August to end September
  - Single male plant can produce as much as 1 Billion pollen, but already at low pollen concentrations high allergic reaction
  - Climatic change results in considerable expansion, increased pollen production and longer flowering period
- Oak processionary moth (Thaumetopoea processionea)
  - Backs of caterpillars (3rd instars) covered with defensive bristles containing a toxin (thaumetopoeine)
  - Cause skin and eye irritations in case of contact, if inhaled, respiratory distress or even anaphylaxis
  - In last 10 years widespread dissemination in the northeast and southwest of Germany, range is expanding northward

common ragweed

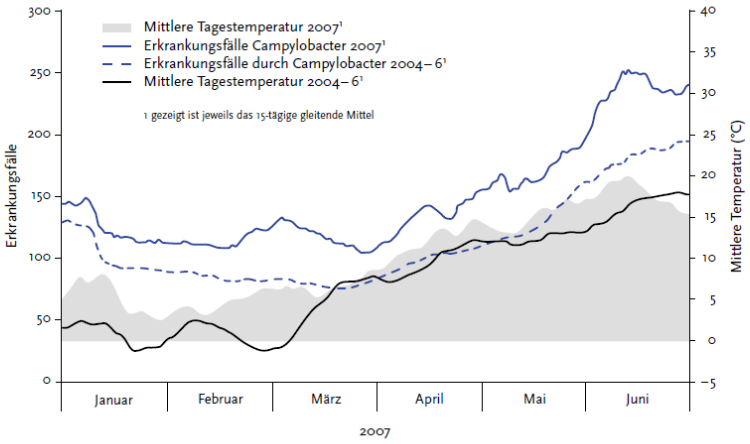
Caterpillars of the
Oak processionary moth

K. Stark, N. Niedrig, W. Biederbick, H. Merckert, J. Hacker, Die Auswirkunegn des Klimawandels, Bundesgesundheitsbl. **2009**
D. Eis, D. Helm, D. Laußmann, K. Stark, *Klimawandel und Gesundheit Ein Sachstandsbericht,* Robert Koch-Institut, Berlin **2010**
Klimawandel in Hessen, Hessisches Landesamt für Umwelt und Geologie, Fachzentrum Klimawandel Hessen, **2015**

# Climate change: Food-, algae- and water-borne infections

## *Indirect* Consequences

- Food-born infections through bacterial Enteritis
  - Higher Incidence  for Salmonella or Campylobacter intestinal infection during summer
  - 1°C Temperature increase may result in 4-5% more bacterial enteritis
- Algae-borne toxins in mussels or fish
  - Toxin forming marine algae e.g. Dinoflagellates, which could enter human food chain
  - Climatic change may be associated with an increased algae bloom at the north coast of Germany
- Water-borne infections and intoxications
  - Climate change induced worldwide increase of toxin forming Cyanobacteria strains (Microcystines)
  - Intestinal infections such as Giardia, Cryptosporidium and Vibriones may become more due to increased storm floods and severe flooding

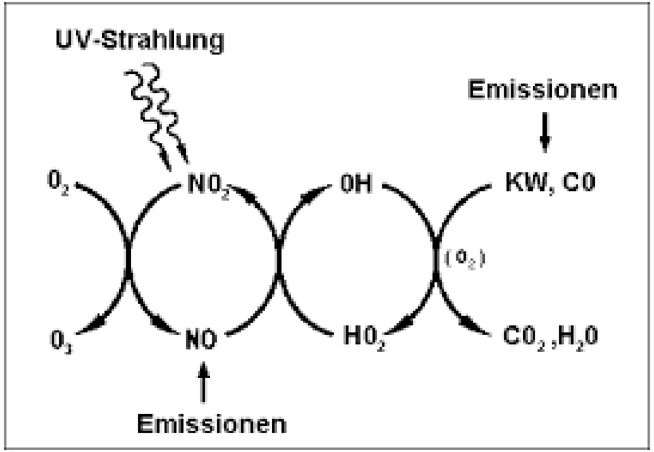



Temperaturabhängigkeit der Campylobacter-Erkrankungen 2007, Deutschland.

# Climate change: Exposition to ambient air pollution

## *Indirect* Consequences

- Increased concentration of ground-level ozone through high solar irradiation
  - Formed in photochemical reaction from nitrogen oxides and volatile hydrocarbons
  - Causes damage of respiratory tract and lung epithelium, chronic respiratory diseases, increased incidence for cardiac failure and arrhythmia
  - Health effects depend on concentration, duration and frequency of exposure
  - Raise of mortality rate by 0,3 % per 10µg/m$^3$ Ozone in air
  - Since about 10 years stagnant ozone annual mean value at elevated level



# Conclusion

- Longevity – based on medical progress – will impact significantly business models of insurances, particularly in the areas of *health-*, *pension-* and *life* insurances
- New medical approaches like personalized medicine will challenge the current business models of insurances, particularly health insurances
- Climatic change will modify (improve) the conditions for specific diseases in industrialized countries resulting in new patterns of endemic diseases challenging local health insurance systems as well.