

# Radiologist vs Surgeon: Misdiagnoses in Radiologic Evaluation by On-duty Surgeons in the Emergency Room

Adonis Nasr, Irene Tomoko Nakano, Ana Valeria Brunetti Rigolini, Guilherme Massaaki Pianovski Kato  
Phillipe Geraldo Teixeira de Abreu Reis

## ABSTRACT

**Background:** Emergency department (ED) care often requires radiographs for definitive diagnosis. In many hospitals the primary review of examinations is by requesting physicians. We studied the importance of having a radiologist assess tests, by assessing diagnostic disagreement.

**Study design:** Retrospective, observational, involving victims of traffic injuries (August 2008). Trauma routine X-rays were analyzed by treating surgeon and by the radiologist at the same hospital. Comparison and review of their reports.

**Results:** Forty-seven lesions were found on cervical, chest and pelvis radiographs. Twenty-three were considered as resulting from traffic injury. Other 24 were chronic injuries or findings with no connection to the mechanism of trauma. Regarding the first group, surgeons identified 19 lesions (82.61%), while the radiologist found 22 (95.66%). There was one lesion described only by the doctor on duty, but not by the radiologist (rib fracture). Four lesions were not identified by the ED surgeons, but only by the radiologist (two fractures: one of the upper limb and another of the clavicle; a pneumothorax and a subcutaneous emphysema). There was a discrepancy of 13.05% between the diagnosed injuries. All lesions misdiagnosed were found on chest X-rays.

**Conclusion:** We found a significant rate of radiographic injuries caused by trauma misdiagnosed by the on-duty doctor (13.05%). This finding points to the need for an on-duty radiologist for evaluation of tests in the emergency department.

**Keywords:** Trauma radiology, Trauma radiologists, Emergency room radiology reports, Misdiagnoses.

**How to cite this article:** Nasr A, Nakano IT, Rigolini AVB, Kato GMP, de Abreu Reis PGT. Radiologist vs Surgeon: Misdiagnoses in Radiologic Evaluation by On-duty Surgeons in the Emergency Room. *Panam J Trauma Critical Care Emerg Surg* 2012;1(1):38-43.

**Source of support:** Nil

**Conflict of interest:** None declared

## RESUMO

**Introdução:** O atendimento em PS exige métodos complementares para definição diagnóstica. Muitos hospitais não possuem condições de manter médicos radiologistas plantonista, tendo seus exames avaliados pelo médico solicitante. Diversos estudos já demonstraram a importância de se manter um radiologista para a avaliação dos exames realizados, devido à alta taxa de discordância diagnóstica. Assim, faz-se necessária uma avaliação da qualidade do atendimento nos hospitais.

**Desenho do estudo:** Retrospectivo observacional envolvendo pacientes vítimas de acidentes automobilísticos, em Agosto/2008. Radiografias sequência trauma analisadas pelos

médicos plantonistas e médico radiologista do mesmo hospital. Comparação e revisão de seus laudos.

**Resultados:** Foram descritas 47 lesões diferentes nas radiografias de cervical, tórax e pelve. Destas, 23 foram consideradas como sendo decorrentes do acidente automobilístico. As outras 24 eram lesões crônicas ou achados que não têm ligação com o mecanismo de trauma. Das lesões causadas pelo mecanismo de trauma, os plantonistas identificaram 19 alterações (82.61%) e o radiologista encontrou 22 (95.66%). Uma lesão descrita pelo plantonista não foi encontrada pelo radiologista (fratura de costela). Quatro lesões identificadas pelo radiologista não foram descritas pelos plantonistas (duas fraturas, de membro superior e clavícula, um pneumotórax e um enfisema subcutâneo). A discrepância foi de 13.05% entre os achados diagnósticos; todas as lesões que passaram despercebidas encontram-se nas radiografias de tórax.

**Conclusões:** Observou-se taxa relevante de alterações radiográficas causadas por trauma não identificadas pelo plantonista (13.05%). Isso atenta para a importância de melhor treinamento desses médicos e da necessidade de radiologista de plantão para avaliação dos exames em pronto socorro.

**Palavras chave:** Radiologia trauma, Radiologista de trauma, relatórios radiológicos da sala de emergência, Diagnóstico errôneo.

## INTRODUCTION

According to the Brazilian Ministry of Health – DATASUS, for the five-year period 2005 to 2009, external causes are the third leading cause of death in Brazil (12.57%), exceeded only by heart disease and cancer.<sup>1</sup> This prevalence is also observed in the international literature, but mainly because of the aging process of population and the increasing incidence of cancer, those disease tend to overcome the external causes. Considering all sorts of external causes (falls, drownings, assaults, etc.), traffic injuries constitute a significant portion, accounting for more than 25% of deaths. About deaths occurring on public roads, 32.9% were due to traffic injuries, only exceeded by assaults (39.7%). These data make clear the importance of preventing deaths related to external causes, which should be seen as a real problem of public health.<sup>1</sup>

Considering the trimodal distribution of deaths in trauma, approximately half of them the first stage (minutes after the initial injury), caused by severe and irreversible injuries to vital structures that could not be repaired despite immediate medical attention to these patients.<sup>2</sup>

Approximately one-third deaths occur in the second stage (from minutes to hours after the trauma). Such deaths are

related to injuries that would have been preventable with efficient prehospital care, combined with a system of referral hospitals to complement the initial treatment properly. In this case, staff training is fundamental to the proper care and to reduce the morbidity and mortality related to trauma.<sup>2</sup>

The medical care performed in the emergency department (ED) requires skill and extensive medical knowledge involving different specialties, which in many cases, may need complementary tests to define a diagnose. Many hospitals cannot afford to keep radiologists on duty so they have their patients' exams evaluated by the requesting physician. Several studies have demonstrated the importance of maintaining a radiologist for the assessment of tests, due to the high rate of diagnostic disagreement.<sup>3-5</sup>

In order to evaluate the need for a radiologist to interpret radiographs obtained in trauma cases, we studied the incidence of radiological misdiagnoses in the emergency department at hospital do trabalhador, in curitiba, and the impact of misdiagnoses on the outcome of the patients involved in traffic injuries.

## METHODS OF RESEARCH

This was a retrospective, observational study. We selected 186 patients who were treated at the Hospital do Trabalhador at Curitiba-PR, after traffic injuries during the first 2 weeks of August of 2008. Patients were registered in the traffic injuries book. The study included patients who underwent radiographic examination of the specific trauma routine (cervical spine, chest and pelvis) in a total 428 radiographs. Radiographs were performed according to the standard protocol adopted in the emergency room: Cervical profile (lateral), chest and pelvis anteroposterior.

Emergency room surgeons registered their reports in the emergency care form of each patient, which was indexed in the complete medical record of the hospital. Chest examinations were evaluated by general surgeons and residents in surgery. Cervical spine and pelvis examinations were evaluated by orthopedic surgeons and residents in orthopedics and traumatology.

Reports from the radiologist physician of the Hospital do Trabalhador at Curitiba were collected in the patients' electronic record, having been carried out in a second time

after the first care, in an appropriate environment for specialized analysis (dark room, the possibility of a quiet consultation to theoretical material). The radiologist had no knowledge of the previous diagnoses made by ED surgeons. There was total freedom in describing lesions, with no standard form nor checklist requiring standardization at the time of data collection for this study.

The inclusion criteria were all patients victims of traffic injuries with indications of cervical spine, chest or pelvis radiographs during the period of the study. The exclusion criteria were all lesions not caused by traffic injuries or those who had no clinical indication for obtaining the aforementioned examinations.

All injuries occurring in the streets of Curitiba and metropolitan region, that involved a motor vehicle, were considered as 'traffic injuries' for the present study.

After collecting data, lesions were classified as life-threatening or not, considering the impact on the management decisions in the emergency environment, and its impact on the prognosis of the patients.

## RESULTS

One hundred and eighty-six patients victims of traffic injuries in the city of Curitiba and metropolitan region who were treated in the period of the study met the inclusion criteria. Considering the mechanisms of trauma, the most important injuries were caused by motor vehicle collisions (60.75%), followed by dropping the motorcycle and pedestrians struck by vehicles (16.7 and 14.5%, respectively). Other mechanisms of injury accounted for 8% of the total. The majority of patients involved were male (66.7%); the median age was 25.5 years (2-84 years).

For the evaluation of those 186 patients, 428 radiographs were performed: 158 of the chest, 117 of the pelvis and 153 of the cervical spine, evaluated both by emergency room surgeons and radiologist at the Hospital do Trabalhador (Table 1).

In total, 47 lesions were found. Of these, 28 found only by the radiologist, one only by the group of on-duty surgeons and 18 found by both groups.

Considering injuries found in each segment, analyzed separately (Table 2), while the group of on-duty surgeons found less than a half of the total of identified lesions (40.4%),

**Table 1:** Radiologic examinations and lesions were found

Radiographs	Total examinations	Lesions found by both	Lesions found only by the radiologist	Lesions found only by on-duty surgeons
Chest	158	12	10	1
Pelvis	117	5	6	0
Cervical spine	153	1	12	0
Total	428	18	28	1

**Table 2:** Description of lesions and misdiagnosis

Segment	Lesion	Lesions found by on-duty surgeons		Lesions found by the radiologist		Lesions misdiagnosed by on-duty surgeons		Lesions misdiagnosed by the radiologist	
		%	N	%	N	%	N	%	N
Chest	Rib fractures	8.5	4	6.4	3			2.1	1
	Other fractures			4.3	2	4.3	2		
	Pulmonary contusion	8.5	4	8.5	4				
	Pneumothorax			2.1	1	2.1	1		
	Widened mediastinum	6.4	3	6.4	3				
	Subcutaneous emphysema	2.1	1	4.3	2	2.1	1		
	Pleural thickening			4.3	2	4.3	2		
	Bone deformity			6.4	3	6.4	3		
	Pleural effusion	2.1	1	2.1	1				
	Increased heart area			2.1	1	2.1	1		
Total		27.7	13	46.8	22	21.3	10	2.1	1
Cervical	Anterolisthesis			4.3	2	4.3	2		
	Osteophyte			12.8	6	12.8	6		
	Intervertebral space reduction			8.5	4	8.5	4		
	Fracture	2.1	1	2.1	1				
Total		2.1	1	27.7	13	25.5	12		
Pelvis	Fracture	10.6	5	10.6	5				
	Prosthesis (intramedullary)			2.1	1	2.1	1		
	Foreign body (IUD)			2.1	1	2.1	1		
	Osteopenia			2.1	1	2.1	1		
	Vascular calcifications			2.1	1	2.1	1		
	Exostosis			4.3	2	4.3	2		
Total		10.6	5	23.4	11	12.8	6		
	Total of findings	40.4	19	97.9	46	59.6	28	2.1	1

**Table 3:** Trauma lesions found and misdiagnosis

Segment	Lesion	Lesions found by on-duty physicians		Lesions found by the radiologist		Lesions misdiagnosed by on-duty physicians		Lesions misdiagnosed by the radiologist	
		%	N	%	N	%	N	%	N
Chest	Rib fractures	17.39	4	13.04	3			4.35	1
	Other fractures			8.7	2	8.7	2		
	Pulmonary contusion	17.39	4	17.39	4				
	Pneumothorax			4.35	1	4.35	1		
	Widened mediastinum	13.04	3	13.04	3				
	Subcutaneous emphysema	4.35	1	8.7	2	4.35	1		
	Pleural effusion	4.35	1	4.35	1				
Total		56.52	13	69.57	16	17.39	4	4.35	1
Cervical	Fracture	4.35	1	4.35	1				
Total		4.35	1	4.35	1				
Pelvis	Fracture	21.74	5	21.74	5				
Total		21.74	5	21.74	5				
Total		82.61	19	95.66	22	17.39	4	4.35	1

the radiologist found 97.9%. Observing only the findings of injuries resulted from trauma, the trauma team found 82.61% of lesions, while the radiologist detected 95.66% (one lesion – 4.34% - was only found by the surgeon (Table 3).

In the medical records 70 examinations included in the study had no reports by on-duty surgeons. However, all patients undergoing these tests were discharged in good general condition, without any necessary treatment at a second time or rescheduled outpatient consultation. When an injury was found, the radiological diagnose made by both groups was concordant in all cases evaluated.

## DISCUSSION

Traffic injuries are among the leading causes of death and disability among men in the economically productive age group. In this study, we compared results of radiographic examinations of patients victims of such trauma. The lesions found in this study do not reflect the most common injuries in the emergency room, since we evaluated only the radiographs for patients examined in a multiple trauma protocol (chest, cervical spine and pelvis).<sup>2</sup>

Papers in national and international literature mostly describe a high rate of disagreement between general practitioners and radiologists in diagnostic radiology, as well as between radiologists themselves.<sup>3-12</sup> The greatest differences relate to the level of training and experience of the professional reading the radiographs. As demonstrated by Eisen et al the accuracy of pneumothorax diagnosis increases up to fivefold comparing radiographs assessments by respirology residents in relation to medical students.<sup>6</sup> However, some centers have demonstrated that their physicians are able to treat in the E&A without a radiology specialist. In contrast to what most of the literature says, Le Corre et al showed no statistically significant difference between the analysis of chest radiographs by radiologists (residents and experts) and anesthesiologists (residents and experts), but their sample was too small and they did not take into account surgeons' assessments.<sup>13</sup>

Similarly to the findings of Gatt et al in the present study, we observed a high rate of misdiagnoses by on-duty physicians.<sup>3</sup> Analyzing the overall diagnosis rate, the on-duty surgeons failed to identify or describe 59.6% of all lesions found. This number may be overestimated if we consider that injuries not related to the acute trauma, such as chronic-degenerative lesions, do not end up being described in the chart. This may be due to the large volume of patients in emergency departments in our country, which sometimes overwhelms the capacity of the local team, reflecting an increased demand presented by the population in relation to the supply of health professionals providing care.

To avoid this alleged overestimation, only tests with acute injuries caused by trauma were analyzed. In radiographs of the pelvis, injuries such as exostosis, the presence of prostheses, foreign body (IUD), osteopenia and vascular calcifications were excluded from this second analysis. Similarly, in examinations of the cervical spine, injuries such as anterolisthesis, osteophytes and reduced intervertebral space were not included. Finally, in examinations of the chest, old injuries such as bone deformities and enlargement of the heart were not considered. With these chronic lesions excluded, there was a significant reduction in the number of misdiagnoses by the attending surgeon of the emergency department, from 59.4 to 17.39%. However, this statistic is still inadequate for a referral trauma center where this study was conducted.

Also, considering lesions identified by the radiologist and not described by the attending surgeon, four of them would be of great importance in the management and treatment of the patient: Two fractures of the upper limb and another of the clavicle, plus one slight pneumothorax (Fig. 1) and one subcutaneous emphysema. The fractures were

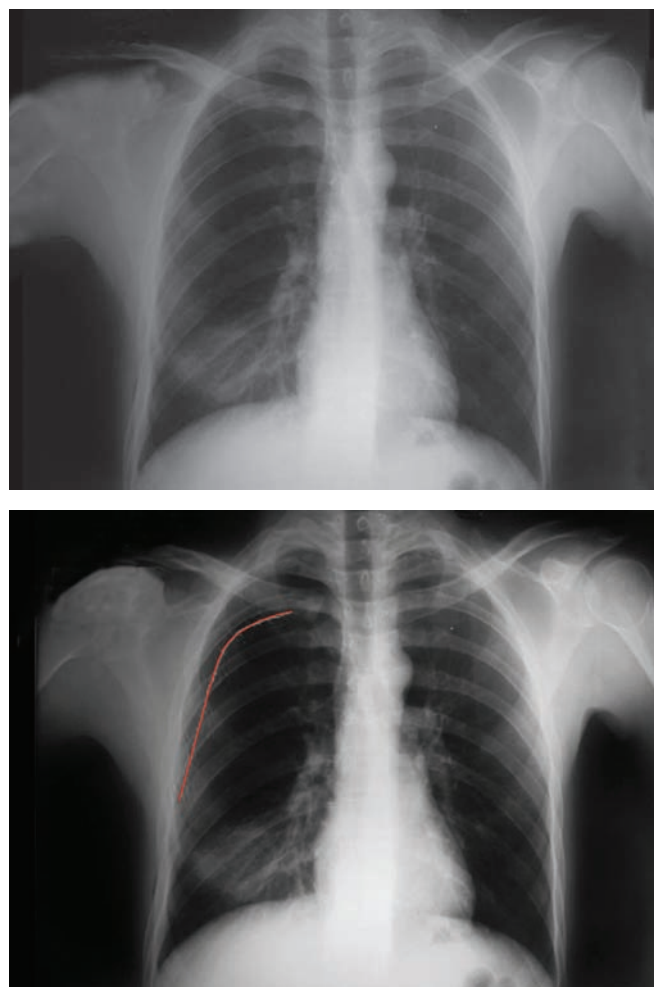


Fig. 1: Chest X-ray: Pneumothorax identified in the left image

investigated by specific radiographs of the affected segment (arm, in the first case, and clavicle in the second), demonstrating that they were identified and treated by staff but not reported in the evaluation of chest radiographs by a general surgeon on duty.

Additionally, there was an injury described by on duty surgeon misdiagnosed by the radiologist (rib fracture) suggesting that some existing lesions may not have been identified by any of the groups, going unnoticed by hospital care as a whole. However, according to Aboutanos et al patient follow-up after hospital discharge contributed substantially to the analysis of this study, when data on patient outcome and earlier return to health centers were considered.<sup>14</sup>

All acute injuries that were not identified by the doctors on duty were on chest radiographs, in agreement with overall data published, that demonstrate higher error rates in this segment. These radiographs in the emergency environment were all evaluated by general surgeons. No injuries due to trauma went unnoticed by the analysis of orthopedic surgeons on duty (responsible for the reports of the cervical spine and pelvis). Also, regarding cervical spine radiographs, is worth emphasizing the importance of clinical examination in relation to radiological findings. As demonstrated by Ivatury et al, because of the high incidence of inappropriate application of the technique, the lateral cervical spine should be removed from the algorithm recommended by ATLS, because of its low diagnostic value. More emphasis should be placed on the use of Computed Tomography.<sup>15</sup> Allied to this, clinical examination should not contraindicate the application of cervical spine imaging investigation, even in patients with Glasgow Coma Scales of 15, as it presents a low sensitivity for the diagnosis of cervical fractures, according Aboutanos et al.<sup>16-18</sup>

There are several important limitations in the present study: (1) it is retrospective, (2) a low number of lesions were found in selected patients, limiting statistical power and (3) the absence of a control group to evaluate radiographs, which would identify possible injuries that went unnoticed by both attending surgeon and radiologists at the hospital.

We observed an important rate of radiographic lesions caused by major trauma not identified by on-duty surgeons (13.05%). This finding indicates the importance of better training of doctors. Considering data from this study, a radiologist on duty is needed for evaluation of imaging tests in the emergency room, reinforcing the suggestion of Gatt et al. Where it remains impossible to implement this

measure, better training of staff on duty can help decrease errors.<sup>19</sup> Where it is not feasible for reasons of cost to have a radiologist on call in every emergency department, central remote reading of radiographs by teleradiology might offer a solution.

Considerations for future studies of this issue would be a study in which radiologists make their assessments in an emergency department environment, away from the quietness and comfort of regular reporting rooms, with larger number of patients and a control analyzer group.

## REFERENCES

1. Ministério Da Saúde – Governo Federal. Sistema de Informações em Saúde. Datasus. Mortalidade Brasil – Óbitos segundo causa. Disponível em <<http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obt10uf.def>>, Acesso em 28/09/11.
2. American College of Surgeons – Committee on Trauma - Advanced trauma life support (ATLS). Course Manual: Course Generalities. Chicago, (8th ed), 2010;(1):1-10.
3. Gatt ME, Spectre G, Paltiel O, Hiller N, Stalnikowicz R. Chest radiographs in the emergency department: Is the radiologist really necessary? *Postgrad Med J* 2003 Apr;79(930):214-17. PubMed PMID: 12743338;
4. Cascade PN, Kazerooni EA, Gross BH, Quint LE, Silver TM, Bowerman RA, et al. Evaluation of competence in the interpretation of chest radiographs. *Acad Radiol* 2001 Apr;8(4):315-21.
5. Robinson PJ, Wilson D, Coral A, Murphy A, Verow P. Variation between experienced observers in the interpretation of accident and emergency radiographs. *Br J Radiol* 1999 Apr;72(856):323-30.
6. Eisen LA, Berger JS, Hegde A, Schneider RF. Competency in chest radiography. A comparison of medical students, residents, and fellows. *J Gen Intern Med* 2006 May;21(5):460-65. PubMed PMID: 16704388.
7. Sarria E, Fischer GB, Lima JA, Menna Barreto SS, Flôres JA, Sukiennik R. [Interobserver agreement in the radiological diagnosis of lower respiratory tract infections in children]. *J Pediatr (Rio J)* 2003 Nov-Dec;79(6):497-503. Portuguese.
8. Branstetter BF 4th, Morgan MB, Nesbit CE, Phillips JA, Lionetti DM, Chang PJ, Towers JD. Preliminary reports in the emergency department: Is a subspecialist radiologist more accurate than a radiology resident? *Acad Radiol* 2007 Feb;14(2):201-06.
9. Ahmed N, Guo A, Elhassan H, Qaiser R, Chung R. Residents managed trauma adequately using their own radiological interpretation as compared with 'nighthawk' radiologists. *J Trauma* 2006 Sep;61(3):555-56; discussion 556-57.
10. Wardrope J, Chennells PM. Should all casualty radiographs be reviewed? *Br Med J (Clin Res Ed)* 1985 Jun 1;290(6482):1638-40. PubMed PMID: 3924202;
11. Ahvenjärvi L, Niinimäki J, Halonen J, Tervonen O, Ojala R. Reliability of the evaluation of multidetector computed tomography images from the scanner's console in high-energy blunt-trauma patients. *Acta Radiol* 2007 Feb;48(1):64-70.
12. Williams SM, Connelly DJ, Wadsworth S, Wilson DJ. Radiological review of accident and emergency radiographs: A 1-year audit. *Clin Radiol* 2000 Nov;55(11):861-65.

13. Le Corre A, Genevois A, Hellot MF, Veber B, Dureuil B. Analysis of chest radiographs of patients with thoracic trauma is not influenced by a grid nor by the experience of the reader. *Ann Fr Anesth Reanim* 2001 Jan;20(1):23-27. French.
14. Malhotra AK, Martin N, Jacoby M, Tarrant J, Guilford K, Wolfe LG, et al. What are we missing: Results of a 13-month active follow-up program at a level I trauma center. *J Trauma* 2009 Jun;66(6):1696-702; discussion 1702-03.
15. Ivatury RR, Sugerman HJ. Chest radiograph or computed tomography in the intensive care unit? *Crit Care Med* 2000 Apr;28(4):1234-35.
16. Duane TM, Mayglothling J, Wilson SP, Wolfe LG, Aboutanos MB, Whelan JF, Malhotra AK, Ivatury RR. National emergency X-radiography utilization study criteria is inadequate to rule out fracture after significant blunt trauma compared with computed tomography. *J Trauma* 2011 Apr;70(4):829-31.
17. Duane TM, Dechert T, Wolfe LG, Aboutanos MB, Malhotra AK, Ivatury RR. Clinical examination and its reliability in identifying cervical spine fractures. *J Trauma* 2007 Jun;62(6):1405-08; discussion 1408-10.
18. Duane TM, Dechert T, Brown H, Wolfe LG, Malhotra AK, Aboutanos MB, Ivatury RR. Is the lateral cervical spine plain film obsolete? *J Surg Res* 2008 Jun 15;147(2):267-69. Epub 2008 Mar 26.
19. Aboutanos MB, Rodas EB, Aboutanos SZ, Mora FE, Wolfe LG, Duane TM, et al. Trauma education and care in the jungle of Ecuador, where there is no advanced trauma life support. *J Trauma* 2007 Mar;62(3):714-19.

## ABOUT THE AUTHORS

### Adonis Nasr (Corresponding Author)

Professor, Department of Clinical Surgery, Hospital do Trabalhador State Health Secretary of Paraná, Federal University of Paraná Curitiba-PR, Brazil, e-mail: adonis@ufpr.br

### Irene Tomoko Nakano

Radiologist, Master in Biomedical Engineering, Hospital do Trabalhador, State Health Secretary of Paraná, Federal University of Paraná, Curitiba-PR, Brazil

### Ana Valeria Brunetti Rigolini

Resident, Physician in Orthopedics and Traumatology, Hospital do Trabalhador, State Health Secretary of Paraná, Federal University of Paraná, Curitiba-PR, Brazil

### Guilherme Massaaki Pianovski Kato

Resident, Physician in Anesthesiology, Hospital do Trabalhador, State Health Secretary of Paraná, Federal University of Paraná, Curitiba-PR, Brazil

### Phillipe Geraldo Teixeira de Abreu Reis

Medical Student, Hospital do Trabalhador, State Health Secretary of Paraná, Federal University of Paraná, Curitiba-PR, Brazil