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Environmental Medicine环境医学

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Health: A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (WHO, 1948)健康不仅是指没有疾病或身体强壮，而是一个全面的生理、心理和社会幸福的状态。

Health is only possible where resources are available to meet human needs and where the living and working environment is protected from life threatening pollutants, pathogens and physical hazards” (WHO, 1992) 只有在能够满足人类需求的资源、免受致命污染物、病原体和物理危害的生活和工作环境中才会有健康

“Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature” (RIO Declaration principle 1; Agenda 21 adopted at the United Nations Conference on Environment and Development, Rio de Janeiro, 1992)

人类是可持续发展的核心，应该在与自然和谐共存的基础上拥有健康与创造性的生活（《里约宣言》，联合国环境发展大会-21世纪议程，里约热内卢,1992）

Environmental Medicine 环境医学

- **Protect humans from illness by regulation of the environment**
 - 通过调整规范环境来保护人类免受疾病困扰
- **Toxicology, epidemiology and risk assessment**
 - 毒理学、流行病学及风险评估
- **Exposure limit values**
 - 暴露/接触极限值
- **Environmental exposure and preventive measures in Sweden and EU**
 - 瑞典和欧盟的环境暴露/接触和预防措施

Examples of Environmental Health Hazards by category of Agent

环境健康危害的因素

**Physical, Chemical, Biological, Psychosocial ,
Mechanical** 物理性的、化学性的、生物性的、社会心理学的、机械的

- **Noise, Lighting, Radiation, Vibration, Temperature** 噪声、照明、辐射、物理震动、温度
- **Solvents, Acids/caustics, Metals (lead, cadmium, mercury)** 有机溶剂、酸腐蚀剂、金属（铅、镉、汞）
- **Dusts (asbestos, silica, wood) Pesticides** 粉尘（石棉、硅石、木材）、农药
- **Animals (rodents, wild stock, wild animals, pets as allergens)** 动物（啮齿类动物、野生动物、作为过敏原的宠物）
- **Bacteria Viruses Spores/fungi Insects** 细菌、病毒孢子、真菌昆虫
- **Load, muscoskeletal** 负荷 肌骨骼

Environmental factors and disease 环境因素和疾病

Major disease groups 主要疾病分类

- * **Cancer**: Ic: smoking, radon, (in door), metals
癌症：吸烟、氡、金属
- * **Respiratory disease**: air pollution; CO₂, NO_x, SO_x, aldehydes 呼吸疾病：大气污染、二氧化碳、氮氧化物、硫化物、醛类
- * **Allergic disease** 变态反应性/过敏性疾病
- * **Cardiovascular disease**: drinking water, Ca/Mg, lead, fat
心血管疾病：饮用水、钙/镁元素、铅、肥胖
- * **Effects on reproduction**: PCB, Pb, Hg, MeHg
生殖系统影响：废弃电路板、铅、汞、甲基汞
- * **Diseases of nervous system**: dementia, Alzheimer, metals 神经系统疾病：痴呆、老年痴呆症、精神疾病
- * **Other diseases**: kidney disease, osteoporosis, auto-immune 其他：肾病、骨质疏松症、自身免疫性疾病

Chemical agent 化学药剂

Exposure inhalation 吸入的药剂

- *air pollution society 空气污染环境
- *air pollution industry 空气污染工业

Exposure via food 通过食品

Exposure via skin 通过皮肤

Environmental factors and diseases

Dose-Effect; Dose – Response

环境因素与疾病
剂量效应、剂量-反应

metabolic models based on
critical organ, biological half life, kinetics
基于关键器官、生物半衰期、动力学的代谢模型

Are dental amalgam fillings a threat to the general population?

牙科汞合金填充物是否对普通人群构成威胁？

Risk estimation based on population not
by individual

基于人口群体而非个人的风险评估

Parents occupation and childrens' risk

父母的职业与孩子的风险

How to deal with chronic low-level exposure in the risk
management

在风险管理中如何处理慢性、少计量的污染物接触

Low exposure level -high exposure; large population; long time
少剂量的接触-高的浓度；人口众多；长期接触

Size of cut-off levels for biomarkers and population fraction
expected to be at risk

处于潜在风险的生物标记物和人口比例的限定值

Public Health and Environment - Preventing Disease through Healthy Environments

公共卫生与环境--通过健康环境预防疾病

- Environment for sustainable health development:
Prepare Action Plan for a nation
可持续健康发展环境：为一个国家制定行动计划
- **DALY (Disability adjusted life years)**
伤残调整生命年
- Burden of Disease
疾病负担

National regulatory rules and other legislation 国家法规与其他立法

In order to protect human health, the government in each country makes recommendations and set regulatory rules influencing human cadmium exposure

为了保护人类健康，每个国家政府都应提议并制定影响人类镉接触的管理条例

Prevention 预防

- Primary prevention prevents a disease to develop by elimination or reduction of risks e.g., stop smoking
首要预防方法：通过消除或减少风险来预防疾病，比如戒烟
- Secondary prevention early recognition in order to prevent natural development of disease
第二大预防方法：尽早发现，防止疾病发展恶化
- Tertiary prevention prohibits reoccurrence of disease or handicap.
第三大预防方法：阻止疾病再复发

Metals and Biological Monitoring

金属和生物监测

- Persistent and natural occurring in the environment
环境中持久和天然存在的
- Long biological half life 过长的生物半衰期
- Bioaccumulation 生物体内积累
- Toxic at low level exposure 少量接触的有毒物质
- Essential elements cause toxicity at high exposure
基本元素在高暴露中引起的毒性反应
- Reactivity 反应度

Metals: Critical organ/effect; Biological half life

金属：对主要器官影响；生物半排出期

Cadmium: Renal tubular
Dysfunction; Osteoporosis

镉：肾小管酸性中毒，功能紊乱，
骨质疏松

Mercury水银; Hg^0 ,
 Hg^{2+} , Methyl-Hg

Methyl-Hg 甲基汞

Hg^0

Org Hg^{2+}

Lead: Neuro toxicity, renal
dysfunction

铅：神经中毒，肾脏功能紊乱

Arsenic 砷

Kidney肾脏, 10-30; bone liver骨骼、肝脏
5-15 years; muscle肌肉 30 years

CNS less variation between different
organs ca 65-70 days中枢神经系统在不
同器官之间差异约65-70天

Different for different organs. Different
within brain 50 days, 100 days,
several years

不同器官间的差异.

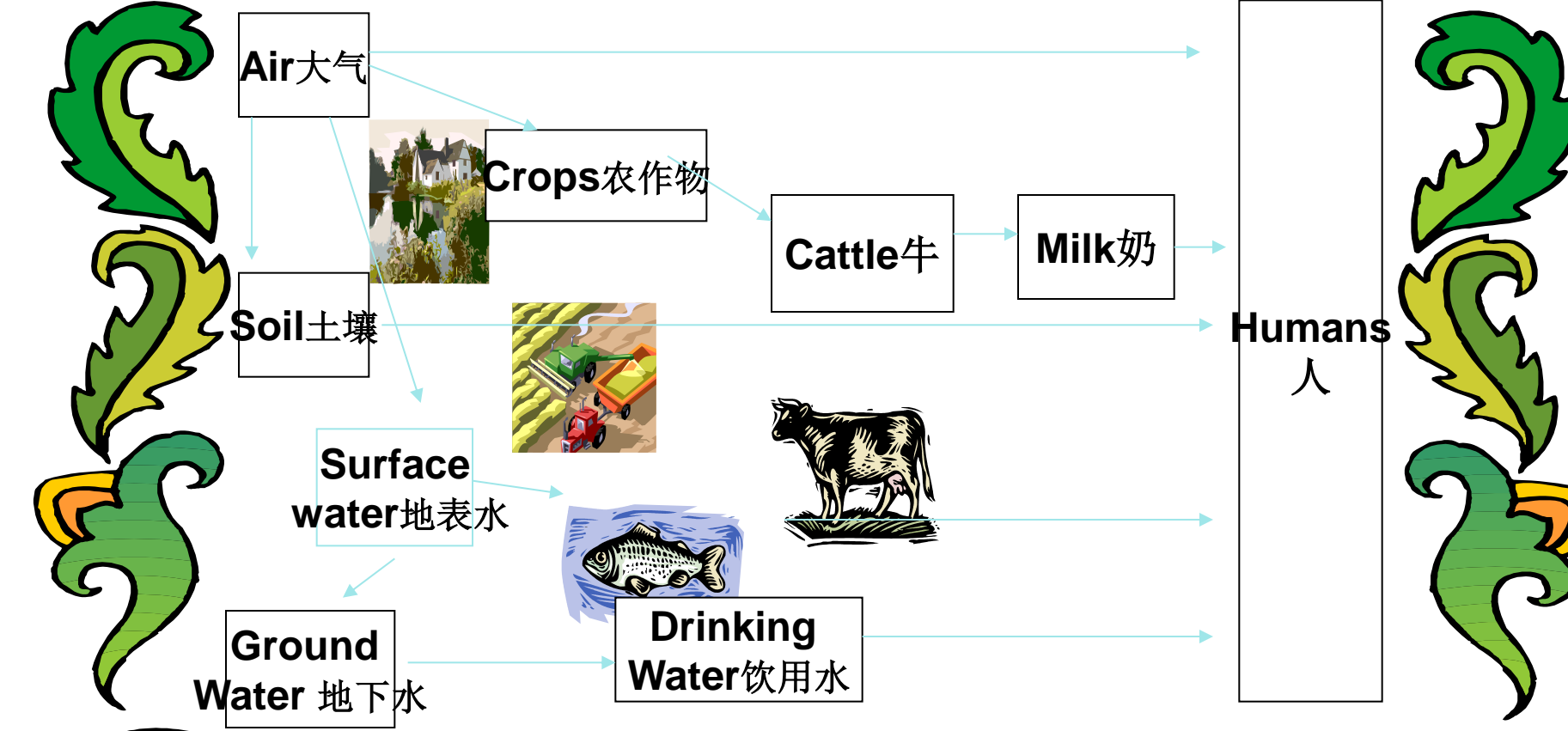
脑部差异：50天，100天，几年

Kidney肾脏

Blood 3 weeks, bone 5-20 years
血液3周、骨骼5-20年

CNS-children; Hb-synthesis-adult
中枢神经系统-儿童；血红蛋白合成-成人

Acute toxicity, cancer 急性中毒 癌症



Media for Biological Monitoring 生物监测媒介

Blood 血液
Urine 尿液
Feces 排泄物
Hair 头发
Exhaled air (Smell) 呼吸系统
Bone 骨骼
Teeth 牙齿

Biomarker in urine 尿液中生物标记物

Biomarkers 生物指示剂

Direct Biomarkers 直接的生物指示剂

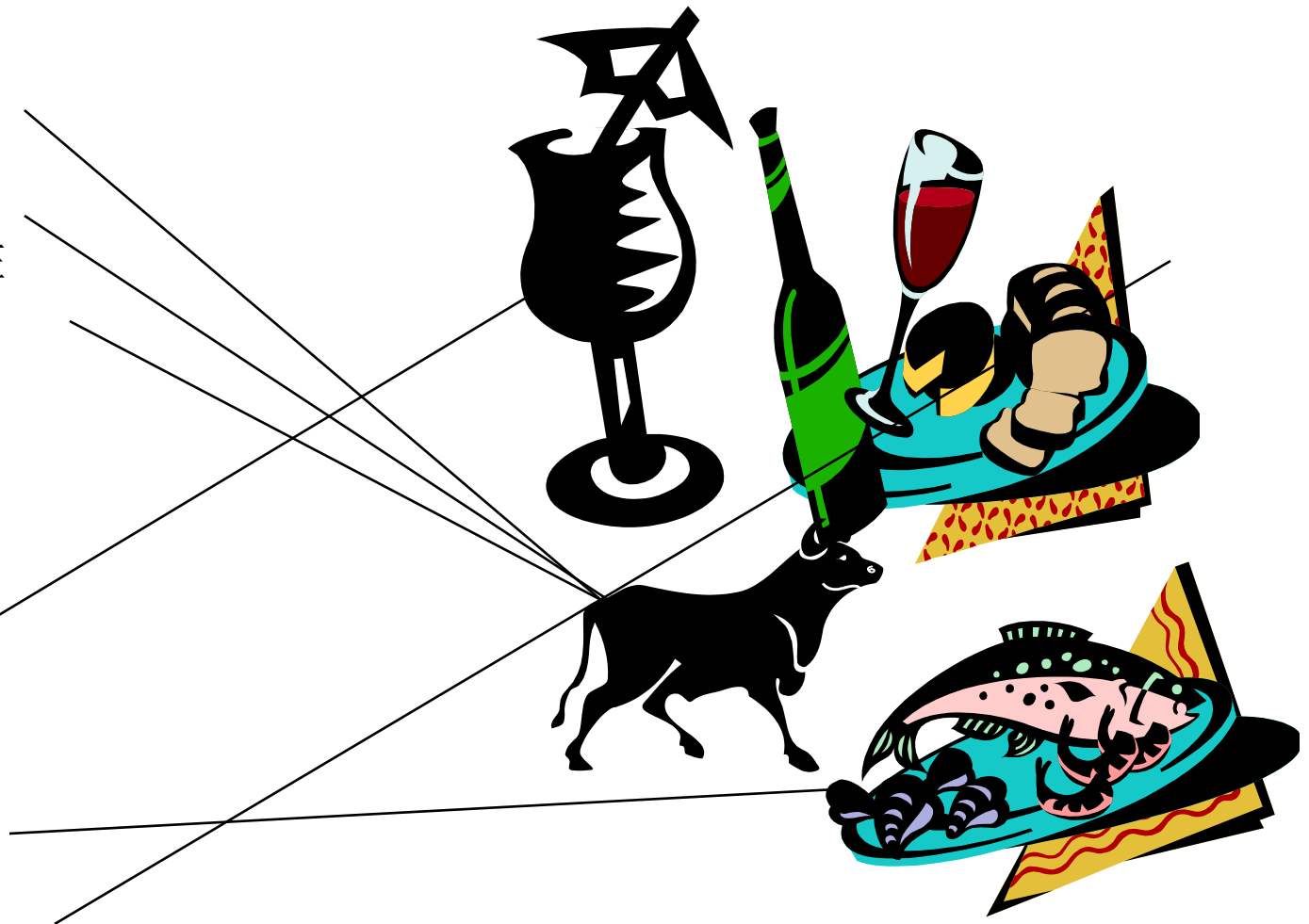
- **Cd in kidney (NAA, XRF)**
- 肾脏中的镉
- **Pb in bone (XRF)**
- 骨骼中的铅

Surrogate Biomarkers 替代的生物指示剂

- **Cd in urine**
尿液中的镉
- **Cumulative blood Pb index**
累积在血液中铅的指标

Cadmium in food 食物中的镉

- Beef 牛肉
- Liver 肝脏
- Kidney 肾脏
- Crab 螃蟹
- Oyster 牡蛎
- Rice 米饭
- Water 水
- Fish 鱼
- Bread 面包



- A health based guidance value for cadmium of 7 $\mu\text{g}/\text{kg}$ body weight (b.w.) per week (Provisional Tolerable Weekly Intake (PTWI)) was established previously by the Expert Committee on Food Additives. Joint FAO/WHO

之前由粮农组织/世界卫生组织（FAO/WHO）联合食品添加剂专家委员会公布标准，镉的摄入量每周不超过7微克每公斤体重

- EFSA's Panel on contaminants in the food chain has set a reduced tolerable weekly intake (TWI) for cadmium of 2.5 micrograms per kilogram of body weight. (1.0 μg Cd/g creatinine). Publication date: 20 March 2009

欧盟食品安全局（EFSA）污染物专家委员会设定镉周摄入量标准为每周每公斤体重2.5微克（1微克镉肌酸酐） 公布日期：2009年3月20日

Chronic cadmium toxicity 慢性的镉中毒

- **Renal damage** 肾损害
- *poisoning Japan, Belgium, England, China
- 日本、比利时、英国、中国的中毒事件
- **Bone effect** 骨骼影响
- *itai-itai disease (慢性镉中毒) 痛痛病
- China 中国
- **Cancer** 癌症

A specific environmental exposure-Japanese experience

Widespread exposure and sub-clinical effects

特定的环境暴露/接触—日本
大面积接触和亚临床影响

- “Itai-itai patients were found only in areas where water from Jinzu river was used for irrigation and the cause of the disease was cadmium”

仅在神通川河水灌溉的地方发现痛痛病患者，发病原因为镉中毒

- “A large number of people living in the cadmium polluted area have renal tubular dysfunction, and people in other polluted areas have the same health effects”

居住在镉污染地区的大部分人有肾小管功能障碍，居住在其他类型污染地区的人群也会产生同样的疾病症状

Bone effects of Cadmium 镉对骨骼的影响

- “Itai-itai disease is characterized by osteomalacia and renal tubular dysfunction” and is an unusual disease

痛痛病的症状是骨软化症和肾小管衰竭障碍，是一种非寻常疾病

- Cadmium gives likely rise to both osteomalacia and osteoporosis 镉会同时引发骨软化和骨质疏松
- age, sex, nutrition, exercise, number of pregnancies influence the type of bone effect

年龄、性别、营养、运动、怀孕次数都对骨骼有影响

- kidney damage leads to bone damage
肾功能损害导致骨骼破坏
- sub-clinical bone effects in cadmium exposed populations may be common and could contribute to more severe effects, such as fractures and kidney stones

镉摄入人群会有共同的亚临床骨骼效应，并能产生更严重的后果

如骨折和肾结石

Analyses分析

Blood血液

- Cadmium in whole blood全部血液中的镉元素

Urine尿

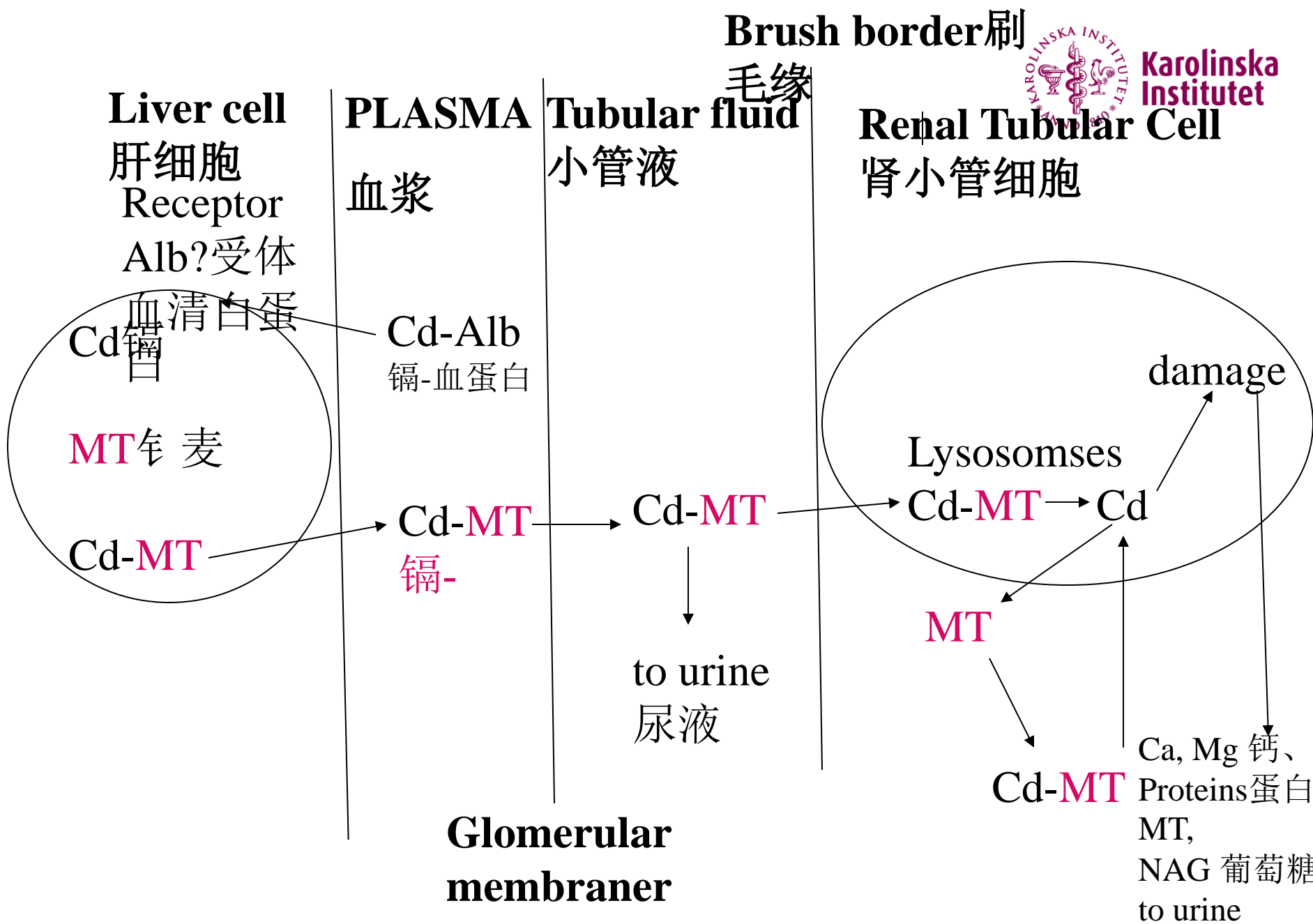
- Cadmium, β 2-microglobulin, albumin, retinol binding proteins, N-Acetyl--D-glucosaminidase activity, creatinine
- 镉, β 2-微球蛋白, 白蛋白, 视黄醇结合蛋白, 氮-乙酰-D-氨基葡萄糖苷酶活性, 肌酸酐

- Statistical 统计的
- Student's t-test 学生的检验
- χ^2 test χ^2 检验
- Multiple regression 多元回归
- Statistical significance $p < 0.05$
- 统计数据 $P < 0.05$

Biomarkers Cadmium exposure and Susceptibility

Metallothionein biomarker effect of exposure to cadmium 生物标记镉接触和敏感性金属硫蛋白效应

- **Blood**血液
 - Cadmium in blood 血液中的镉
- Isolation of lymphocytes for MTmRNA
分离淋巴细胞取得MTm核糖核酸
 - **Urine**尿
 - Cadmium in urine 尿中镉元素
- Metallothionein in urine 尿中的金属硫因



Input in Biological Monitoring-SCTM

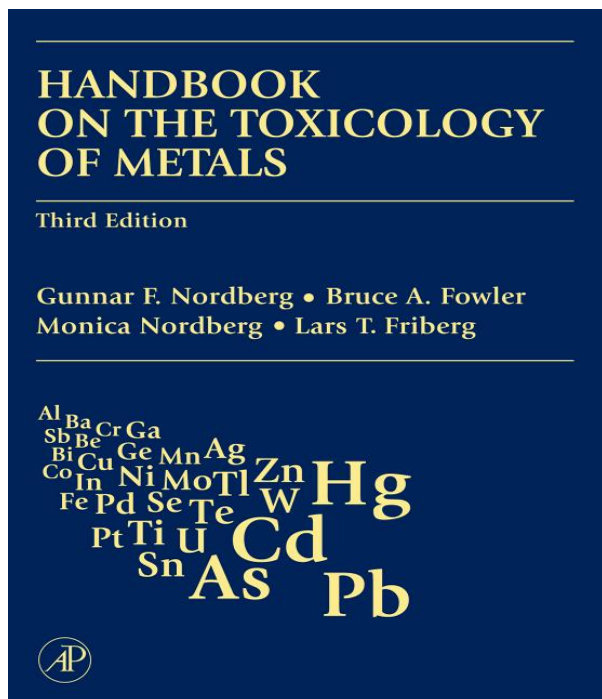
生物监测投入—干细胞转化医学（SCTM）

- SCTM introduced BM early in the activities and metals have since and thus become "model" substances for other chemicals.
SCTM活动早期引进BM，自此成为其他化学物质的“模板”
- BM work by SCTM has resulted in threshold limit values for metals in Occupational and Environmental Exposure giving rise to improved work environment.
BM针对在工作场所和生活环境中设定了金属阈限值，改进了工作环境
- Biological threshold limit values in practice for e.g., lead (Pb) and cadmium (Cd)
实践中的生物传输安全值，如铅、镉
- Training and educational programs which also has been applied in China已经应用于中国的培训和教育当中
- Preventive measures and Ethical issues 预防措施和道德影响
- SCTM has enthused and made other SCs aware of the importance of BM for all kind of Chemicals.SCTM鼓舞了其他SCs的热情也使其了解到了BM对于其他化学物品的重要性

3rd edition Handbook on the Toxicology of Metals; Members SCTM
chapter contributors and editors chairmen of SCTM, Nordberg, G.F, Fowler
B.A., Nordberg M., Friberg L T., Elsevier, 2007

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