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

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MASSACHUSETTS GENERAL HOSPITAL

Understanding tracking What?

Understanding tracking

1. Tracking of Individual patient's exposures or doses

2. Tracking doses of Group of patients

Understanding Individual patient tracking

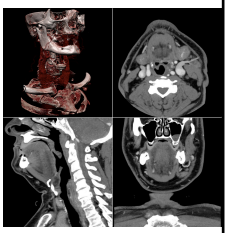
1. Individual patient exposures or doses
   A. Only procedure tracking (number & type of imaging studies)- Exposure tracking
   B. Doses involved in these studies- Dose tracking
   C. It does NOT automatically imply cumulative dose of an individual patient

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

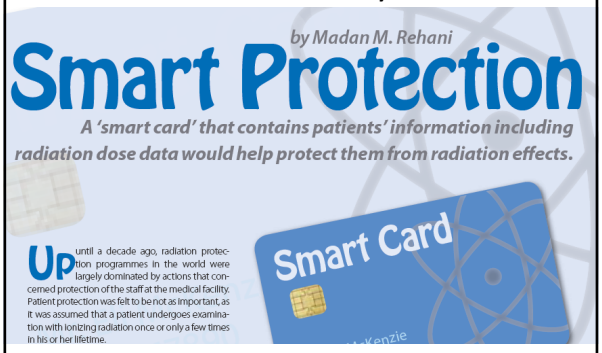
Understanding tracking

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

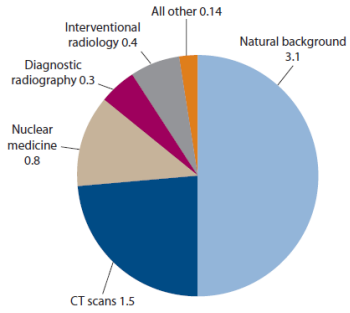
Doses from group of patients

- 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)



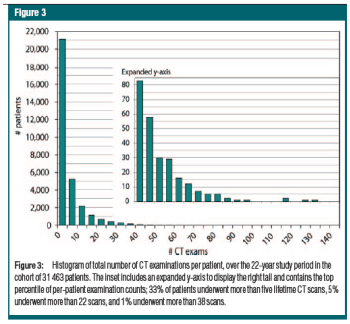
mSv contribution to population dose

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

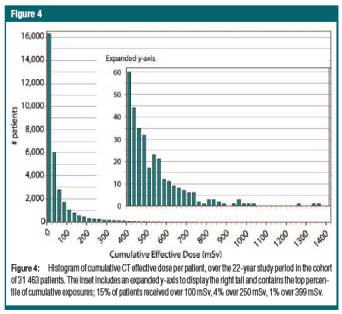


31,500 patients
190,712 CT examinations
22 year period

- **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

CLINICAL RESEARCH www.jasn.org

Estimated Radiation Exposure from Medical Imaging in Hemodialysis Patients

Andreana De Mauri,* Marco Brambilla,† Doriana Chiarinotti,* Roberta Matheoud,† Alessandro Carriero,‡ and Martino De Leo*

*Nephrology Department, †Medical Physics Department, and ‡Radiology Department, University Hospital "Maggiore della Carità," Novara, Italy

ABSTRACT

Radiation exposure accompanying medical imaging associates with cancer risk. Patients with recurrent or chronic diseases may be especially at risk, because they may undergo more of these procedures. The aim of this study was to assess the individual cumulative effective doses (CEDs), which quantify radiation from medical imaging procedures, in a cohort of 106 hemodialysis patients during a median follow-up of 3 years. We retrospectively calculated individual radiation exposures by collecting the number and type of radiologic procedures from hospital records. We also estimated organ doses for computed tomography procedures. The mean and median annual CEDs were 21.9 and 11.7 mSv per patient-year, respectively. The mean and median total CEDs per patient during the study period were 57.7 and 27.3 mSv, respectively. By radiation dose group, we classified 22 patients as low (<3 mSv/yr), 51 as moderate (3 to <20 mSv/yr), 22 as high (20 to <50 mSv/yr), and 11 as very high (≥50 mSv/yr). Seventeen patients had a total CED >100 mSv, a value associated with a substantial increase in risk for cancer-related mortality. Of the total CEDs, 76% was a result of CT scanning. The annual CED significantly associated with age and transplant waitlist status. In summary, this study shows that a significant fraction of surviving hemodialysis patients during a 3-year period receives estimated radiation doses that may put them at an increased risk for cancer.

J Am Soc Nephrol 22: 571–578, 2011. doi: 10.1681/ASN.2010070784

Rehani MM. Rad Prot Dosim 2015 Jul;165(1-4):50-52

TRACKING OF EXAMINATION AND DOSE: OVERVIEW

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This paper reviews the developments in tracking of patient exposures and dose after the earlier paper published in the same journal in 2011. A global survey in which 76 countries responded indicated strong interest in programme and another survey among referring physicians showed vast majority (71.7 %) of physicians expressing that awareness of previous history of CT scans would always or mostly lead them to a better decision on referring patients for CT scans. A sizable number of countries have system of assigning permanent ID to individuals and nearly half of them use this ID in medical records. This can easily permit tracking of exposures. Templates for tracking at different levels of health care have been provided, and experience from a country where tracking is routinely practised has been published.

Tracking of exposures & doses of an individual patient

Down the memory lane

Situation 2003-2008: Critics

2030???

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 qu'au cours de leur vie, ceux-ci ne subiraient qu'un

Radiation Record Card

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【出版日期】2009
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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.

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INDUSTRY NEWS

IAEA calls for enhanced radiation protection of patients

Written by Editorial Staff
April 30, 2009
PRINT E-MAIL

The International Atomic Energy Agency (IAEA), in collaboration with other international organizations, is developing a series of measures aimed at strengthening patient radiation dose protection. The focus of recent efforts is a Smart Card project, to log how much radiation a person receives in the course of a lifetime.

MEDICAL IMAGING REVIEW

Trends in technology and applications for hospital executives

http://www.imagingbiz.com/images/site/mir/head-mir.jpg

Tracking Patient Radiation Dose: IT Implications

Posted: April 16, 2010

by Cat Vasko

Return to *Medical Imaging Review*

In February, the FDA announced a new initiative to reduce unnecessary radiation exposure from CT, nuclear-medicine, and fluoroscopy exams. The agency's three-pronged approach will include issuing safeguard requirements for device manufacturers, incorporating quality-assurance measures in mandatory CMS accreditation for imagers, and creating national dose registries to aid in the development of diagnostic-radiation reference levels.

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International agency wants smart cards to track patient radiation histories

By Paula Gould | May 4, 2009

The International Atomic Energy Agency has launched an effort to create a running total of how much medical radiation patients are exposed to over time by issuing smart cards and modifying electronic medical records.

IAEA safety experts note that tracking dose for patients would provide a level of protection already available to medical practitioners. Standard protocols already exist to monitor levels of ionizing radiation that radiologists, technologists, and nursing staff are exposed to over prolonged periods.

The wearing of film badge or thermoluminescent dosimeters for several weeks or months is common practice. No such efforts, however, are made to record the cumulative x-ray dose received by patients.

For more information from the Diagnostic Imaging and SearchMedica archives:

Radiation dose fears color coronary CTA guidelines.

Soaring CT-based radiation exposure points at self-referral.

Study blasts agencies for radiation standards.

Organizers expand scope of Image Gently radiation reduction program.

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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

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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.[6] This information, when shared by the patient, also could prevent unnecessary repeat scans and would overcome data gaps

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May 2010

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NIH Adopts Radiation Exposure Tracking Policy

Patient concern about repeated radiation exposure has prompted a National Institutes of Health (NIH) plan to require all makers of CT and other radiation-producing scanners used at NIH clinics to have software to track a patient's radiation dose and log it into an electronic medical record (EMR).

David A. Bluemke, M.D, Ph.D. National Institutes of Health

Sheila Farooki, M.D. Columbus Radiology Corporation

Although the policy impacts only vendors for NIH clinics, the organization strongly encourages all medical imaging facilities to adopt similar requirements, according to Ronald D. Neumann, M.D., and David A. Bluemke, M.D, Ph.D., who outlined the proposal in the February 2010 issue of the *Journal of the American College of Radiology* (JACR).

While patient record keeping "by itself is insufficient to provide needed answers regarding low-dose radiation exposure and increased cancer risk, it is nonetheless a necessary first step toward achieving that goal," wrote Drs. Neumann and Bluemke, both from Radiology and Imaging Sciences at NIH in Bethesda, Md.

Systems needed to record the data are readily achievable because EMRs are in place and because CT and PET/CT scanners already output the information, according to Dr. Bluemke.

"The information has simply never been recorded and tabulated in the radiology

Learn More
To read the article, "Tracking Radiation Exposure from Diagnostic Imaging Devices at the NIH," in the *Journal of the American College of Radiology*, go to jacr.org/article/S1546-1440%2809%2900382-7/abstract

Aviation Offered as Example for Radiation Reduction Efforts
Those looking to reduce unnecessary radiation exposure from medical imaging should take a page from the aviation industry playbook, according to a radiology safety expert.

"Aviation errors have been greatly reduced through transfer of data from flight data recorders to a central registry," explained James R. Duncan, an associate professor in the Interventional Radiology Section of the Mallinckrodt Institute of Radiology at Washington University School of Medicine in St. Louis. "Airlines and the Federal Aviation Administration analyze that data and use that knowledge to improve their processes." Dr. Duncan serves as the department's chief quality and safety officer.

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'Smart Card' project aims to better protect patients from radiation, say UN experts

IAEA says making radiotherapy accessible is a key component in any comprehensive cancer control programme

29 April 2009 – A Smart Card project to log how much radiation a person receives in the course of a lifetime is among the latest efforts by the United Nations International Atomic Energy Agency (IAEA) and its partners to ensure better protection of patients from any unnecessary exposure.

Radiation safety experts from the **IAEA** have lauded advances in imaging technology that enable doctors to detect hidden diseases and make better diagnoses. At the same time, they caution that overuse of high-tech scanning procedures may unnecessarily expose patients to increased radiation levels.

Of particular concern are procedures such as computed tomography (CT) scans because they deliver higher doses of radiation to patients in comparison to conventional X-rays (radiographs), according to a news **release** issued by the agency.

RELATED STORIES

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IAEA Calls for Enhanced Radiation Protection of Patients

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by WebteamRtdEuropa

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

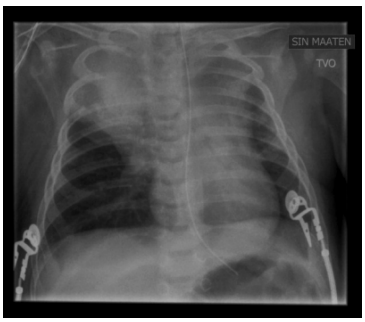
Raija Seuri[1]
Madan M. Rehani[2]
Mika Kortesniemi[1]

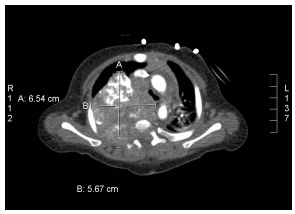
OBJECTIVE. The purpose of our study was to review the experience of tracking radiologic procedures and radiation dose for individual patients in terms of impact on justification and optimization.

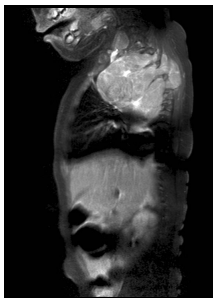
MATERIALS AND METHODS. Examples were collected at the Hospital for Children

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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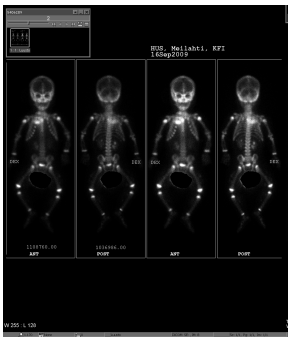
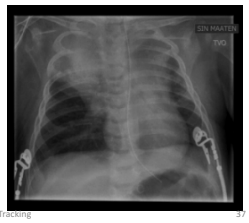


Bone scan shows increased uptake in the posterior upper ribs on the right.



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.

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

Case Report: 1 (Justification)

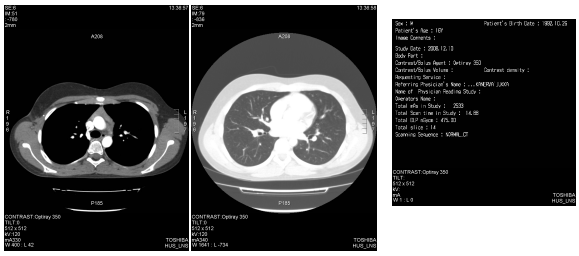
- Re-evaluation of the previous CT, showed erosion of the ribs by the tumour, which is a usual phenomenon with this kind of tumour but which was not mentioned in the initial report.
- **Thus no further imaging was justified and a new CT scan was avoided**

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

Case 2

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

Dec 2008, DLP 475 mGy*cm

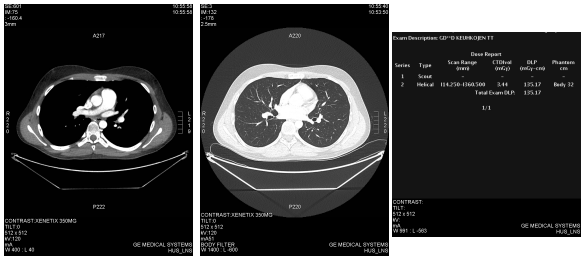


Boy 16 y, osteosarcoma of the femur

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**

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

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**

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

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.**

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

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.**

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

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

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

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.**

Seuri, Rehani, Kortesniemi, , AJR April 2013, 771-775

Message

Tracking of radiological examinations & dose

is useful

Note: No consideration of cumulative dose

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

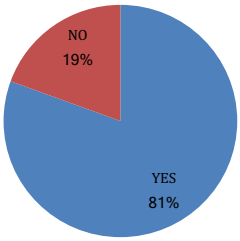
Madan M. Rehani[1]
Theocharis Berris

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

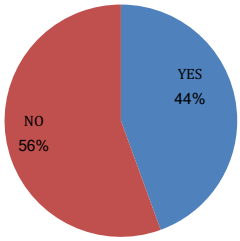
Algeria, Argentina, Armenia, Bosnia and Herzegovina, Bulgaria, Colombia, Costa Rica, Czech Republic, Egypt, Estonia, Finland, Greece, Honduras, Hong Kong (China), Ireland, Ireland, Kenya, Lithuania, Malaysia, Macedonia, Malta, Mexico, Moldova, Montenegro, Portugal, Nicaragua, Romania, Russian Federation, 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?



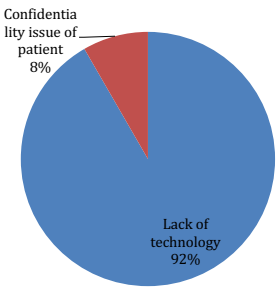
Total=36

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

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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

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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.

Clarifications achieved

- **Tracking of doses in reference dose quantities**
- **Medical physicist (MP) uses these to assess organ and effective dose.**
- **For patients not having characteristics of reference person, use relevant factors**
- **MP communicates risk in correct context to clinicians and radiologists**

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 (?)

- Lifetime radiation dose history
- 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
- How to use information
- 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]
- Rehani MM, Berris T. International Atomic Energy Agency study with referring physicians on patient radiation exposure and its tracking: a prospective survey using a web-based questionnaire. BMJ Open. 2012 Sep 20;2(5). doi:pii: e001425. 10.1136/bmjopen-2012-001425 [11 citations]

Some publications

- Rehani M, Frush D, Berris T, Einstein AJ. Patient radiation exposure tracking: Worldwide programs and needs—results from the first IAEA survey. Eur J Radiology 2012. Oct;81(10):e968-976 [**16 citations]**
- 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

Some publications

- Rehani MM, Berris T. Survey of Unique Patient Identification Number in 40 Countries for Radiation Exposure Tracking. AJR Am J Roentgenol 2013 April; 200(4):776-779
- Rehani M. The IAEA Smart Card. Tracking Radiation Exposure from Medical Diagnostic Procedures: Workshop Reports (2012), National Academies Press, http://www.nap.edu/catalog.php?record_id=13416, pp 14-15, 28-30.

Thank You

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