# **Patient Radiation Exposure Tracking**

# Madan M Rehani, PhD Radiation Protection of Patients Unit, IAEA & **Director of Radiation Protection**, European Society of Radiology, Vienna madan.rehani@gmail.com Atoms for Peace: The First Half Century

1957-2007

# What was and What is Now

### 2006

- Why track examinations?
- What for?
- How is it going to be useful?
- How to do it?
- What dose quantities?
- Is it possible, may be by 2030?

### 2012

- Who does not want it?
- It is possible 🗸
- It is done 🖌
- It is promising area
- How to extend coverage?
- How to include nuclear medicine?



It is rare to find examples of actions (not discoveries) where so much change has occurred in so few years



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### 2011 GILBERT W. BEEBE SYMPOSIUM

### TRACKING RADIATION EXPOSURE FROM MEDICAL DIAGNOSTIC PROCEDURES

December 8-9, 2011

The National Academies Keck Center Room 100, 500 Fifth Street, NW Washington, DC 20001



# Sessions in Many Conferences



### Critics

- 2003: Started talking about it, but NO from almost all
- Not feasible
- Why? What are you going to use it for?
- It may implicate staff for having given more radiation dose to patient.



### **Situation before 2008**



# FUTILITY

No matter how hard you try, you will fail.



# MISSION:





# Looking back

- It was good that I did not pursue it aggressively about 7 years ago
- Radiation units were not as matured
- 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



# **NOW in 2013**



# Who Doesn't Want It?



# IAEA http://rpop.iaea.org

| 🛞 IAEA 🛛 R   | adiation Protection of Patients (RPOP)   | GO  |
|--|--|---|
| Home Information for   | Additional Resources Special Groups Member Area  | About Us Our Work IAEA.org  |
| Information for<br>Health Professionals<br>Member States         | Home * News<br>IAEA Smart Card/SmartRadTrack Project   | Related Links Article on Smart Card project   |
| Patients Member Area  Member States Area  Drafts Management Area | IAEA launches project to develop methodologies to track radiation exposure of patients for Radiation SmartCare   | Summary of the minutes of<br>the first meeting<br>Focus page<br>News links<br>Recommendations <sup>New!</sup><br>Videos |
|  | Although the scope of the Smart Card project that was initiated by the IAEA in 2006 was comprehensive, it tended to give a narrow impression and, thus, the new name <b>Smart Card/SmartRadTrack</b> has been adopted. It includes following possibilities:  | Enhanced Radiation<br>Protection of Patients Needed<br>Radiation Protection of<br>Patients                              |
|  | <ul> <li>a. An electronic card that contains a patient's information, including radiation exposure history.</li> <li>b. A card only as a digital signature to access the radiation exposure data that is actually available online. <i>I</i> patient-accessible website can serve as a 'virtual' card.</li> <li>c. The information about radiation exposure history is made available in e-health records in a manner that can help track individual patients' exposure over time. With intereparability, it should provide the</li> </ul> | A   |
|  | <ul> <li>d. In countries where neither an electronic card nor e-health record is feasible, a methodology to achieve information on tracking all radiological procedures, such as a radiation passport, somewhat like a vaccination card, could be initiated.</li> <li>Project in part by Extra budgetary gran</li> </ul>   | nt from U S Govt  |

The project is aimed at:



IAEA Smart card

iaea smart card

iaea smart card project

iaea smart card smartradtrack project

### IAEA Smart Card/SmartRadTrack Project

rpop.iaea.org/RPOP/RPoP/Content/News/smart-card-project.htm Although the scope of the Smart Card project that was initiated by the IAEA in 2006 was comprehensive, it tended to give a narrow impression and, thus, the new ...

Report of the IAEA Smart Card/SmartRadTrack Project meeting rpop.iaea.org/RPOP/RPoP/.../report-SmartRadTrack-project.htm The brief report of the recent Technical Meeting held on 18-21 Oct.2010 is available.

<u>Smart Protection - International Atomic Energy Agency (IAEA)</u> www.iaea.org/Publications/Magazines/Bulletin/.../50205813137.html by MM Rehani - Cited by 3 - Related articles An electronic "Smart Card" could serve as a digital medical record of radiation exposure for patients who want one.

Joint position statement for the IAEA Smart Card/SmartRadTrack ... https://rpop.iaea.org/.../joint-position-statement-IAEA-smartcard- ... Joint position statement for the IAEA Smart Card/SmartRadTrack protect, 30 January -1 February 2012. As a follow-up of the recommendations of the earlier ...

IPDFJ AbstractID: 14438 Title: IAEA Smart Card Initiativefor Patient Expo... www.aapm.org/meetings/amos2/pdf/49-14438-62523-620.pdf File Format: PDF/Adobe Acrobat - Quick View



Atoms for Peace: The First Half Century

### **IAEA Bulletin May 2009**

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

by Madan M. Rehani

Upper 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.





vonzie

Smart Card

# Madan M. Rehani Une protection intelligente

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

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

toms for Peace: The First Half Century

Rehani. IAEA Smart Card

Radiation Record Card



【作者】Madan M. Rehani 【刊名】IAEA Bulletin, International Atomic Energy Agency 【出版日期】2009 【卷号】Vol.50 【期号】No.2 【关键词】Radiation Protection;Medical Facilities;Radiation Doses;Healthcare;Profession

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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: <u>isr@isradiology.org</u>

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 <u>International Atomic Energy Agency</u> (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 <u>Smart Card</u> project, to log how much radiation a person receives in the course of a lifetime.

REVIEW

Trends in technology and applications for hospital executives

**MEDICAL IMAGING** 

http://www.imagingbiz.com/images/site/mir/head-mir.jpg Tracking Patient Radiation Dose: IT Implications

Posted: April 16, 2010

#### by Cat Vasko

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 practititioners. 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. Email this article

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

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.

AAPM 2010

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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| 'Smart Card'  | project ain  | ns to bei | tter protect |
|---------------|--------------|-----------|--------------|
| patients from | n 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.

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# When there is light, everyone can see, but seeing in dark matters.....



# Radiology

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### Recurrent CT, Cumulative Radiation Exposure, and Associated Radiation-induced Cancer Risks from CT of Adults<sup>1</sup>

To estimate cumulative radiation exposure and lifetime Purpose: attributable risk (LAR) of radiation-induced cancer from computed tomographic (CT) scanning of adult patients at a tertiary care academic medical center. This HIPAA-compliant study was approved by the institu-Materials and Methods: tional review board with waiver of informed consent. The cohort comprised 31 462 patients who underwent diagnostic CT in 2007 and had undergone 190 712 CT examinations over the prior 22 years. Each patient's cumulative CT radiation exposure was estimated by summing typical CT effective doses, and the Biological Effects of Ionizing Radiation (BEIR) VII methodology was used to estimate LAR on the basis of sex and age at each exposure. Billing ICD9 codes and electronic order entry information were used to stratify patients with LAR greater than 1%. Results: Thirty-three percent of patients underwent five or more lifetime CT examinations, and 5% underwent between 22 and 132 examinations. Fifteen percent received estimated cumulative effective doses of more than 100 mSv, and 4% received between 250 and 1375 mSy. Associated LAR had mean and maximum values of 0.3% and 12% for cancer incidence and 0.2% and 6.8% for cancer mortality, respectively. CT exposures were estimated to produce 0.7% of total expected baseline cancer incidence and 1% of total cancer mortality. Seven percent of the cohort had estimated LAR greater than 1%, of which 40% had either no malignancy history or a cancer history without evidence of residual disease. Conclusion: Cumulative CT radiation exposure added incrementally to baseline cancer risk in the cohort. While most patients accrue low radiation-induced cancer risks, a subgroup is potentially at higher risk due to recurrent CT imaging. \*RSNA, 2009

<sup>4</sup> From the Department of Radiology and Center for Evidence Based Imaging (K.S., P.F.B., KP.A., LM.P., R.H., R.K.), Beigham and Womerie Heaptila, 75 Francis SI, Boston, MA 02115; and Harvard Medical School, Boston, Mass (A.S., P.F.B., KP.A., LM.P., R.D.H., R.K.), From the 2008 RSNA Annual Meeting. Received July 25, 2009; revision requested August 26, revision received September 30; accepted October 24; final version accepted November 3. Address correspondence to A.S. (e-mait asocials and/partners. or g).

RSNA, 2009

Radiblogy: Volume 251: Number 1—April 2009 • radiology.rstajnik.org

# **Number of CT Examinations**



Figure 3: Histogram of total number of CT examinations per patient, over the 22-year study period in the cohort of 31 463 patients. The inset includes an expanded y-axis to display the right tail and contains the top percentile of per-patient examination counts; 33% of patients underwent more than five lifetime CT scans, 5% underwent more than 22 scans, and 1% underwent more than 38 scans.

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

### • 33%: <u>></u> 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



### Estimated Radiation Exposure from Medical Imaging in Hemodialysis Patients

Andreana De Mauri,\* Marco Brambilla,<sup>†</sup> Doriana Chiarinotti,\* Roberta Matheoud,<sup>†</sup> Alessandro Carriero,<sup>‡</sup> and Martino De Leo\*

\*Nephrology Department, <sup>†</sup>Medical Physics Department, and <sup>‡</sup>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 <u>106 hemodialysis patients</u> 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 ( $\geq$ 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

• Cook SH, Fielding JR, Phillips JD.

Repeat abdominal computed tomography scans after pediatric blunt abdominal trauma: missed injuries, extra costs, and unnecessary radiation exposure. J Pediatr Surg. 2010 Oct;45(10):2019-24.

 Stiles BM, Mirza F, Towe CW, Ho VP, Port JL, Lee PC, Paul S, Yankelevitz DF, Altorki NK Cumulative radiation dose from medical imaging procedures in patients undergoing resection for lung cancer. Ann Thorac Surg. 2011 Oct;92(4):1170-8;



 Guite KM, Hinshaw JL, Ranallo FN, Lindstrom MJ, Lee FT Jr.Ionizing radiation in abdominal CT: unindicted multiphase scans are an important source of medically unnecessary exposure. J Am Coll Radiol. 2011 Nov;8(11):756-61.



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- Private medical institutes:
- Private CT clinics:



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### Courtesy E Gerrshkevitsh

Studies selected: 1

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### Patient Name:

### Accession Number: EEH21K1080715423

### Patient ID: ACCES#@EEHZIK1080715423 Exam Description: PEAAJU



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Courtesy E Gerrshkevi Shart Card

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Gender: Date of Birth: Ctat

2

| Status:             |         |
|---------------------|---------|
| Pregnancy Status:   | Unknown |
| Medical Alerts:     | N/A     |
| Contrast Allergies: | N/A     |

#### Study Information

| Accession Number:      | EEH21N1110816004                           |
|------------------------|--|
| Referring Physician:   | UNKNOWN                                    |
| Reason for Study:      | N/A  |
| Study Date:            | 18.08.2011                                 |
| Study Time:            | 8:39:00                                    |
| Requesting Physician:  | UNKNOWN                                    |
| Study Description:     | SOMATOSTATIINI RETSEPTORITE STSINTIGRAAFIA |
| Procedure code:        | 6184                                       |
| Procedure description: | SOMATOSTATIINI RETSEPTORITE STSINTIGRAAFIA |
| Resource Name:         | UNKNOWN                                    |
| Modalitz               | OT   |

#### **Report Information**

| Report Status:             | APPROVED |
|----------------------------|----------|
| Diagnostic Code:           | N/A      |
| mpression:                 | N/A      |
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| nterpretation Time:        | N/A      |
| nterpretation Transcribed: |          |

Kogu keha staatiline stsintigraafia Tc - 99m - Tektrotyd, i/v 526 MBq. KT/SPECT uuring rindkere ja kõhu piirkonnast.

#### Kliiniliselt: NET?

Kogu keha uuringul visualiseerub füsioloogiline märkaine kogunemine maksas, põrnas, neerudes, kusepõies, foonist veidi intensiivsema kogunemisena ka kilpnäärmes. Atüüpilist patoloogilist märkaine kogunemist ei tähelda.

SPET/KT-uuringul visualiseerub preparaadi füsioloogiline kogunemine, atüüpilisi preparaadi kogumeid ei esine.



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00:24

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8

Rehani, IAEA Smart Card

#### Displaying report

User ID : marinasanina, Team : Unrestricted Team

## Similar Situation but at sub-national level

- Finland
- Denmark
- Malta
- .....about a dozen countries



# IAEA Survey for Smart Card/SmartRadTrack Project 76 countries (All of the six most populous countries and 16 of the 20 most populous)



European Journal of Radiology 81 (2012) e968-e976



http://www.elsevier.com/locate/ejrad

# Patient radiation exposure tracking: Worldwide programs and needs-Results from the first IAEA survey

Madan M. Rehani<sup>a,\*</sup>, Donald P. Frush<sup>b,1</sup>, Theocharis Berris<sup>a,2</sup>, Andrew J. Einstein<sup>c,3</sup>

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<sup>c</sup> Division of Cardiology, Department of Medicine, and Department of Radiology, Columbia University Medical Center, New York, NY 10032, USA



|                 |                      |                 | • /                |
|-----------------|----------------------|-----------------|--------------------|
| Afghanistan     | Czech Republic (2)   | Kyrgyzstan      | Peru               |
| Armenia (2)     | Dem Rep of Congo     | Lebanon (2)     | Philippines        |
| Australia       | Egypt                | Lithuania       | Poland             |
| Azerbaijan (2)  | El Salvador          | Macedonia       | Portugal           |
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| Belgium (2)     | Ethiopia             | Malta           | Russian Federation |
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| Croatia (2)     | Italy (2)            | Pakistan        | Uganda             |
| Cuba            | Japan                | Panama          | USA                |

Paraguay

Kazakhstan (2)

### 76 countries that participated in the survey (more than one response)

1957–2007

Cyprus

Vietnam
How useful do you think a radiation exposure tracking program would be (assuming practicalities are attended to)?





Total=76 countries

## **IAEA Survey in 76 countries**

- Eight (11%) countries indicated that such a program is actively being planned and
- 3 (4%) stated that they have a program for tracking procedures only, but not for dose.
- 8 respondents from 8 different countries (Belgium, Bulgaria, Iran, Italy, Lebanon, PR of China, Slovakia and USA), stated that such a program is actively being planned.



#### **IAEA Survey**

- Which types of studies will be tracked?
- What radiation quantities will be tracked?
- Goals of the program: Justification, Optimization, QA, policy development, licensure/certification/regulation, decision support for ordering examinations, risk assessment, research and for population doses.



# **New BSS Interim version Nov 2011**

3.156. The justification of medical exposure for an individual patient shall be carried out through consultation between the radiological medical practitioner and the referring medical practitioner, as appropriate, with account taken, in particular for patients who are pregnant or breast-feeding or paediatric, of:

- (a) The appropriateness of the request;
- (b) The urgency of the procedure;
- (c) The characteristics of the medical exposure;
- (d) The characteristics of the individual patient;
- (e) Relevant information from the patient's previous radiological procedures.



Draft European Basic Safety Standards Directive - Version 24 February 2010

#### PROTECTION OF PATIENTS AND OTHER INDIVIDUALS SUBMITTED TO MEDICAL EXPOSURE

Article 80

Justification

The referrer and the practitioner as specified by Member States, shall seek, where practicable, to obtain previous diagnostic information or medical records relevant to the planned exposure and consider these data to avoid unnecessary exposure.



### **Definition-European BSS**

**Clinical responsibility:** responsibility regarding individual medical exposures attributed to a practitioner, notably: justification; optimisation; clinical evaluation of the outcome; cooperation with other specialists and the staff, as appropriate, regarding practical aspects; obtaining information, if appropriate, of previous examinations; providing existing medical radiological information and/or records to other practitioners and/or referrer, as required; giving information on the risk of ionising radiation to patients and other individuals involved, as appropriate.



# Misconceptions

- Radiation doses on a card with patient
- Card like ATM card or Credit Card
- Acts as digital signature to access information online



# Tracking does not mean only cumulative dose

#### **Tracking of procedures:**

- Clinical information
- Justification

# Tracking of dose Optimization



# **Case Report: 1 (Justification)**

- 6 month old boy diagnosed with neuroblastoma of the posterior mediasti-num 2 weeks earlier.
- 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



# **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



# **Case Report: 2 (Optimization)**

- Boy 16 y, osteosarcoma of the femur diagnosed in 2008.
- Initial imaging: CT of the chest (old scanner). PACS showed DLP 475 mGy.cm.
- Follow-up examination in 2009, in another hospital but connected by PACS.
- DLP 221 mGy.cm.



# **Case Report 2: Optimization**

- Difference (almost half DLP) emphasized the need for optimization.
- Follow-up with new scanner DLP 135 mGy.cm. Good image quality despite such low dose values



# IAEA http://rpop.iaea.org

|   | adiation Protection of Patients (RPOP) Search RPoP:  | GO   |
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| Information for<br>Health Professionals<br>Member States<br>Patients<br>Member Area<br>• Member States Area<br>• Drafts Management Area | Home » News<br>IAEA Smart Card/SmartRadTrack Project   | Related Links Article on Smart Card project  |
|   | IAEA launches project to develop methodologies to track radiation exposure of patients for Radiation SmartCare   | Summary of the minutes of<br>the first meeting<br>Focus page<br>News links<br>Recommendations New!<br>Videos |
|   | Although the scope of the Smart Card project that was initiated by the IAEA in 2006 was comprehensive, it tended to give a narrow impression and, thus, the new name <b>Smart Card/SmartRadTrack</b> has been adopted. It includes following possibilities:  | Radiation of Patients Needed<br>Radiation Protection of<br>Patients  |
|   | <ul> <li>a. An electronic card that contains a patient's information, including radiation exposure history.</li> <li>b. A card only as a digital signature to access the radiation exposure data that is actually available online. A patient-accessible website can serve as a 'virtual' card.</li> <li>c. The information about radiation exposure history is made available in e-health records in a manner that can help track individual patients' exposure over time. With interoperability, it should provide the possibility of access from anywhere.</li> </ul> | A  |
|   | <ul> <li>In countries where neither an electronic card nor e-health record is feasible, a methodology to achieve information on tracking all radiological procedures, such as a radiation passport, somewhat like a vaccination card, could be initiated.</li> <li>The project in part by Extra budgetary gran</li> </ul>  | t from U S Govt  |

The project is aimed at:



#### Tracking radiation exposure of patients



As recently as only 6 years ago, it was not possible to come across a radiation-induced skin injury (erythema such as a burn, or hair loss) to a patient resulting from CT. However, in 2009–10, overexposure of about 400 patients undergoing brain-perfusion CT protocols, resulting in hair loss or skin redness in some patients, was brought to the attention of the US Food and Drug Administration<sup>1</sup> and in media reports. 20 years ago, it was not possible to come across a patient who had undergone scores of CT scans in a few years, especially the patient without cancer. Did we see this coming? The answer is largely "no" for visible radiation effects and "probably yes" for usage. In view of these recent events, what might be the scenario in a few years? There are no indications that the increase in CT use will decrease. On the contrary, CT might replace some traditional fluoroscopy-based angiographic procedures.<sup>2</sup> The medical profession has a responsibility to account for radiation exposure from medical imaging.

What are the risks and are the risks real? Essentially there are two types of radiation effects. Ones that are visible, documented, and confirmed (deterministic effects:



#### www.thelancet.com Vol 376 September 4, 2010

the radiology facility has a major role to optimise the technique to do the examination with the minimum possible radiation dose without hampering the diagnostic purpose. The approach towards justification so far has been to promote use of appropriateness criteria developed by professional societies. Obviously the current situation with arguably unjustified CT scans ranging from 3% to 77% for certain indications and patients subjected to multiple radiological examinations shows that this approach is insufficient.<sup>45</sup> A compelling answer is to track lifetime radiation exposure (radiation history, which should work efficiently to improve justification).

There are currently no successful examples of pro-

younger individual, one should aim at recording either doses or factors that can give a reasonable dose estimate within, say, ± 50%. At younger ages (20–40 years), if the number of examinations is low (say below five CT scans), tracking the number of examinations might suffice. But above five CT scans during this period, tracking of doses might be warranted.

#### \*Madan Rehani, Donald Frush

International Atomic Energy Agency, Vienna 1400, Austria (MR); and Duke Radiology, Durham, NC, USA (DF) m.rehani@iaea.org

MR works on the SmartCard project. DF received travel assistance for project meetings.

#### Rehani & Frush. The Lancet 376 (9743); 754-755







# Foremost necessity Use of Patient Identifier



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1957–2007

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

Madan M. Rehani<sup>1</sup> Theocharis Berris

Rehani MM, Berris T

**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.



### **36 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 :





### Most basic: paper card

#### Like Vaccination card Merits:

- Helps tracking of individual exposure procedures
- Dose history by using generic doses
- Can serve a great deal of purpose

• Is very good so long as it is maintained and used

| RADIATION IMAGING RECORD  |
|---|
| Your name:  |
| Unique personal ID number   |
| Date of Birth: Date of Birth: Date of Birth: Date of Birth: Date Date Date Date Date Date Date Date |
| Address:  |
|   |
|   |

| nuuluuon muging procedules |  |            |                |                       |   |      |  |  |
|----------------------------|--|------------|----------------|-----------------------|---|------|--|--|
| Date                       | Hospital/room where<br>procedure was carried out | Typ<br>(ma | e of<br>rk the | Body part<br>examined |   |      |  |  |
|                            |  | СТ         | IR             | R                     | F | NM   |  |  |
|                            |  | СТ         | IR             | R                     | F | NM   |  |  |
|                            |  | СТ         | IR             | R                     | F | NM   |  |  |
|                            |  | СТ         | IR             | R                     | F | NM   |  |  |
|                            |  | СТ         | IR             | R                     | F | NM   |  |  |
|                            |  | СТ         | IR             | R                     | F | NM   |  |  |
| P                          | ehani IAEA Smart Card                            | ст         | п              | п                     | C | NINA |  |  |

Radiation imaging procedures

#### Important information

✓ This individual card is designed to keep record of all radiation imaging procedures utilizing either X-rays or radioactive substances.



toms for Peace: The First Half Century

# Most basic: paper card

- Sensitizes the professionals involved and patient Demerits:
  - Record is only with patient, not with health care system
  - Is highly dependent upon patient and health care provider





# we now?



# **Unique Card Number**

- World Population 6.7 billion
- Credit Cards have already 16 digits. That can cover all people in world
- BUT health system unfortunately has not been as sexy to global service providers as financial



### **Issues nearly Resolved**

- Use of reference dose quantities (e.g. DLP & CTDI in CT; KAP & CAK in fluoroscopy ...)
- CT & fluoroscopy have dose displays & records
- DICOM- communication of images
- IHE- Structured dose reports, REM communication of dose



## **Practicability issues largely unresolved**

- Use of patient identifiers
- Off line studies
- Nuclear Medicine



#### **Nuclear Medicine**

The Need for an Integrated Approach to Tracking Radiation Exposure: Challenges with Nuclear Medicine

#### M Mercuri, M Rehani, A Einstein

#### Paper accepted : J Nuclear Cardiology



#### European Commission planning to give patients secure access to digital health records by 2015

European Commission Information Society & Media DG | information technology (IT) | 10/25/2010



HAMBURG, GERMANY – (HealthTech Wire / PremiumPro) – The European Commission's Digital Agenda for Europe (DAE) is a flagship initiative of the EU 2020 strategy, which focuses on sustainable growth through ICT. eHealth is a key part of it, said Flora Girogio of the EC's ICT for Health unit, speaking at the Global eHealth Forum in Hamburg today. The DAE will develop the necessary infrastructure.

There are seven pillars, which encompass issues ranging from developing interoperability and standards to ultra fast Internet access, digital literacy and eGovernment solutions. The EC invests € 11 billion until 2020 in driving and developing Europe's digital infrastructure. The goal is to raise Internet coverage to 100% by 2013 and to facilitate data exchange at greater than 30 Mbps by 2020. Standards and interoperability among IT systems across Member States is another major concern of the DAE, and by 2012 a minimum set of common patient data should be available for interoperable patient records. The EC

#### Story Highlights

- EC to invest € 11 billion in driving and developing Europe's digital infrastructure
- "In Europe, healthcare is a human right."
- Europeans will get secure online access to their medical health data by 2015

-funded epSOS project, involving 12 Member States, has launched a pilot project in this area. Girogio also announced that a Memorandum of Understanding is to be signed between the United States and Europe in around four months on the interoperability of health data exchange.

#### MoU US & Europe for health care data exchange



#### Radiation Protection Dosimetry Advance Access published July 20, 2011

Radiation Protection Dosimetry (2011), pp. 1-3

doi:10.1093/rpd/ncr300

#### PATIENT EXPOSURE TRACKING: THE IAEA SMART CARD PROJECT

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# **Recommendations from Meeting of the** IAEA

#### Smart Card/SmartRadTrack Project 25-27 January, 2010

https://rpop.iaea.org/RPOP/RPoP/Content/Documents/ Whitepapers/recommendations-smartradtrack.pdf

- Action for manufacturers
- Government
- Appropriate groups, professional societies and organizations, and regulatory bodies



# What do referring physicians think?



# **Referring physicians**

| Country           | Resp. |        | Country     | Resp. |       | Country   | Resp. |        |
|-------------------|-------|--------|-------------|-------|-------|-----------|-------|--------|
| Czech<br>Republic | 175   | 28.14% | Iran        | 16    | 2.57% | Cyprus    | 3     | 0.48%  |
| Finland           | 90    | 14.47% | Kazakhstan  | 15    | 2.41% | Armenia   | 2     | 0.32%  |
| India             | 51    | 8 20%  | Hungary     | 14    | 2.25% | Georgia   | 2     | 0.32%  |
| Pakistan          | 43    | 6.91%  | Malaysia    | 14    | 2.25% | Lithuania | 2     | 0.32%  |
| Croatia           | 37    | 5 95%  | Lebanon     | 12    | 1.93% | Australia | 1     | 0.16%  |
| FYR               | 51    | 5.9570 | USA         | 12    | 1.93% | Bulgaria  | 1     | 0.16%  |
| Macedonia         | 34    | 5.47%  | Sri Lanka   | 11    | 1.77% | Ireland   | 1     | 0.16%  |
| Brazil            | 26    | 4.18%  | P.R. China  | 5     | 0.80% | Spain     | 1     | 0.16%  |
| Indonesia         | 24    | 3.86%  | Republic of |       |       | UK        | 1     | 0.16%  |
| Philippines       | 21    | 3.38%  | Moldova     | 4     | 0.64% |           |       | 0.1070 |
|                   |       |        | Slovenia    | 4     | 0.64% |           |       |        |

622 physicians from 28 countries



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#### **Open Access**



International Atomic Energy Agency study with referring physicians on patient radiation exposure and its tracking: a prospective survey using a web-based questionnaire

Madan M Rehani, Theocharis Berris



How often in your clinical practice do you think knowing history of previous CT scans will help in making a better decision?




Do you think having a system by which you have quick information about patients dose history will be helpful?







## A Study of Smart Card for Radiation Exposure History of Patient

Madan M. Rehani<sup>1</sup> Joseph F. Kushi<sup>2</sup>

Rehani MM, Kushi JF

**OBJECTIVE.** The purpose of this article is to undertake a study on developing a prototype of a smart card that, when swiped in a system with access to the radiation exposure monitoring server, will locate the patient's radiation exposure history from that institution or set of associated institutions to which it has database access.



Rehani. IAEA Smart Card

## We are in a situation where turning back is Not possible







Rehani. IAEA Smart Card

## Recap

- 2006 vs 2012
- Current momentum, series of studies
- IAEA survey: 76 countries-status & interest
- IAEA & EU requirements
- Patient identifier
- Issues nearly resolved & unresolved
- Referring physician's survey: IAEA







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