



# Cancer effects from Chernobyl: 20 years later

*E. Cardis, IARC, Lyon*



# Basis for my talk

- ◆ What have we learnt about the effects of the accident on the risk of cancer ?
  - UN Chernobyl Forum – Looking back to go forward
  - Cardis E, Howe G, Ron E, Bebeshko V, Bogdanova T, Bouville A, Carr Z, Chumak.V, Davis S, Demidchik Yu, Drozdovitch V, Gentner N, Gudzenko N, Hatch M, Ivanov V, P, Kapitonova E, Kenigsberg J, Kesminiene A, Kopecky KJ, Kryuchkov V, Likhtarev I, Loos A, Pinchera A, Reiners C, Repacholi M, Shibata Y, Shore R, Thomas G, Tirmarche M, Yamashita S, Zvonova I. *Cancer consequences of the Chernobyl accident: 20 years after.* *J Radiol. Prot.* Vol 26: 2, pp 125-137. doi:10.1088/0952-4746/26/2/001 <http://www.iop.org/EJ/journal/JRP>
  
- ◆ What is our estimation of the cancer burden to date – and in the future from Chernobyl?
  - IARC Working Group on the Chernobyl accident
  - Cardis E., Krewski D., Boniol M., Drozdovitch V., Darby SC., Gilbert ES., Akiba S., Benichou J., Ferlay J., Gandini S., Hill C., Howe G., Kesminiene A., Moser M., Sanchez M., Storm H., Voisin L. & Boyle P. Estimates of the Cancer Burden in Europe from Radioactive Fallout from the Chernobyl Accident. *International Journal of Cancer.* <http://www3.interscience.wiley.com/cgi-bin/jissue/76502439>



# The status today

- ◆ Many reports on health effects of Chernobyl in 20 years
- ◆ Within UN Chernobyl Forum, critical review by EGH:
  - Peer-reviewed scientific literature
  - Scientific meeting presentations
  - Reports and statistics prepared by National authorities
  - Focus: Belarus, Russian Federation and Ukraine
- ◆ Outcome
  - Scientific consensus about what is known about the health impact from radiation to date
  - Identification of research gaps
  - Recommendations for health care programs

# Summary of cancer findings from Health report of UN Chernobyl Forum - authors: members of the WHO EGH

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## REVIEW

### Cancer consequences of the Chernobyl accident: 20 years on

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# Thyroid cancer in young people after Chernobyl

- ◆ Major increase in risk :
  - Nearly 5,000 cases among those who were below 18 at the time of the accident (1992-2002)
  - *4,000 among those who were below 15 !*
- ◆ Many epidemiological studies
  - Confirm increased risk
  - Attribute a large proportion of the cases to radiation from the accident
- ◆ Prognosis to date is good
  - 15 deaths to date among those exposed in childhood



# Thyroid cancer risk – what have we learnt?

- ◆ Increase in thyroid cancer following exposure to  $^{131}\text{I}$  *in childhood* - clearly demonstrated
  - ◆ Risk related to  $^{131}\text{I}$  exposure appears to be similar to risk from external photon exposure
  - ◆ Stable iodine status
    - Iodine deficiency appears to increase risk per Gy
    - Dietary iodine supplements may reduce risk
- ... potentially important implications – need confirmation*

Cardis,E.; Kesminiene,A.; Ivanov,V.; Malakhova,I.; Shibata,Y.; Khrouch,V.; Drozdovitch,V.; Maceika,E.; Zvonova,I.; Vlassov,O.; Bouville,A.; Goulko,G.; Hoshi,M.; Abrosimov,A.; Anoshko,J.; Astakhova,L.; Chekin,S.; Demidchik,E.; Galanti,R.; Ito,M.; Korobova,E.; Lushnikov,E.; Maksioutov,M.; Masyakin,V.; Nerovnia,A.; Parshin,V.; Parshkov,E.; Piliptsevich,N.; Pinchera,A.; Polyakov,S.; Shabeka,N.; Suonio,E.; Tenet,V.; Tsyb,A.; Yamashita,S.; Williams,D. [Risk of thyroid cancer after exposure to  \$^{131}\text{I}\$  in childhood](#). J Natl Cancer Inst. 97(10)724-32. 2005



# Thyroid cancer risk – what more is there to learn?

## ◆ Uncertainties

- Pattern over time – no information

*... increased risk likely to continue for many more years*

- Effect of exposure as an adult - *unclear*



# Cancers other than thyroid

- ◆ No scientifically demonstrated effect of Chernobyl radiation exposures on leukemia or solid cancers (except thyroid cancer)

... *Suggestions of possible increase in:*

- *leukemia/cancer risk among liquidators*
- *breast cancer in young women in most contaminated districts*





# Why is there no clear evidence of effects attributable to radiation from Chernobyl?

◆ THERE IS NO RISK ?

OR

◆ THE STUDIES TO DATE ARE NOT SUFFICIENTLY INFORMATIVE ?



# Why can we not conclude ?

1. **Studies are few and methodologically limited**
  - Doses to most organs (except thyroid) tend to be low
  - Expected increase is small compared to risk due to other causes ("baseline" rates)
  - Insufficient numbers of subjects to allow conclusion
  - Reliable individual (and even group) doses generally not available
  - No information on other potentially much more important risk factors for the diseases (such as tobacco and alcohol)



# Why can we not conclude ?

2. It may be too early to evaluate whether a risk exists
  - Most studies include cases only up to 2000/2001
  - Minimum latent period for most cancers is likely to be much higher than that for leukemia or thyroid cancer – of the order of 10 to 15 years or more
3. And it is certainly too early to evaluate the full radiological impact of the accident
  - Radiation-related solid cancers continue to occur decades after exposure



# So what is the cancer burden from Chernobyl?

- ◆ No clearly demonstrated increased cancer risk  
*... does not imply that no increase in risk has occurred.*
- ◆ It is expected that the low to moderate doses received will cause a small increase in the relative risk of cancer  
*... a small increase in the relative risk could mean **many** cancer cases, given the large number of individuals exposed*



## IARC WG on Cancer following the Chernobyl accident – Scope of work

- ◆ update of the map of dose distribution in Europe using new dosimetric models and radiological data;
- ◆ comprehensive examination of trends in cancer incidence and mortality in Europe over time and by radiation dose level;
- ◆ evaluation of the number of cancer cases (and associated uncertainties) possibly attributable to radiation to date and in the 80 years after the accident applying state-of-the-art risk models.

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### FAST TRACK

## Estimates of the cancer burden in Europe from radioactive fallout from the Chernobyl accident

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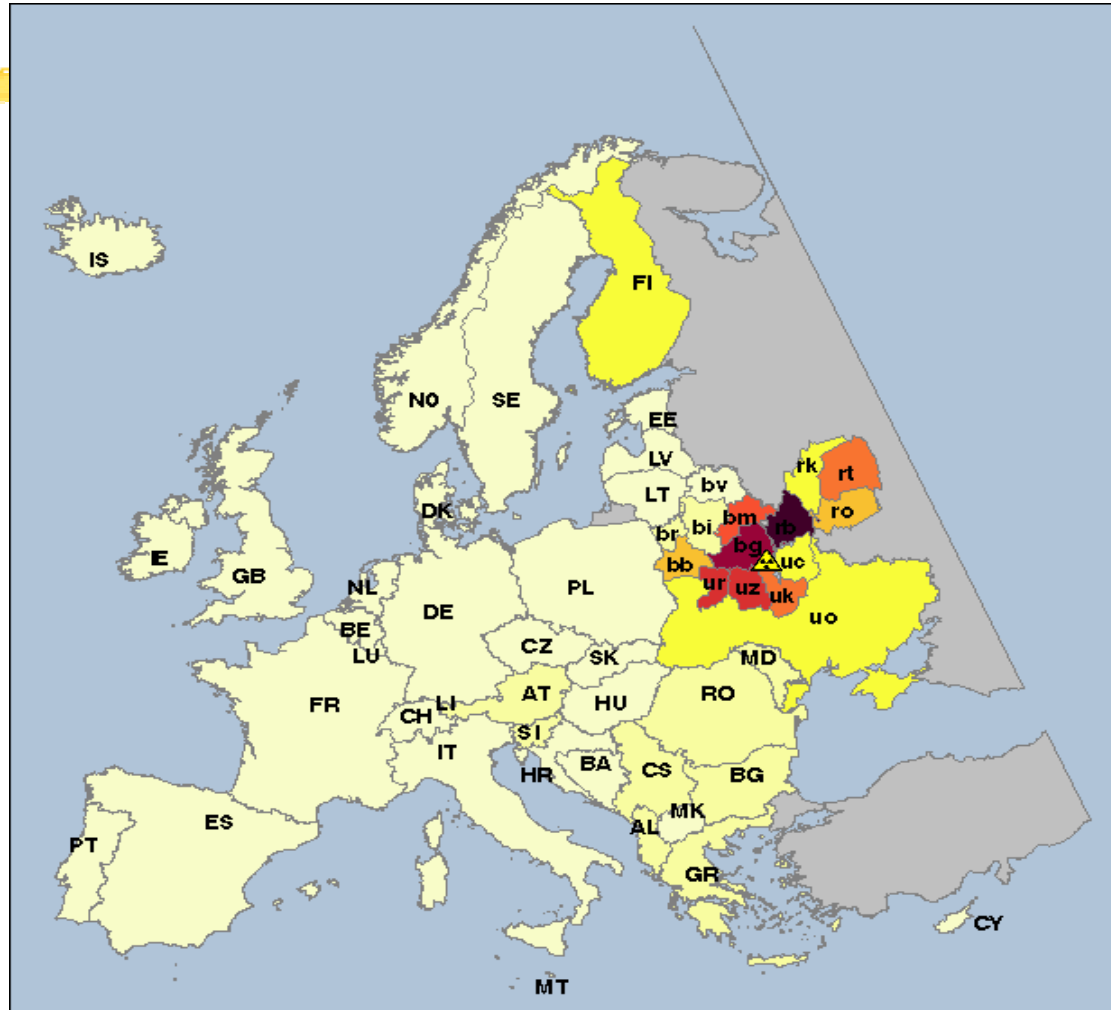
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The Chernobyl accident, which occurred April 26, 1986, resulted in a large release of radionuclides, which were deposited over a very wide area, particularly in Europe. Although an increased risk of thyroid cancer in exposed children has been clearly demonstrated in the most contaminated regions, the impact of the accident on the risk of other cancers as well as elsewhere in Europe is less clear. The objective of the present study was to evaluate the human cancer burden in Europe as a whole from radioactive fallout from the accident. Aver-

Epidemiological studies focusing on the most contaminated regions of the 3 most affected countries have confirmed a causal relationship between the observed increased risk of thyroid cancer and exposure to radioactive iodines from the Chernobyl fallout among those who were children or adolescents when the accident happened.<sup>3–5</sup> Other types of cancer, including leukemia, have also been investigated,<sup>1,6–17</sup> but as yet no association with radiation ex-

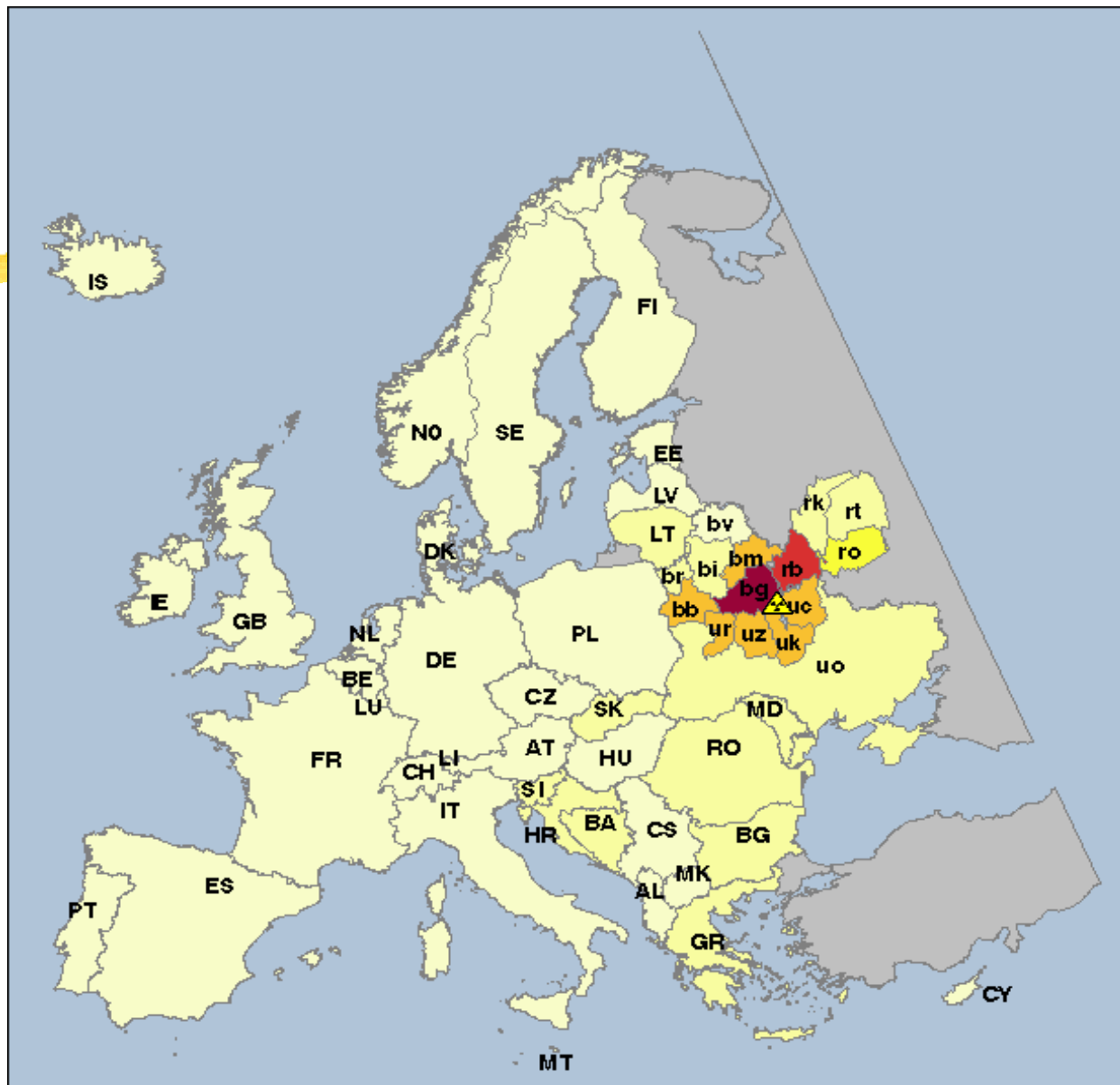


# Average country/region-specific cumulative whole body radiation doses 1986-2005 (mSv)





Average  
country/  
region-specific  
thyroid doses  
– children  
(mSv)



Dose in mSv    Less than 10    11-49    50-99    100-149    150-199    600-649





# Predictions – Europe

*(population 570 000 000 in 1986)*

## ◆ Thyroid cancer

- Up to 2065: 16 000 cases *(3 500 à 72 000)*
- Up to 2005: 1 000 cases *(200 à 4 400)*

*... two thirds of the cases predicted in Belarus, the Russian Federation and Ukraine.*

## ◆ Other cancers

- Up to 2065: 25 000 cases *(11 000 – 59 000 )*
- Up to 2005: 4 000 cases *(1 700 – 10 000 )*

*... half of the cases predicted in Belarus, the Russian Federation and Ukraine.*

## ◆ That is, over all, until 2065:

- 41 000 cases of cancer *(200 000 000 expected due to other causes)*
- 16 000 cancer deaths *(6 700 – 38 000 )*



# Comparison with previously published predictions

Population	Size of the population	Mean cumulative dose (mSv)	Predicted number of cancer deaths	Estimated AF%	Reference
Liquidators, evacuees and residents of strict control zones	600 000	66	4 000	3,5%	<i>Cardis et al, 1996<sup>2</sup>; cited in UN Chernobyl Forum, 2006<sup>6</sup></i>
Liquidators, evacuees and residents of strict control zones + persons living in "contaminated areas"*	~6 000 000	14	9 000	0,9%	<i>Cardis et al, 1996<sup>2</sup>; cited in UN Chernobyl Forum, 2006<sup>6</sup></i>
Europe**	~570 000 000	0,5	16 000 (6 700-38000)	0,01%	<i>Cardis et al 2006 –</i>
World			30-60 000		<i>EP Greens – TORCH report 2006</i>
World			200 000		<i>Greenpeace 2006</i>

\* <sup>137</sup>Cs deposition density >37 kBq/m<sup>2</sup>

\*\* excluding Andorra, San Marino, Turkey and most of the Russian Federation



# Conclusions - 1

- ◆ With the exception of thyroid cancer in the most contaminated regions, there is at present no increase in cancer rates that can be clearly attributed to radiation from the Chernobyl accident.
- ◆ Thus it is not possible to infer the possible cancer burden from the accident on the bases of studies of its health effects to date.
- ◆ *The estimation of the cancer burden from Chernobyl must rely on risk prediction models developed from studies of other populations exposed to radiation in other settings.*



## Conclusions - 2

- ◆ By 2065, these models predict that about 16,000 cases of thyroid cancer and 25,000 cases of other cancers may be expected due to radiation from the accident and that about 16,000 deaths from these cancers may occur.
- ◆ *About two-thirds of the thyroid cancer cases and at least one half of the other cancers are expected to occur in Belarus, Ukraine and the most contaminated territories of the Russian Federation.*
- ◆ The figures presented here give only an order of magnitude of the possible number of radiation-related cancers. *The uncertainty associated with these predictions is large.*



## Conclusions - 3

- ◆ While these figures reflect human suffering and death, they nevertheless *represent only a very small fraction (0.01%) of the total number of cancers* seen since the accident and expected in the future in Europe.
- ◆ It is unlikely therefore that the cancer burden from the largest radiological accident to date could be ever be detected by monitoring national cancer statistics.



# Future research needs

## ◆ Monitoring of disease trends

- Support to disease registries (cancer, congenital anomalies)
  - Useful for public health planning
  - Useful for epidemiological surveillance
- Maintenance of registries of exposed persons
- Monitoring of disease trends
  - Cancer incidence and mortality among liquidators and general population



## Future research needs *(cont'd)*

### ◆ Specific analytical studies – Current priorities

- Careful studies of selected populations\* and health outcomes
  - Leukemia and other cancers in liquidators
  - Breast cancer in young women in most contaminated districts
  - Thyroid cancer following  $^{131}\text{I}$  in adults
- Other priorities may arise in the future

\* *focus on specific populations that can provide information on the issues of concern*



## Conclusion – what will we learn?

- ◆ If priority studies can be conducted, they will allow
    - Direct evaluation of specific effects of radiation from the Chernobyl accident
    - Comparison with predictions
    - Possibly new information about radiation risks
- ... And perhaps, by 2011 or 2016, we will begin to be able to evaluate more fully the radiological impact of the accident*