Good, Bad & Ugly of Patient Exposure & Dose Tracking

Overview of Dose and Procedure Tracking: What, Why and How?

Madan M. Rehani, PhD
Massachusetts General Hospital,
Harvard Medical School, Boston
Duke Radiology and Medical Physics
Ex-International Atomic Energy Agency
madan.rehani@gmail.com
mrehani@mgh.harvard.edu

MASSACHUSETTS GENERAL HOSPITAL

Understanding tracking What?

Understanding tracking

1. Tracking of Individual patient's exposures or doses

2. Tracking doses of Group of patients

Terminology

- Patient exposures implies imparting of radiation
- Patient exposure tracking: Gives a sense of tracking of exposures (dose gets implied but in qualitative sense)
- Dose tracking: Specific focus on dose

Understanding Individual patient tracking

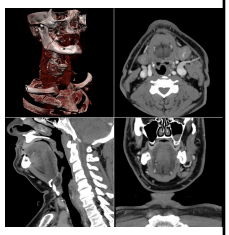
1. Individual patient exposures or doses
   A. Only procedure tracking (number & type of imaging studies)- Procedure or exposure tracking
   B. Doses involved in these studies- Dose tracking
   C. It does NOT automatically imply cumulative dose of an individual patient

Rehani MM. Tracking of examination and dose: overview. Radiat Prot Dosimetry. 2015 Jul;165(1-4):50-52.

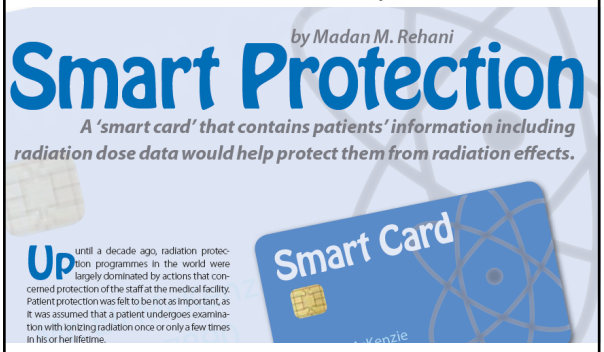
Understanding tracking

1. Individual patient exposures
2. Evaluating only previous imaging studies
   I. Clinical purpose (images)
   II. Avoid unnecessary exam (justification) >>>100% dose reduction

(Without consideration of dose)



IAEA Bulletin May 2009



Misconception & Myth

- ~~Radiation doses on a card with the patient~~
- Card like ATM card- No cash on card
- Credit Card- No credit on card
- Card acts as digital signature to access information on the server

Understanding tracking

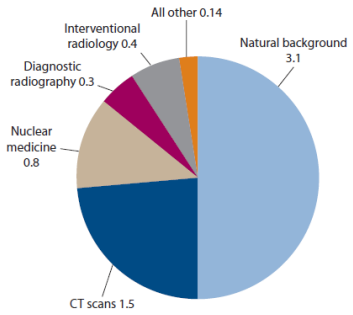
Doses from group of patients

- Has been done for decades (dose monitoring)
  - Effective doses or other dose indices
  - Collective dose
  - DRLs
  - dose registries
  - Dose records
  - Dose optimization

Tracking of dose to Group of Patients

- Has been quite prevalent (less barriers of confidentiality of patient identification)
- Comparing doses within an institution
- Comparing doses with others
- Accreditation

USA (NCRP)



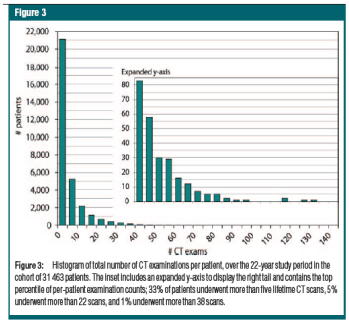
mSv contribution to population dose

Tracking of Individual patient doses Relatively New

WHY new focus on individual?

- DRLs not applicable to individual
- Risk estimates not applicable to individual
- We want to protect individual
- Day-to-day situations
- Regulatory requirements (California law)
- Individual patient doses are increasing

Number of CT Examinations

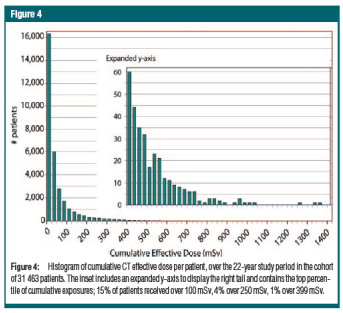


31,500 patients
190,712 CT examinations
22 year period

- 33%: ≥ 5 CT exams
- 5%: 22-132 exams

Sodickson et al. Radiology **251;** 175-184, 2009

Estimated Cumulative Dose



- 15%, ED > 100 mSv
- 4%, 250 -1375 mSv
- 1% >399 mSv

Sodickson et al. Radiology **251;** 175-184, 2009

Tracking of exposures & doses of an individual patient

Down the memory lane

Situation 2003-2008: Critics

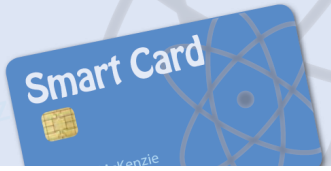
2030???

IAEA Bulletin May 2009

by Madan M. Rehani

Smart Protection

A 'smart card' that contains patients' information including radiation dose data would help protect them from radiation effects.



Up until a decade ago, radiation protection programmes in the world were largely dominated by actions that concerned protection of the staff at the medical facility. Patient protection was felt to be not as important, as it was assumed that a patient undergoes examination with ionizing radiation once or only a few times in his or her lifetime.

Madan M. Rehani

Une protection intelligente

Une carte à puce pourrait servir de carnet électronique d'irradiation médicale pour les patients qui le souhaitent.

Jusqu'à il y a une décennie, les programmes de radioprotection en médecine avaient principalement pour objet la protection du personnel médical. La protection des patients était jugée moins importante car on partait de l'hypothèse

ISR

Newsletter

International Society of Radiology
Jan Labsucagne, MD — Secretary-General

International Society of Radiology
7910 Woodmont Avenue, Suite 400
Bethesda, Maryland 20814 (USA)

Phone: 1 (301) 657-2652 x22
Fax: 1 (301) 907-8768
website: www.isradiology.org
E-mail: isr@isradiology.org

August 2009

IAEA MOUNTS EFFORT TO RECORD PATIENT DOSE

In April of this year, the International Atomic Energy Agency announced a new project to record medical radiation exposures to patients over a lifetime. Besides calling attention to the increased exposure from the growing volume of x-ray examinations, the IAEA also notes a jump in patient exposure from CT scans as distinct from traditional x-ray examinations, said Madan Rehani, an IAEA radiation safety specialist.

The IAEA has invited the ISR and other international organizations to participate in the design of a "smart card" which people might carry to record their radiation exposures over a lifetime. How such a system might function has not been determined, he said.

5) IAEA "SMART CARD" EFFORT TO CREATE RADIATION PASSPORTS

AAPM 2010

PHILADELPHIA, PA (July 22, 2010) -- Patients going from one radiology facility or one doctor to another, or indeed moving from one country to another, can leave a confusing trail of documentation about radiation exposure in radiological examinations. M. Rehani, who works at the International Atomic Energy Agency (IAEA) in Vienna, Austria, will report today at the 52nd meeting of the American Association of Physicists in Medicine (AAPM) on efforts to develop an international system for tracking patient exposures. The idea was first broached in 2001 but became an active program only around 2008.

Called a Smart Card/SmartRadTrack, the system ultimately may be something like an ATM card. It does not contain money on it but allows one to use the card to access money and account details. For the patient, radiation exposure history is sufficient whereas for health authorities radiation dose information is needed. Aggregate data obtained through the eHealth system would enable countries to establish radiation and exposure standards and help in future epidemiological studies. This would require manufacturers to develop equipment and software for tracking procedures and doses.

The presentation " IAEA Smart Card Initiative for Patient Exposure" by M Rehani will be at 8:30 a.m. on Thursday, July 22, 2010 in Room 202 of the Pennsylvania Convention Center.

ABSTRACT: http://www.aapm.org/meetings/amos2/pdf/49-14438-62523-620.pdf

From: Suzanne H. Reuben [mailto:progressive_hlth@msn.com]
Sent: Thursday, 04 June 2009 20:28
To: HANSEN, Kirstie
Subject: IAEA YouTube Video -- Enhanced Radiation Protection of Patients Needed

Dear Ms. Hansen:

I am Chief Writer for the U.S. President's Cancer Panel, and am currently working on the Panel's 2008-2009 report to President Obama.

A longtime friend at IAEA, Laura Rockwood, forwarded to me the Agency's YouTube video on excess medical radiation exposure, a topic that will be part of the Panel's report on environmental factors in cancer.

Two statistics included in the video caught my attention and I am hoping you can provide or refer me to the literature references for them:

- One average CT equals about 500 chest x-rays
- Radiation doses potentially can be reduced in many imaging examinations by up to 50 percent

Thank you for any information you can provide.

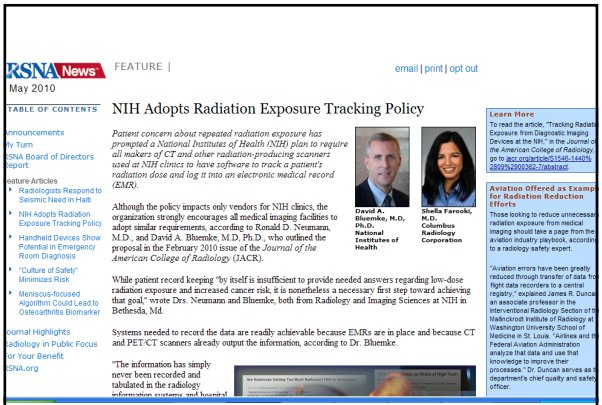
Sincerely,

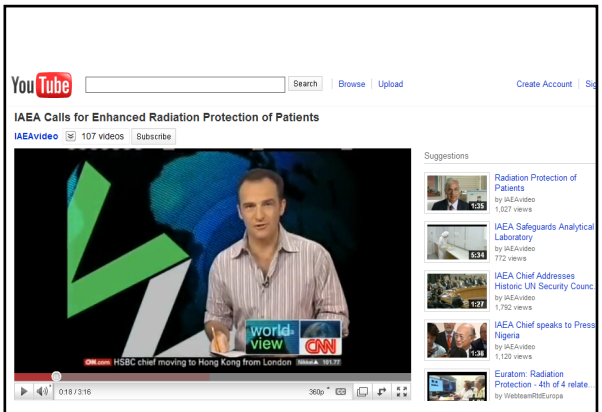
Suzanne H. Reuben
President
Progressive Health Systems
Communications for Science and Health
9105 Paddock Lane
Potomac, Maryland 20854-2336

...a third of all CT scans practically could be replaced by other approaches or don't have to be performed at all. But it's going to be really hard to target this one-third because there are so many pressures on physicians to do CT scans.

DAVID BRENNER
COLUMBIA UNIVERSITY MEDICAL CENTER

The public is largely unaware of the radiation doses delivered by CT, positron emission testing, and other examinations that involve ionizing radiation, or of potential lifetime medical radiation doses and associated cancer risk. Speakers suggested that if patients were more aware of radiation exposure due to specific tests and the cancer risk that can accrue with cumulative medical radiation exposure, they might be more likely to raise this issue with their physicians. Doctors then may suggest alternatives that do not involve radiation (e.g., blood tests, magnetic resonance imaging, ultrasound) but still yield sufficient diagnostic information. A recently initiated international project would facilitate such doctor-patient discussions; efforts are underway to develop "smart cards" on which all radiation doses received by an individual are recorded.[2] This information, when shared by the patient, also could prevent unnecessary repeat scans and would overcome data gaps





Outcomes

- Implementation by Industry in few years
- Difficult to find another example
- Call for action>>>>>>>>>>>CNN
- Some countries already having experience
- Enthusiasm in others to establish

How ?

AJR April 2013, 771-775

AJR FOCUS ON: AJR JOURNAL CLUB

How Tracking Radiologic Procedures and Dose Helps: Experience From Finland

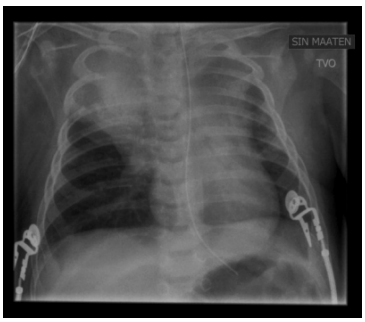
Raija Seuri[1]
Madan M. Rehani[2]
Mika Kortesniemi[3]

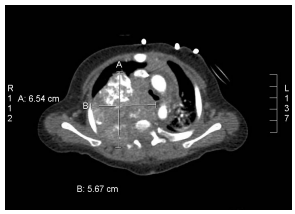
OBJECTIVE. The purpose of our study was to review the experience of tracking radiologic procedures and radiation dose for individual patients in terms of impact on justification and optimization.

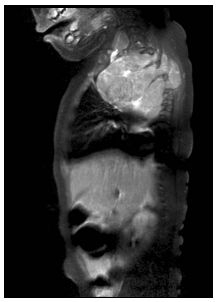
MATERIALS AND METHODS. Examples were collected at the Hospital for Children

CONCLUSION. Patient-specific justification and optimization becomes possible using the tracking of radiologic procedures and radiation dose of individual patients.

6 mo boy, neuroblastoma of the posterior mediastinum







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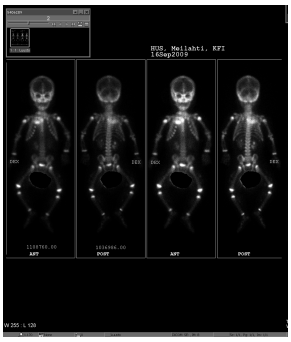
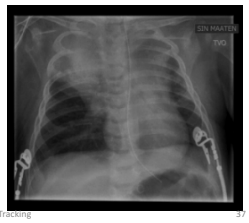


Bone scan shows increased uptake in the upper ribs on the right.



Case Report: 1 (Justification)

- 6 month old boy diagnosed with neuroblastoma of the posterior mediastinum.
- The initial imaging included CT of the thorax as well as abdominal MRI.
- Bone scan performed two weeks later showed increased uptake in the posterior upper ribs on the right.
- Alarmed the oncologist to think of metastases in the ribs and thus a request for new CT scan.

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Case Report: 1 (Justification)

- Re-evaluation of the previous CT, showed erosion of the ribs by the tumour, which is a usual phenomenon with this kind of tumour but which was not mentioned in the initial report.
- **Thus no further imaging was justified and a new CT scan was avoided**

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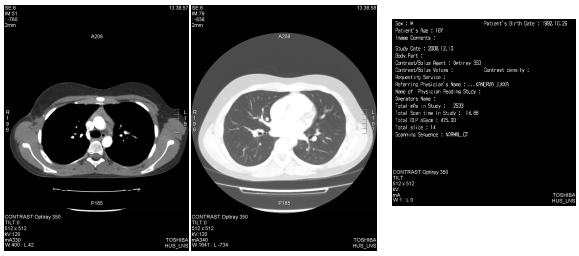
Case 2

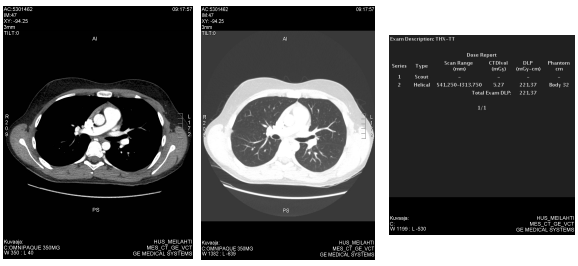
Boy 16 y, osteosarcoma of the femur, CT chest for metastasis survey

Dec 2008, DLP 475 mGy*cm



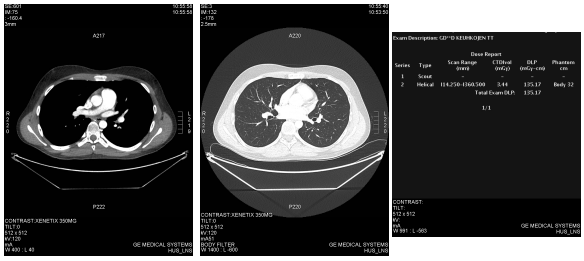
Boy 16 y, osteosarcoma of the femur

Oct 2009 CTDI 5.27mGy, DLP 221mGycm



Boy 16 y, osteosarcoma of the femur

May 2010 CTDI 3.44 mGy, DLP 135 mGycm



Case Report 2 (Optimization)

- **Boy 16 y, osteosarcoma of the femur.**
- **Initial imaging: CT of the chest (old scanner in 2008). DLP 475 mGy.cm.**
- **Follow-up examination in 2009,in another hospital but connected by PACS.**
- **DLP 221 mGy.cm.**
- **New scanner DLP 135 mGy.cm. Good image quality despite such low dose values**

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Case Report 2 (Optimization)

- **Feedback was provided to facilities that provided higher doses for the same study for the same patient**
- **It helped them to optimize**
- **Thus tracking provided opportunities to strengthen optimization of patient protection**
- **Patient acting as a self control for comparison (not comparison to DRL)**
- **Fundamental issue of Individual optimization**

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Case Report 3 (Justification & Optimization)

- **A 7-year-old boy had been operated for omphalocele at another hospital soon after birth.**
- **He had been doing quite well but had lately developed elevation of liver transaminase levels during infections.**
- **A pediatric gastrointestinal surgeon in the Hospital for Children and Adolescents in Helsinki, Finland, was consulted, who suggested CT angiography because of the anomalous anatomy.**

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Case Report 3 (Justification part)

- **CT of the abdomen had been performed for the same reason in the local hospital, although only in one vascular phase.**
- **The study was sent electronically to the PACS at the Hospital for Children and Adolescents and was found to be sufficient for vascular analysis.**
- **Thus, CT angiography could be avoided.**

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Case Report 3 (Optimization part)

- The scanning metadata also included radiation parameters, such as kVp, tube current, and exposure indices (DLP and CTDIvol).
- The analysis of radiation dose data, together with the image quality, revealed lower exposure than in normal practice, 0.79 mGy compared with 1.7–2.0 mGy (32-cm phantom) with a child about the same size.
- This provided the need for further optimization with specific CT unit and validate the outcome of successful optimization

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Common point

- **The common denominator in all such examples is the specific patient who acts as a control for comparison.**
- **This perspective is markedly different from merely comparing average values with variable sample populations between facilities, which is the approach used traditionally.**

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Experience of patient exposure tracking indicates that it leads to

- Strengthening the process of justification by avoiding another examination
- Strengthening the process of optimization
- Information for audit of patient doses for quality assurance purpose

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Future of optimization

- **Based on**
  - **the individual patient**
  - **Doses for indication based examination**
  - **Suggested settings**
- **Whole new area of optimization, departure from DRLs**

2008

- **What tracking means?**
- **Why track?**
- **What to track?**
- **How to track?**
- **Usefulness of tracking?**

2017

- **What to do with dose information from tracking?**
- **Should dose be used for justifying next examination?**
- **How to deal with cumulative dose information?**

Tracking of individual patient

How to make it happen?

Foremost necessity

Use of permanent ID of patient

AJR FOCUS ON:

Radiation Exposure Tracking: Survey of Unique Patient Identification Number in 40 Countries

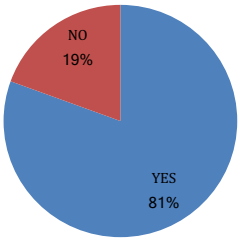
Madan M. Rehani[1]
Theocharis Berris

OBJECTIVE. The purposes of this study were to survey in 40 countries the availability and use of unique patient identification numbers for radiologic examinations to facilitate radiation exposure tracking and to address plans for nationwide use of PACS networks and regulations in support of tracking.

Countries who responded to IAEA survey

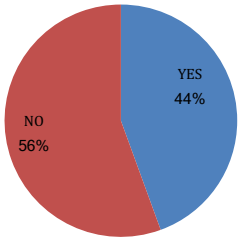
Algeria, Argentina, Armenia, Bosnia and Herzegovina, Bulgaria, Colombia, Costa Rica, Czech Republic, Egypt, Estonia, Finland, Greece, Honduras, Hong Kong (China), Ireland, Ireland, Kenya, Lithuania, Malaysia, Macedonia, Malta, Mexico, Moldova, Montenegro, Portugal, Nicaragua, Romania, Russian Federation, Serbia, Singapore, Slovakia, Slovenia, Spain, Sri Lanka, Sudan, Tajikistan, Tanzania, Uruguay

Is there a unique permanent identification number for every person in the country valid for life?



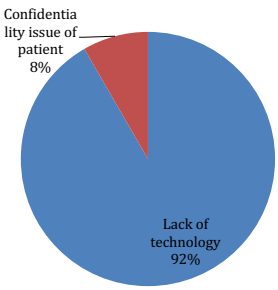
Total=36

Is this permanent number used for X ray examinations whenever a person visits a hospital?



Total=36

If this number is NOT used, it is because of :



Percentages out of 20 answers!!

Unfortunately in USA, there is no usage of permanent ID for health care across various service providers (except in VA)

Framework development

Rehani MM, Berris T. Radiat Prot Dosimetry. 2014 Jan;158(1):36-42.

TEMPLATES AND EXISTING ELEMENTS AND MODELS FOR IMPLEMENTATION OF PATIENT EXPOSURE TRACKING

Madan M. Rehani* and Theocharis Berris
International Atomic Energy Agency, Radiation Protection of Patients Unit, Vienna International Centre, PO Box 100, A 1400 Vienna, Austria

*Corresponding author. madan.rehani@gmail.com

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There is wide interest currently in patient exposure tracking. This paper provides templates for implementation of tracking at the practice (hospital) level, multi-practice level, national level and international level. It provides suggestions for implementation in less-resourced countries. It includes elements such as patient identifier, dose quantities that should be covered and how to make sense from dose figures, availability of digital imaging and communications in medicine files with dose information or structured dose reports and capabilities of picture archiving and communication system (PACS). While tracking at several hospitals in a country connected by PACS and nationwide PACS is also a reality, tracking at the international level is currently a challenge. Guidance provided in this paper will facilitate its implementation at all levels.

Table 2. Potential benefits of patient radiation exposure tracking.

(I)	Benefits to patients
(a)	Receiving minimal radiation exposure needed for optimal care
(b)	Knowledge that there is accountability/responsibility in the delivery of medical radiation
(c)	Facilitation of dialogue with health care providers regarding radiation exposure
(d)	Improvement in patient confidence in health care providers' care
(II)	Benefits to health care providers referring patients for imaging/intervention
(a)	Improvement in justification including decision support
(b)	Control of resources/costs from unneeded duplicate tests
(c)	Minimisation of radiation effects by tracking cumulative exposure
(d)	Assistance in choosing among imaging/intervention providers and facilities
(e)	Assistance in choosing between modalities and techniques
(f)	Facilitation of dialogue with patients regarding radiation exposure
(g)	Improvement in patient confidence in health care providers' care
(III)	Benefits to health care providers involved in performance of imaging/intervention
(a)	Improvement in justification including decision support
(b)	Control of resources/costs from unneeded duplicate tests
(c)	Minimisation of radiation effects by tracking cumulative exposure
(d)	Assistance in protocol optimisation
(e)	Establishment and continuous review of reference levels
(f)	Dosimetry feedback mechanism for health care provider quality improvement
(g)	Facilitation of dialogue with patients regarding radiation exposure
(h)	Improvement in patient confidence in health care providers' care
(IV)	Benefits to policymakers
(a)	Improved quantitative tools to protect the public health and safety
(b)	Improved quantitative approaches to radiation safety policymaking
(c)	Control of resources/costs from unneeded duplicate tests
(V)	Benefits to regulators
(a)	Establishment and continuous review of reference levels
(b)	Data-rich regulatory environment enabling assessment of practice patterns beyond a single reference level
(c)	Ability to quantitatively audit individual providers, practices and facilities
(VI)	Benefits to researchers
(a)	Extensive and robust radiation safety data sets to address research questions
(b)	Incorporation of patient-specific radiation metrics into research studies, including observational, epidemiologic, comparative effectiveness, outcomes and randomised control
(c)	Quantitative basis for development of best practices
(d)	Incorporation of radiation metrics into appropriateness criteria
(VII)	Benefits to researchers
(a)	Facilitation of partnership with other stakeholders in establishing radiation cumulative exposure programmes

Home » News

Joint Position Statement on the IAEA Patient Radiation Exposure Tracking

The IAEA Smart Card/SmartRadTrack Project aims at enhancing the implementation of principles of justification and optimization for radiation protection of patients. As quoted from Robert Glass earlier in the summary of the first meeting of the Smart Card Project, "Managing in the presence of data is far better and easier than managing in its absence". It is believed that referring physicians will be in a better position to achieve appropriateness when provided information about previous radiological examinations and radiation doses of patients. A recent survey by the IAEA among referring physicians, currently under publication, confirms this belief.

The joint position statement is currently endorsed by the World Health Organization (WHO), the U.S. Food and Drug Administration (FDA), the European Society of Radiology (ESR), the International Organization for Medical Physics (IOMP), the International Society of Radiographers and Radiological Technologists (ISRRT) and the Conference of Radiation Control Program Directors (CRCPD) of USA.

Summary of the statement: Radiation protection of patients includes accountability for radiation exposure from multiple medical imaging procedures. While there are challenges, it has become increasingly necessary for organizations and professional communities to embrace a patient radiation exposure tracking programme for many reasons, in particular patient safety and welfare.

It is believed that organizations involved will take necessary actions to standardise the dose data provided by imaging equipment. It is important to be aware that, currently, only dose estimates are provided and not the actual individual patient dose. There is need to standardise the terminology of examinations.

Cover note by the Director of the Division of Radiation, Transport & Waste Safety »

Full text of the statement »

Joint Position Statement

- World Health Organization (WHO),
- U.S. Food and Drug Administration (FDA),
- European Society of Radiology (ESR),
- International Organization for Medical Physics (IOMP),
- International Society of Radiographers and Radiological Technologists (ISRRT) and
- Conference of Radiation Control Program Directors (CRCPD) of USA.

Looking back

- **It was good that I did not pursue it aggressively in 2003-2007**
- **Ahead of time**
- **Radiation units were not as matured (IAEA TRS -2007, ICRU 74-2006)**
- **PACS not talking to each other**
- **e-Health was in infancy**
- **Reports of few tens of or of ≥100 mSv doses to an individual were not there, but we predicted it to come**

How to use information?

Tentative

- **The decision for the examination at hand should primarily be based on benefit versus risk of current examination but there should also be an awareness of risk from patient's prior radiation history.**
- **Holistic reflection of the quality and safety of patient's care**

Cumulative dose (Ugly?)

- **An area which is yet to mature**
- **Like in case of occupation exposure, despite availability of lifetime record, what really matters is the 5 year slot.**
- **Likewise, from clinical standpoint what may be of use is the examination done in past 2 years**

Future

- **Future: ? Dose constraints for patients**
- **If the concept of dose constraints is accepted, there may a value of cumulative dose e.g. in research subjects currently**
- **Yellow light, rather than red**
- **Cultural shift from ALWAYS green**
- **Utility in epidemiological studies**

Recap

- **What? Understanding tracking: Individual patient's versus group of patients, exposure tracking vs dose tracking**
- **Why tracking**
- **How did it start and initial years, momentum through Call for action**
- **Patient ID (Crucial for individual tracking)**
- **Case reports from published paper**
- **Patient acting as his/her control (optimization)**
- **Future**

Some publications

- Rehani M, Frush D. Tracking radiation exposure of patients. Lancet. 2010 Sep 4; 376(9743):754-755. [47 citations]
- Rehani MM, Frush DP. Patient exposure tracking – the IAEA smart card project. Radiat Prot Dosimetry. 2011 Sep;147(1-2):314-316 [43 Citations]
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- Mercuri M, Rehani MM, Einstein AJ. The Need for an Integrated Approach to Tracking Radiation Exposure: Challenges with Nuclear Medicine. J Nucl Card June 2012. Oct;19(5):895-900

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Thank You

madan.rehani@gmail.com
mrehani@mgh.harvard.edu