How is STUK responding to emerging challenges?

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OECD/NEA Committee for Radiological Protection and Public Health Workshop

Science and Values in Radiological Protection

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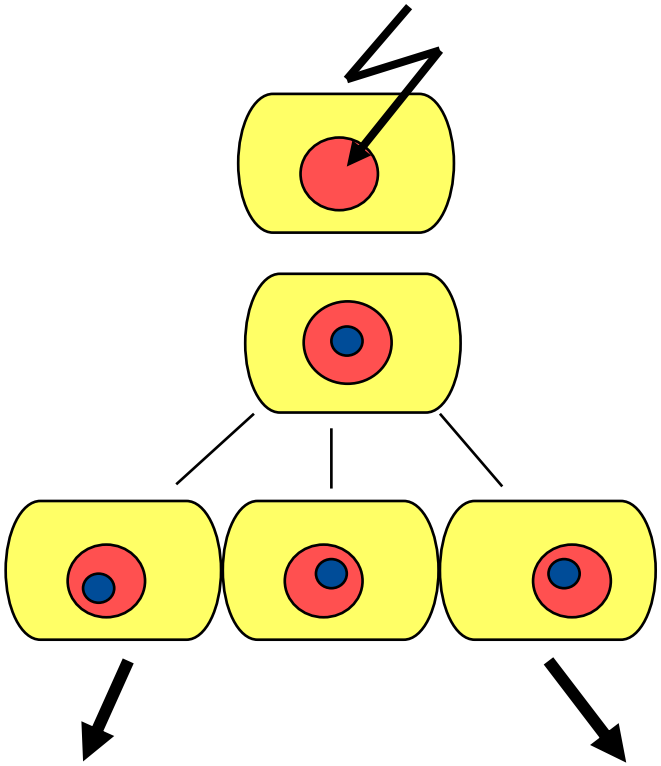
Activities and milestones in response to emerging challenges

- Lessons from Chernobyl - STUK as WHO Collaborating Centre
  - thyroid cancer in children - a sensitive subpopulation
  - WHO Guidelines on Stable Iodine Prophylaxis
- Scientific breakthroughs on non-targeted effects
  - delayed cell death (Seymour *et al.* 1986)
  - genomic instability (Kadhim *et al.* 1992)
  - bystander effect in vitro (Nagasawa and Little 1992, Prise *et al.* 1998)
  - bystander effect in vivo / 3-D (Watson *et al.* 2000, Belyakov *et al.* 2005)
- Organising international workshops and training courses
- STUK research priorities
- Coordination of international research projects
- Contribution to international research strategy

The classical paradigm in radiobiology - the basis of radiation-induced health effects



DNA damage induced at the time of exposure

mutation fixed in the first cell division (misrepair of damage)

clonal proliferation

cancer **hereditary effects**

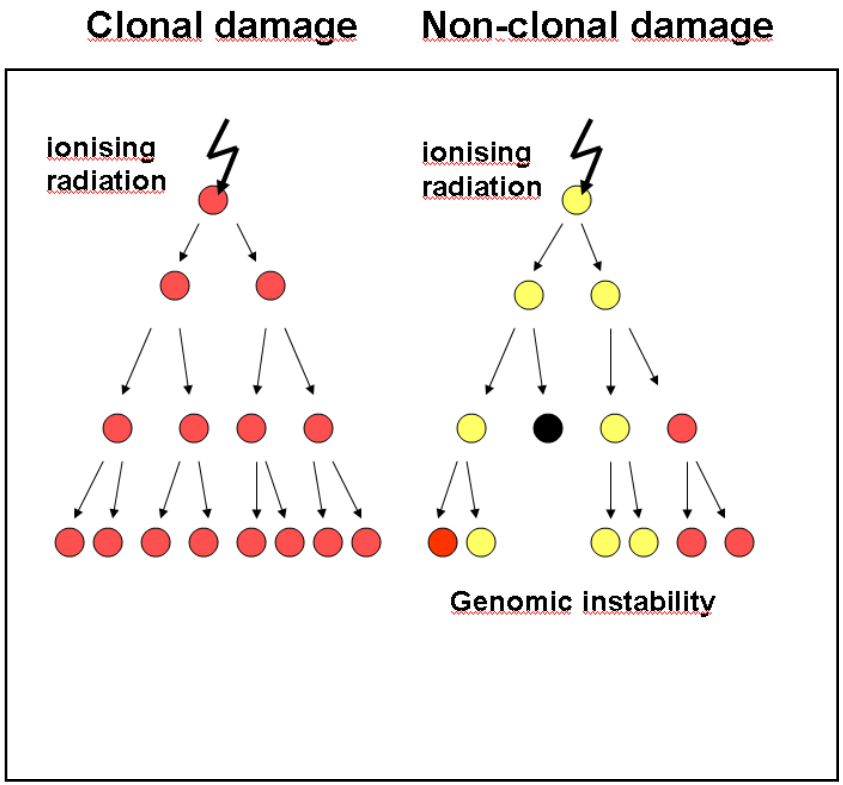
HEALTH EFFECTS

Genomic instability

The progeny of irradiated cells show

- occurrence of new aberrations and/or new mutations
- lethal mutations (delayed cell death)

These non-clonal effects occur in cells that have never been irradiated



International Workshop on Public Health Aspects of Radiation-Induced Genomic Instability

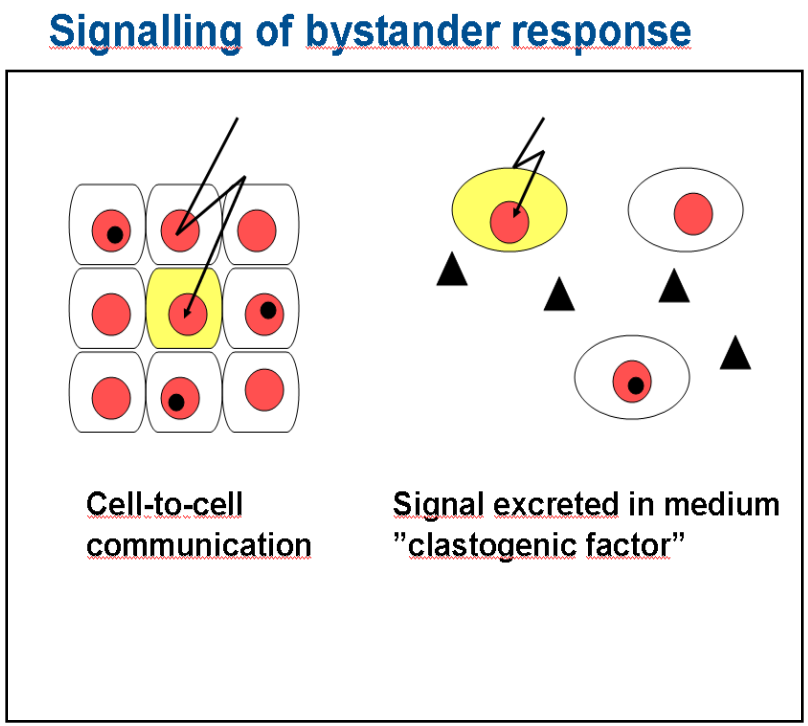
Helsinki 25-28 October 1995

STUK and WHO

Bystander effect

mutation and cell killing seen in cells that were not directly hit by radiation but were nearby

These effects occur in cells that have never been irradiated.



Minisatellite mutations and biodosimetry of population around the Semipalatinsk nuclear test site (SEMIPALATINSK)

- coordinated by STUK 1998-2000
- INCO COPERNICUS programme
- Kazakhstan, UK, Finland
- transgenerational effects after paternal exposure
- three-generation study
- minisatellites are non-coding DNA repeat sequences; mutations scored as changes in repeat number

Genomic instability and radiation-induced cancer (RADINSTAB) 2000-2003

- coordinated by STUK
- 5th Framework Programme, Euratom
- 9 European partners from Finland, UK, France, Germany, Sweden, Ireland
- induction and transmission of genomic instability
- relationship to radiation dose and quality
- delayed gene expression
- genotype differencies

RISC-RAD Training Course: Non-targeted effects of ionising radiation

14-16 February, 2005

Helsinki

Non-targeted effects of ionising radiation
Integrated Project, 2006-2010

General information

- Start date of the project: 1 September 2006
- Duration: 48 months
- 22 partner organisations
- Coordinating organisation: STUK - Radiation and Nuclear Safety Authority
- Project coordinator: Prof. Sisko Salomaa
- EURATOM Specific Programme for Research and Training on Nuclear Energy, 6th Framework Program
- Total eligible costs: 11.89 M€
- EC contribution: 6.33 M€

System of radiation protection

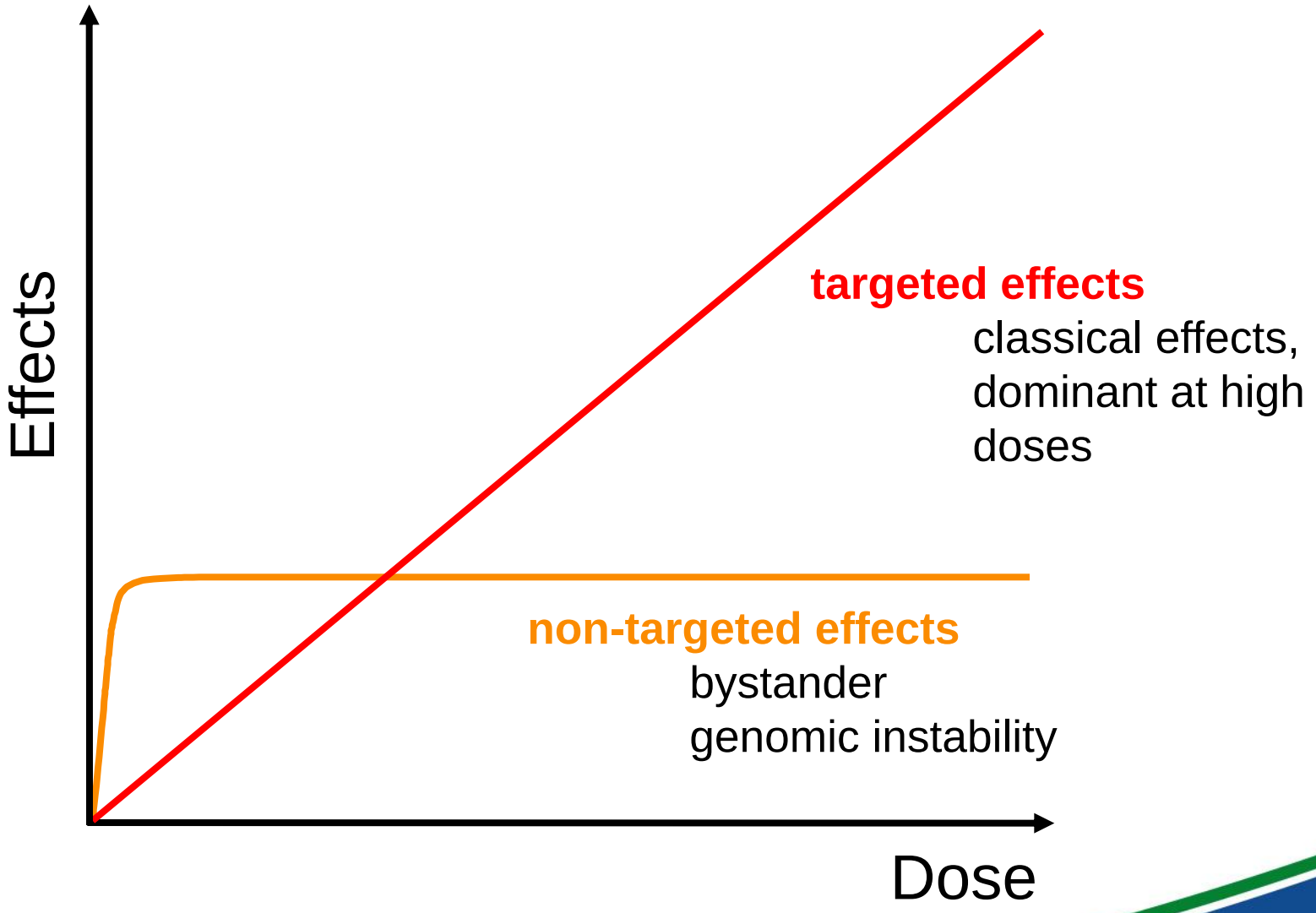
- Knowledge of radiation risk is based on direct epidemiological evidence, as well as scientific study of radiation biology
- The system is designed to protect against both deterministic and stochastic effects
- A linear, non-threshold (LNT) dose-response relationship is used for all long-term health effects (e.g. cancer, genetic effects)
- A dose and dose-rate correction factor is used to relate the effects of acute exposures to chronic exposures (DDREF)
- Radiation dose is used as a surrogate for risk
- The effects produced by different types of radiation are qualitatively the same
- Doses can be summed to predict overall risk

Concept of dose as surrogate of risk

LNT and radiation protection

- a linear dose response means that every increment of dose and the associated risk can be assessed separately, irrespective of prior or future doses, as long as doses are below deterministic effects
- a fixed dose increment is always associated with the same additional risk
- doses received by an individual at different time points can be summed up (cumulative dose)
- (collective dose can be used to predict risk at the population level)

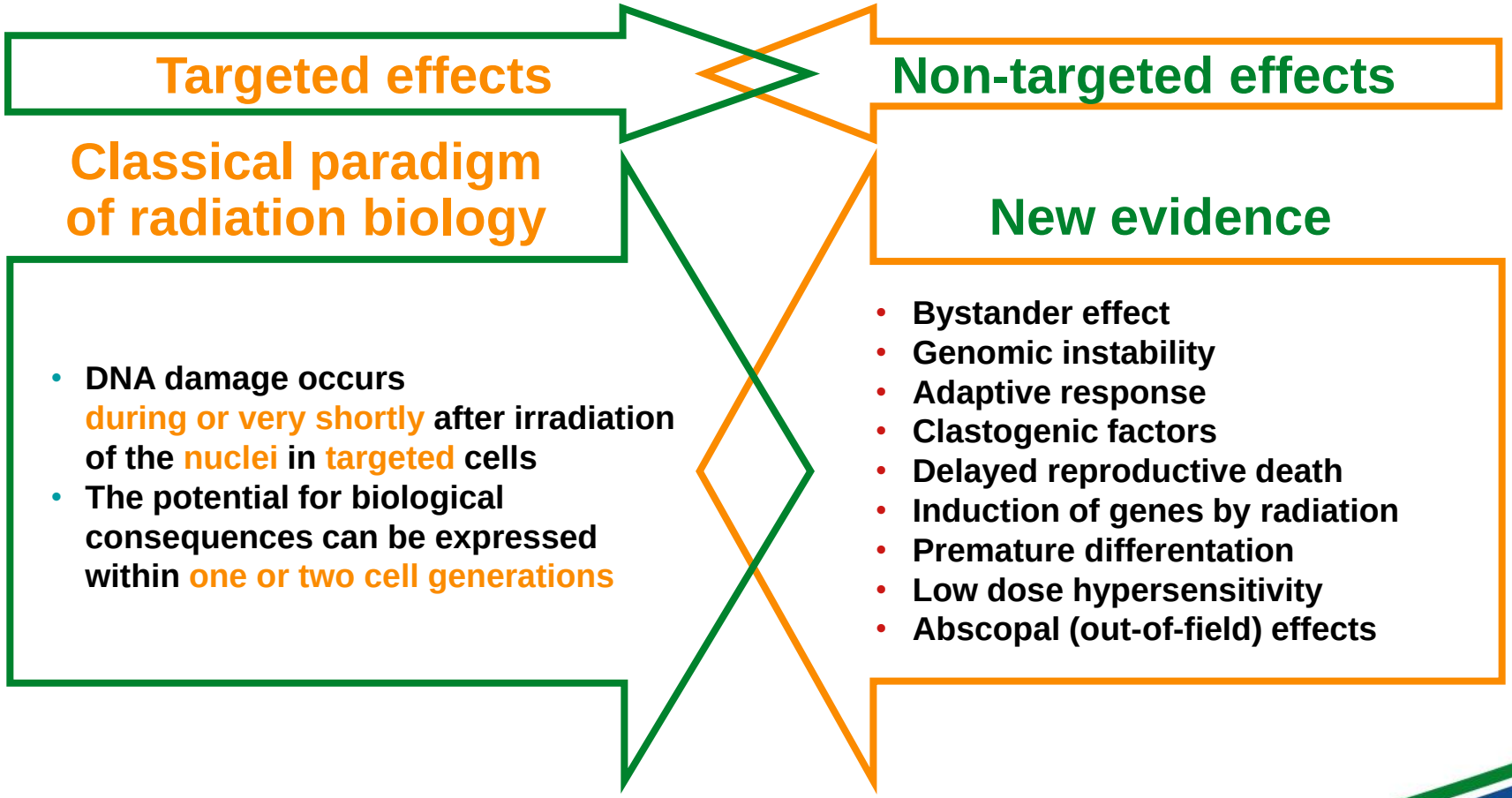
Low-dose effects



Non-targeted effects may be important

modifiers of risk at the low dose region

A new paradigm of Radiation Biology



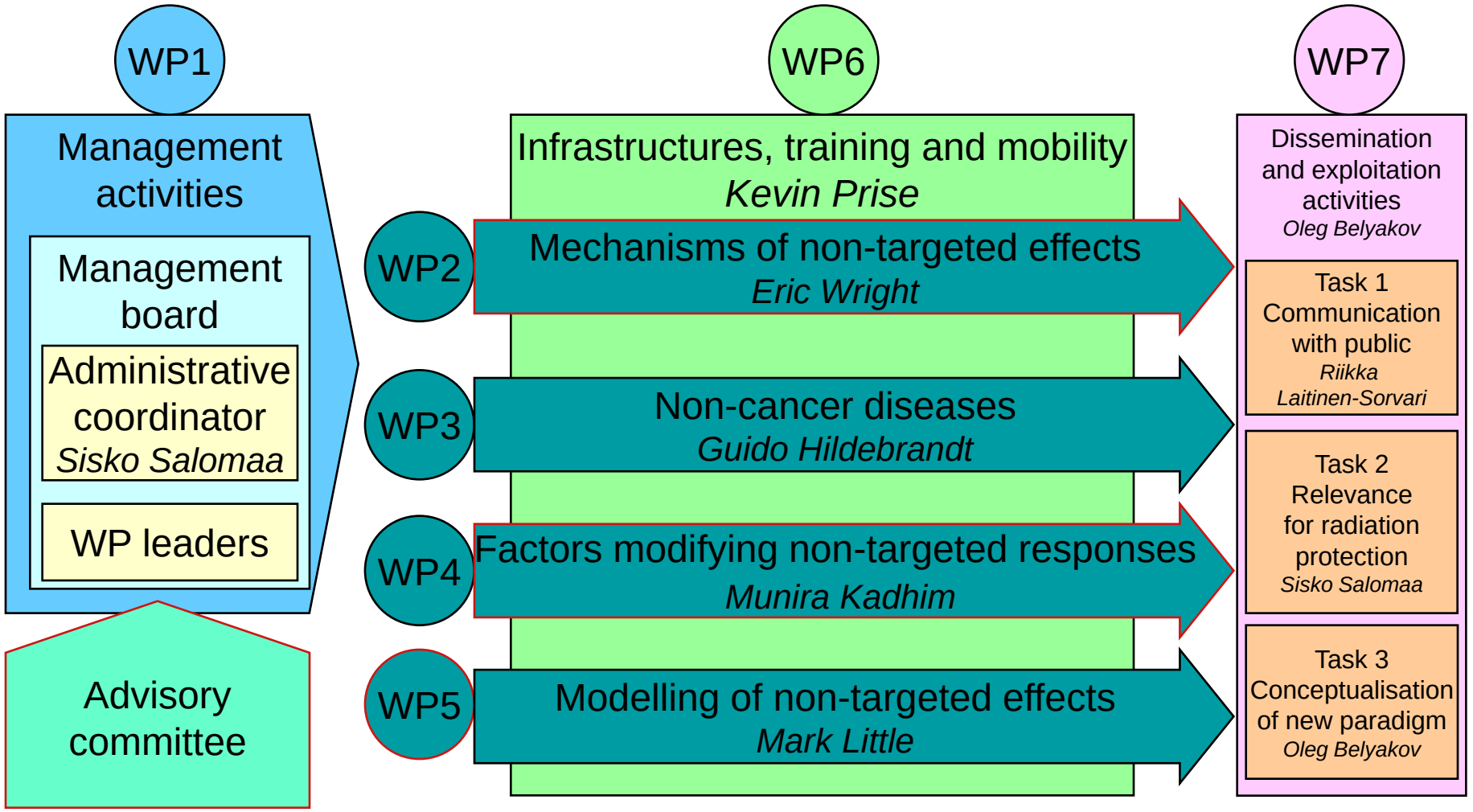
Paradigm shift

Classical paradigm

- DNA-targeted
- cells considered as isolated units
- clonal effects
- linear / linear quadratic dose response
- classical radiation biology (effects on DNA)
- physics, biophysics

New evidence

- non-targeted
- cells are communicating
- tissue responses
- non-clonal effects
- plateau-like dose response (on/off)
- need for new methodological approaches
- biology, biochemistry


WP1
Management activities
Management board
Administrative coordinator
Sisko Salomaa
WP leaders
Advisory committee
WP6
Infrastructures, training and mobility
Kevin Prise
WP2
Mechanisms of non-targeted effects
Eric Wright
WP3
Non-cancer diseases
Guido Hildebrandt
WP4
Factors modifying non-targeted responses
Munira Kadhim
WP5
Modelling of non-targeted effects
Mark Little
WP7
Dissemination and exploitation activities
Oleg Belyakov
Task 1
Communication with public
Riikka Laitinen-Sorvari
Task 2
Relevance for radiation protection
Sisko Salomaa
Task 3
Conceptualisation of new paradigm
Oleg Belyakov

General objectives of the NOTE IP …

- To investigate the mechanisms of non-targeted effects, in particular, bystander effects, genomic instability and adaptive response
- To investigate if and how non-targeted effects modulate the cancer risk in the low dose region
- To investigate if ionising radiation can cause non-cancer diseases or beneficial effects at low and intermediate doses
- To investigate individual susceptibility and other factors modifying non-targeted responses

General objectives of the NOTE IP

- To contribute to the conceptualisation of a new paradigm in radiation biology that would cover both the classical direct (DNA-targeted) and non-targeted effects.
- To assess the relevance of non-targeted effects for radiation protection and to set the scientific basis for a modern, more realistic, radiation safety system

NOTE website

http://www.note-ip.org

Key questions from the radiation protection policy point of view

- For cancer risk: is there a deviation from LNT at low doses?
- Can ionising radiation cause non-cancer diseases or modify their risk at low / intermediate doses?
- Are there differences in the radiation sensitivity between individuals?

➢ International collaboration is essential to solve these issues (Europe, US, Japan, Canada...)

OECD Nuclear Energy Agency Committee on Radiation Protection and Public Health

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