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Exploring the use of the Swiss medical tariffication codes (TARMED) in the establishment of the frequency of radiodiagnostic examinations

Radiography practice at the Lausanne University Hospital as a case study

Regis Le Coultre[a], Abbas Aroua[b], Eleni T. Samara[b], Maxime Rochat[a], Stéphane Coendoz[c], Francis R. Verdun[b]

[a] University of Health Sciences HESAV, HES-SO; University of Applied Sciences Western Switzerland, Lausanne, Switzerland
[b] Institute of radiation physics, Lausanne University Hospital, Switzerland
[c] Diagnostic Radiology Department, CHUV/University of Lausanne, Switzerland

Summary

In population surveys of the exposure to medical X-rays both the frequency of examinations and the effective dose per examination are required. The use of the Swiss medical tariffication system (TARMED) for establishing the frequency of X-ray medical examinations was explored. The method was tested for radiography examinations performed in 2008 at the Lausanne University Hospital. The annual numbers of radiographies determined from the "TARMED" database are in good agreement with the figures extracted from the local RIS (Radiology Information System). The "TARMED" is a reliable and fast method for establishing the frequency of radiography examination, if we respect the context in which the "TARMED" code is used. In addition, this billing context provides most valuable information on the average number of radiographs per examination as well as the age and sex distributions. Radiographies represent the major part of X-ray examinations and are performed by about 4,000 practices and hospitals in Switzerland. Therefore this method has the potential to drastically simplify the organisation of nationwide surveys. There are still some difficulties to overcome if the method is to be used to assess the frequency of computed tomography or fluoroscopy examinations; procedures that deliver most of the radiation dose to the population. This is due to the poor specificity of "TARMED" codes concerning these modalities. However, the use of CT and fluoroscopy installations is easier to monitor using conventional survey methods since there are fewer centres. Ways to overcome the "TARMED" limitations for these two modalities are still being explored.

Key words: *frequency of X-ray examinations; tariffication codes; automated data collection; TARMED code*

Introduction

The usefulness of X-rays as a powerful diagnostic tool in medicine has been established for many decades. X-ray examinations are prescribed and/or carried out by physicians for confirming or refuting a diagnostic suspicion, deciding or modifying a therapeutic choice, controlling the effectiveness of a treatment, guiding an intervention, screening an asymptomatic patient and controlling periodically a patient at risk, or even reassuring a patient. But the diagnostic benefit to the patient from radiodiagnostic X-ray imaging may be offset by the associated radiological risk. According to the 2008 report of the United Nations scientific committee on the effects of atomic radiation (UNSCEAR), the average effective dose to the population in industrialised countries due to medical X-ray irradiation is estimated to 1.9 mSv/year [1].

Medical exposure accounts for most of the artificial irradiation and about a fourth of the total dose received by the population, and hence surveying the population exposure to medical X-rays is a useful tool in radiation protection. The main objectives of population dose assessments are: to observe trends in the annual collective dose and the annual average per caput dose from medical X-rays in a country with time; to determine the contributions of different imaging modalities and types of examination to the total collective dose from all medical X-rays; to determine the relationship between the frequencies of different types of X-ray examination, the typical radiation doses given to patients and their contribution to the total collective dose; to determine whether there are any regional variations within a country in the frequency and per caput dose from particular types of X-ray examination; to compare the frequencies and the annual per caput doses from medical X-rays between countries; to compare the contribution from medical X-rays with those from other natural and man-made sources of population exposure in a country; and to determine the age and sex distribution of the patients undergoing specific types of X-ray examination, particularly those making a major contribution to the total collective dose [2]. At the international level, the UNSCEAR surveys are conducted with a periodicity of five to ten years. Nationwide surveys are conducted at more or less the same periodicity in several European countries [3] and particularly in Switzerland [4–7].

Two main methods have been used for assessing the annual frequency of X-ray examinations: (1.) from the healthcare providers (hospitals, clinics or practices, etc.) and (2.) from central statistics held by government departments or insurance companies. Another method that could be used, although it is difficult to implement, is the patient-oriented method where a sample of the population is directly surveyed [8].

In the past, the Swiss surveys have primarily used paper forms sent to participants who were asked to fill them in. This is not only time consuming and demands a heavy investment from the participants, but the recording of data on paper and then transcribing them into data processing software is a source of errors. Considering the fast information technology developments, the automation of the frequency and dose data collection is an objective followed by several European groups specialised in the periodic assessment of the irradiation of the population by medical X-rays. In their recent national surveys, attempts were made in Denmark [9], Germany [10, 11], Holland [12], Luxembourg [13] and Norway [14, 15]. In its recent recommendations the European Dose Datamed group predicts that "in the future the national authorities responsible for population dose surveys may gather the electronic information on patient doses from RIS/PACS systems around the country as input to any national dose databases for the establishment of diagnostic reference levels and/or for future population dose estimates" and encourages them to explore these new avenues [2].

Obviously the use of encoding systems has to be validated since it presents several difficulties: they are often designed for billing and not for counting the number of X-ray examinations, they might vary with time (several countries have experienced that almost every year there are minor changes in the encoding system), they differ between European countries which makes any intercomparison a tedious task, etc. But once validated this method will definitely bring several advantages: better accuracy, gain in time and resources, less work load for the practitioners, additional information on the age and sex distributions as well as the number of X-rays per examination.

The aim of this work is to explore the use of the Swiss medical tariffication (TARMED) as a tool to assess the annual frequency of medical X-ray examinations in the country.

Methods

The implementation of "TARMED" in Switzerland followed the Swiss federal bill of 18 March 1994 on health insurance (LAMal) that came into force on 1 January 1996, and which enjoins the use of a unique tariff structure in the whole country. "TARMED" consists of an encoding system, where a medical consultation is split in a series of codes associated to basic medical procedures. The various codes are grouped into categories related to medical specialties, called "chapters". For instance, "chapter 39" entitled "medical imaging" is the category that includes most, but not all, of the procedures performed in a radiology department. Some such as, for instance, interventional cardiac fluoroscopy procedures are considered in "chapter 17" related to cardiology. For each code a number of "points", corresponding, for example, to the duration in minutes, is defined. The "point" is valued in Swiss francs after negotiations between the various partners and stakeholders (health authorities, health providers, health insurers, etc.). Although the "TARMED" codes and their equivalent in "points" are the same all over the country, their value in Swiss francs may vary from one canton to another, and among health insurance companies. As an example table 1 summarises some of the TARMED codes used for radiography that have been used in this work. It is interesting to notice that the codes given for the first and second radiograph of a given anatomical region are not identical.

The gold standard of this study is the number of radiological examinations (for example "chest X-ray examination") recorded in the RIS (Radiological Information System) of the University Hospital of Lausanne (CHUV). For each radiological examination found, we analysed the various TARMED codes declared. We then checked if using only the TARMED codes we were able to recover the numbers of the various radiological examinations indicated in the RIS. In this study a 5% agreement for type of examination was considered as reasonable. We also took advantage of the information available within TARMED to evaluate the average number of radiographs performed for a given anatomical region. Finally we also analysed the age and sex distribution for chest, abdomen and wrists radiographs.

No particular statistical method was applied within this work since the whole set of data was available for the analysis.

Results

The "TARMED" codes corresponding to a radiological examination are grouped in a series which corresponds to what is commonly called in a radiology department "a diagnostic session". Every series is linked with a completion date and assigned to a permanent patient identifier (PPI).

Table 1 presents the analysis of the TARMED codes for various types of X-ray examinations. For each anatomical region it is possible to know precisely the total number of codes associated to a given step of radiological examination. For example in the case of lumbar spine we have recorded 3,643 "TM 39.0150" that corresponds to the first radiograph performed in a patient referred for a lumbar spine examination. From these data it is also possible to know if additional X-rays are performed during the radiological examination. The last column of table 1 gives the "TARMED" estimation of the total of radiological examinations to be compared with our RIS data. This number is a combination of the number of the first radiograph code with cross examination date and permanent patient identifier (PPI). This dual check has an influence in those cases where it is possible to charge the code "first radiograph" in the same radiological examination twice. This is, for example, the case for anatomical regions that include two similar parts (such as shoulders, wrist, legs...).

Table 2 compares our gold standard of the annual number of radiological examinations performed in 2008 at CHUV (N“RIS”) with the number of radiological examination inferred from the TARMED information alone (N“TARMED”). The overall discrepancy between the RIS and TARMED records is 2% when all the examinations are considered. For a few examinations the discrepancy between both ways of counting is larger than the 5% considered as reasonable. The last column of table 2 gives the discrepancy between both methods in absolute numbers.

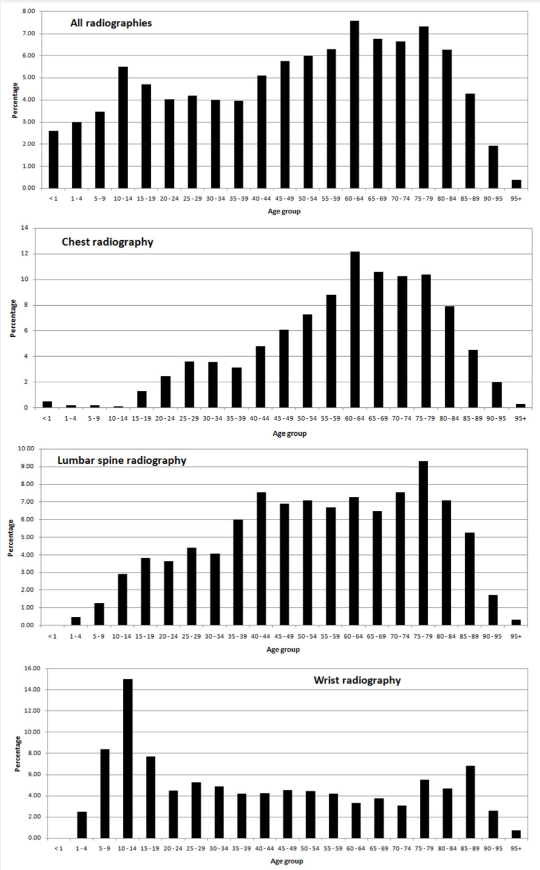

Figure 1:

Patient age distributions for all radiological examinations and specific for chest, lumbar spine and wrist, extracted from the 2008 data of CHUV.

Table 3 shows the number of radiographs per radiological examination; it varies from 1 for OPG (orthopantomogram) and an average of 2.6 for foot radiography, with an average of 1.8 projections per examination when all types of radiographies are considered. This parameter is quite important in establishing a realistic average effective dose per diagnostic session; data that is in general given when reporting a national survey on the radiology practice [5].

From the dataset recorded together with the TARMED codes it is also possible to obtain some information concerning the gender and age profile of the patients. On average, if all types of examinations are considered, there is no major difference between the frequency of diagnostic session between male and female (respectively 52% vs. 48% – see table 4). However, as shown in figure 1 the distribution of the age of the patients can significantly vary with the type of radiological examination. The analysis of these histograms shows that the mean value of the age distribution associated with all radiographies is about 50 years; it is slightly higher for lumbar spine radiographies (55 years) and chest radiography (54 years). For chest radiographies the mean age increases to 58 when ignoring the examinations performed in infants younger than one year.

Discussion

This exploration of the use of the “TARMED” encoding system to establish the frequency of the radiological examinations performed in 2008 at CHUV indicates that this automation method is reliable since for most of the radiological examinations both records (RIS and TARMED) agreed within 5%. For a few examinations, the discrepancy was larger than 5%, in particular for anatomical regions

Table 1: Detailed analysis of various diagnostic sessions where the number of radiographs per anatomical region is given.

Examination	Radiograph*	“TARMED code”	Number of codes	Total number of codes (radiographs)	Total number of first radiographs	Number of radiological examinations (N”TARMED”)
Lumbar spine	First radiograph	TM 39.0150	3,643	7,265	3,643	3,643
	Following X-rays	TM 39.0155	3,622			
Chest	First radiograph	TM 39.0190	44,779	50,132	44,779	44,779
	Following X-rays	TM 39.0195	5,353			
Abdomen	First radiograph	TM 39.0200	3,690	3,779	3,690	3,690
	Following X-rays	TM 39.0205	89			
Wrist	First radiograph	TM 39.0260	2,883	7,837	2,883	2,787
	Following X-rays	TM 39.0265	4,042			
Shoulder	First radiograph	TM 39.0220	3,798	8,158	3,798	3,626
	Following X-rays	TM 39.0225	4,360			
Hand	First radiograph	TM 39.0270	2,628	3,353	2,628	2,171
	Following X-rays	TM 39.0275	725			
Knee	First radiograph	TM 39.0310	8,573	18,435	8,573	6,126
	Following X-rays	TM 39.0315	9,862			
Foot	First radiograph	TM 39.0340	5,295	10,828	5,295	4,171
	Following X-rays	TM 39.0345	5,533			

* A radiological examination recorded in the RIS of a hospital is in general associated to a series of two radiographs with different orientations.

that count as two similar parts (such as shoulders, legs ...). This is due to the fact that in a radiological session one can either take a radiograph of two parts at once or not. In such a case we have a difference in the way the RIS and the TARMED interpret the information. This is certainly a limitation of our approach but one has to remember that when dealing with surveys aiming at assessing the dose burden to a population, uncertainties associated with the dose delivered to extremities have no major impact on the results.

Moreover, the use of TARMED data provides additional valuable information. It is, for example, possible to have a better idea of the number of radiographs taken during a radiological examination in a particular anatomical region. This is rather important in the framework of patient dose optimisation. The first step of patient dose optimisation can be done by using of the Dose Reference Levels (DRL). This, however, applies only to one radiograph. The number of radiographs for a radiological examination should also be considered when dealing with patient dose optimisation, and the use of TARMED allows for a monitoring of this parameter. Accessing this information enables to improve the precision of the effective dose evaluation.

Dose surveys are mainly performed in order to develop strategies for improving the radiation protection of the patients. Since radiological risks are gender and age dependent it is essential to have access to this kind of data when organising surveys. However, this is rather tedious and practically feasible only for a limited sample. The use of TARMED is also quite interesting in gathering such information. As shown in Figure 1 variations in the age distribution of the radiological examinations exist among the population. The distribution of the chest X-ray will be, for example, very different between centres where there is no neonatology in comparison to our centre. It is also interesting for the wrist examination to notice the existence of two peaks one for younger patients (that could be associated with the practice of sport) and the second for older patients (fractures associated with osteoporosis).

There are still some difficulties to overcome if the method is to be used in the case of computed tomography and fluoroscopy examinations, due to the poor specificity of "TARMED" codes. At the moment it remains difficult to clearly establish a link between the "TARMED" information available and the delivered dose. Indeed, it is not possible to separate more clearly than the frequency of examinations and the dose associated with each of these examinations. Nevertheless the frequency of CT and fluoroscopy examinations is easier to estimate than the frequency of radiographies since the number of centres involved is a lot lower. Nevertheless ways to overcome the limitation of "TARMED" concerning frequency assessments in CT and fluoroscopy are being explored. As a matter of fact it seems to be necessary to add an intrinsic factor that takes into account the context of the examination.

Table 2: Annual number (N) of radiological examination performed in 2008 at CHUV.

	N ("TARMED")	**N ("RIS")**	**N("TARMED") / N("RIS")**	**N("TARMED") — N("RIS")**
Head	1,404	1,412	0.99	–8
OPG	1,169	1,169	1.00	0
Cervical spine	1,975	1,975	1.00	0
Thoracic spine	1,330	1,330	1.00	0
Lumbar spine	3,643	3,643	1.00	0
Sacro-iliac joint	112	112	1.00	0
Full spine	541	541	1.00	0
Clavicle	787	744	1.06	43
Chest	44,779	44,886	1.00	–107
Abdomen	3,690	3,687	1.00	3
Pelvis	5,600	5,648	0.99	–48
Shoulder	3,798	3,639	1.04	159
Arm	655	620	1.06	35
Elbow	1,688	1,652	1.02	36
Forearm	844	817	1.03	27
Wrist	2,883	2,787	1.03	96
Hand	2,171	2,170	1.00	1
Fingers	1,029	1,022	1.01	7
Hip	5,088	4,714	1.08	374
Leg	1,178	1,081	1.09	97
Knee	8,573	8,351	1.03	222
Foreleg	1,709	1,660	1.03	49
Ankle	4,366	4,170	1.05	196
Foot	4,171	4,171	1.00	0
Calcaneum	445	445	1.00	0
Forefoot and toes	785	762	1.03	23
Full lower limbs	985	986	1.00	–1
All examinations	105,398	104,194	1.02	1,204

Conclusion

The use of the tariff codification used in Switzerland enables an estimation not only of basic statistics concerning the number of radiological examinations for radiographies but also of important complementary information such as gender and age distribution. However to be in a position to perform such analysis one needs a detailed listing of the TARMED codes. In order to simplify our national surveys the access to such data in a centralised and anonymous way is important; this will improve the present practice.

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Correspondence: *Professor Regis Le Coultre, University of Health Sciences HESAV, HES-SO; University of Applied Sciences Western Switzerland, Avenue de Beaumont 21, CH-1011 Lausanne, Switzerland,* regis.lecoultre[at]hesav.ch

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Table 3: Number of radiographs per radiological examination at CHUV.

Examination	Number of radiographs	N"TARMED" (radiological examination)	Radiograph / N"TARMED"
Head	2,026	1,404	1.44
OPG	1,169	1,169	1.00
Cervical spine	4,913	1,975	2.49
Thoracic spine	2,576	1,330	1.94
Lumbar spine	7,265	3,643	1.99
Sacro-iliac joint	113	112	1.01
Full spine	958	541	1.77
Clavicle	1,131	787	1.44
Chest	50,132	44,779	1.12
Abdomen	3,779	3,690	1.02
Pelvis	5,993	5,600	1.07
Shoulder	8,158	3,798	2.15
Arm	1,249	655	1.91
Elbow	3,318	1,688	1.97
Forearm	1,660	844	1.97
Wrist	6,069	2,883	2.11
Hand	3,353	2,171	1.54
Fingers	2,044	1,029	1.99
Hip	7,481	5,088	1.47
Leg	2,248	1,178	1.91
Knee	18,435	8,573	2.15
Foreleg	3,371	1,709	1.97
Ankle	8,265	4,366	1.89
Foot	10,828	4,171	2.60
Calcaneum	846	445	1.90
Forefoot and toes	1,547	785	1.97
Full lower limbs	1,967	985	2.00
All radiographies	160,894	105,398	1.77

Table 4: Some characteristics of the sex and age distributions concerning the radiographies performed at CHUV in 2008.

Radiography	N	Male	Female	Mean age
Chest	44,779	59%	41%	53.6
Lumbar spine	3,643	47%	53%	55.4
Wrist	2,883	45%	55%	41.6
All radiographies	160,894	52%	48%	49.9

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Figures (large format)

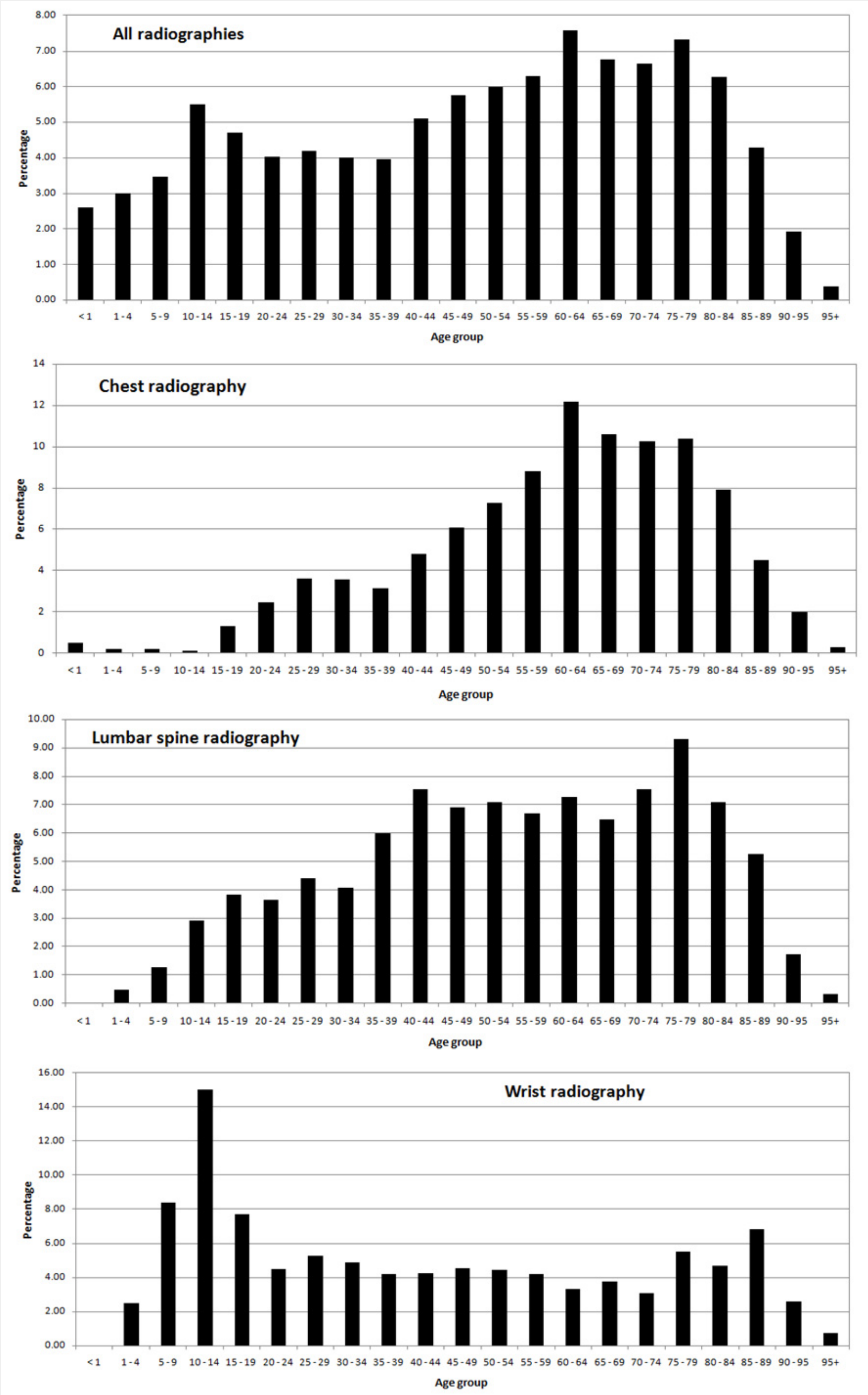

Figure 1:

Patient age distributions for all radiological examinations and specific for chest, lumbar spine and wrist, extracted from the 2008 data of CHUV.