NEURORADIOLOGY IN AZERBAIJAN AND IN THE NETHERLANDS: A HEALTHCARE ASSESSMENT FROM THE NEUROLOGIST'S PERSPECTIVE

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Background. Referring physicians are valuable sources of information for radiologist to improve quality in radiology. In different healthcare systems neuroradiology has developed differently. Healthcare in Azerbaijan is developing and investments take place both in infrastructure and knowledge. Tools to compare healthcare in Azerbaijan and western countries can help to guide these improvements by providing detailed information about a specific field resulting in a more focused approach.

Methods. A survey covering the field of neuroradiology was developed, with a variety of items including the availability of equipment, the contentment with the radiological report, the experience of the neurologist, and factors omitting neurological imaging. Data was collected both in Azerbaijan and the Netherlands.

Results. In both countries most neurologist do not receive formal neuroradiology training. The data demonstrate a higher availability of advanced computed tomography (CT) and magnetic resonance imaging (MRI) machines in the Netherlands compared with Azerbaijan, and a higher experience with requesting imaging and case reading for the Dutch respondents. The financial situation of the patient can be a reason for Azerbaijan neurologists to omit imaging (due to the establishment of CT and MRI in most cases in specialized and private centers).

Conclusion. The presented survey allows comparison of neuroradiological healthcare between countries in general, and identification of required preconditions to improve collaboration between neurologists and radiologists. A future lower financial threshold for imaging and a future increase in availability of PACS (picture archiving and communication system) will facilitate the improvement of neuroradiological skills of Azerbaijan neurologists. Both Dutch and Azerbaijan neurologists consider weekly clinical neuroradiological conferences together with radiologists useful to improve their skills.

Keywords. Healthcare Quality Assessment, International Educational Exchange, Neuroradiology, Azerbaijan, the Netherlands.

Background. Referring physicians are valuable sources of information for radiologist to improve quality in radiology. In different healthcare systems radiology has developed differently [1-3]. Assessing differences in healthcare can take place at various levels [4-6]. Identifying possible bottlenecks can help in the planning of improvements [7]. We developed a survey covering the field of neuroradiology with items ranging from availability of radiological equipment, the contentment with the radiological report, the experience of the neurologist, to factors omitting neuroradiological imaging. Radiologists and neurologist have complementary roles in neuroradiological patientcare [8]. Therefore a good collaboration between radiologist and neurologists is important to ensure quality in patient care in a developing environment [9].

A survey can be a suitable tool to assess how

doctors make use of healthcare resources in different countries [10,11]. In the past decade healthcare in Azerbaijan, which is provided by a combination of state-owned and private facilities, is developing [12]. Investment takes place both in infrastructure and in knowledge. Comparative information helps healthcare professionals to optimize international cooperation and to focus on best-practice. Tools to provide this information are needed to facilitate comparison between countries, in this case Azerbaijan and the Netherlands. A description of the current situation and an international comparison can be a basis for future development [13,14].

This paper reports on the results of using the developed survey in Azerbaijan and the Netherlands.

Methods. A survey containing both closed and open questions was developed, covering the items as listed in table 1.

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Table 1

Items of the survey and response rates per question

		Percentage of returned surveys in which a particular question is answered	
Theme	Items of the survey	Azerbaijan	Netherlands
Technical equipment (to assess the availability of imaging equipment and to assess the technical knowledge of the requesting neurologist.)	-availability CT and MRI	88%	100%
	-technical details of equipment	88%	100%
	-waiting times CT	70%	100%
	-waiting times MRI	43%	100%
	-methods of reading imaging cases	66%	100%
Perceived quality of radiologist's report (to assess whether the neurologist considers the report of the radiologist useful)	-answers the question	55%	100%
	-is understandable	47%	100%
	-gives an advice	43%	100%
	-concurs with own interpretation	38%	100%
	-general appreciation	34%	100%
Experience of neurologist (to assess the formal training and practical experience of the neurologist. to assess self confidence.)	-education	94%	100%
	-number of examinations ordered	78%	100%
	-percentage viewed	83%	100%
	-self confidence in reading radiological cases	83%	100%
Health care (to assess external factors that interfere with patient care.)	reasons not to order imaging despite indication	92%	100%
Future training (to inventory desired future training to improve neuroradiological skills.)	desired future training	94%	100%

Note: CT - computed tomography, MRI - magnetic resonance imaging

The survey was originally made in English (additional file 1), and then translated in Azerbaijani (additional file 2) and Dutch (additional file 3). Data collection and data storing was anonymous. According to information on the website of the Dutch Central Committee on Research Involving Human subjects, this survey does not fall under the scope of the Medical Research Involving Human Subjects Act. Therefore, approval of the Medical Research Ethics Committee was not required.

For logistic reasons the Azerbaijan and Dutch participants of this study received the survey in a different way, and at a different moment in time.

The European Academy of Neurology (EAN) and the Azerbaijan National Association of Neurologists organized a regional teaching course (RTC) in June 2014 in Baku, Azerbaijan. EAN-RTCs are “specially designed for the purpose to bring neurological standards directly to the countries in the East as to avoid that our young colleagues have to travel to expensive congresses” [15]. This gathering of over 100 neurologists, mostly from Azerbaijan, was a unique possibility to collect data. Therefore, during this teaching course, the described survey was held by distributing a paper version of the survey, among the participants. A short oral introduction was held to promote participation.

The Dutch version of the survey was made by using a website for online surveys. In total, the neurology departments of 13 general hospital sites in the northern part of the Netherlands were contacted by telephone. Besides that, 2 university hospitals participated. The coordinating persons of all these hospitals sent the invitational mails to the participating neurologists. One reminder was sent after two weeks. The data collection in the Dutch general hospitals was in November 2014 and in the university hospitals in December 2014.

The data were collected by one of the authors (AO) and analyzed using a freely available statistical software package (PSPPIRE, the free software foundation).

Results. From the about 100 participants on the second day of the Regional Teaching Course in Baku, Azerbaijan, 47 (47%) persons returned the survey, including 4 residents (9%). The female to male ratio was 6,17:1 and the average age 38 years

[standard deviation SD (12,8)]. From the 170 invited Dutch neurologists or neurology residents 50 (29%) filled in the online survey, including 16 residents (32%). The female to male ratio was 1,08:1, and the average age 41 years (SD 10,4). The neurologists (n=10) of one of the general Dutch hospitals collectively decided not to participate and in another hospital one neurologist filled in the survey on behalf of the whole group (n=6), as was mentioned in the free text field at the end of the survey. The percentage of respondents with a PhD-degree was in the Azerbaijan group 11% and in the Dutch group 36%.

In the paper version of the survey in many cases, not all questions were answered. The percentage of the returned surveys in which a particular question was answered is demonstrated in table 1.

The availability of computed tomography (CT) and magnetic resonance imaging (MRI) in the hospitals of the participants and the waiting times are summarized in table 2. In the Azerbaijan group most respondents reported that no CT or MRI was available in their own institution. Compared with the Dutch respondents, Azerbaijan has less technically advanced CT or MRI machines. Only few Azerbaijan respondents reported reading cases on a PACS (picture archiving and communication system), while this was common practice for most Dutch respondents.

The neurologists perceived quality of the radiologist's report is summarized in table 3.

The Dutch respondents gave a slightly but significant higher score for the questions “The report of the radiologist is understandable”, “I concur with the radiologist's report”, and “General appreciation of the radiologist's report”.

Most respondents in both groups did not receive a formal neuroradiology training (table 4). The Dutch respondents more frequently request CT and MRI compared with the Azerbaijani respondents. They also read more cases by themselves. For MRI there was no significant difference in self-confidence between the two neurology groups. The Azerbaijan respondents reported a lower self-confidence score for reading CT.

The Azerbaijan respondents reported that the financial situation of the patient can be a reason to omit imaging (due to the establishment of CT and

Table 2

**The availability of CT and MRI in the hospitals of the participants,
the waiting times, and how cases are read by neurologists**

	Azerbaijan	Netherlands	
Availability CT			
None	15 (36%)	1 (17%)	
Single slice CT	1 (2%)	0	
4 MDCT	2 (5%)	0	
16 MDCT	15 (36%)	0	
32 MDCT	2 (5%)	1 (2%)	
64 MDCT	0	19 (38%)	
Other	0	2 (4%)	
Unknown	7 (17%)	27 (54%)	
Availability MRI			
None	32 (78%)	0	
Less than 1,5 Tesla	2 (5%)	0	
1,5 Tesla	3 (7%)	26 (52%)	
3 Tesla	0	22 (44%)	
Unknown	4 (10%)	2 (4%)	
Waiting time (working days)			
Routine CT	1,6 (SD 1,7)	5,7 (SD 4,5)	p < 0,001
Urgent CT	0,8 (SD 0,5)	0,2 (SD 0,6)	p < 0,001
Routine MRI	2,0 (SD 1,5)	24 (SD 23)	p < 0,001
Urgent MRI	0,9 (SD 0,7)	1,2 (SD 1,7)	p = 0,478
How cases are read			
Film	17 (55%)	0	
CD/DVD	1 (3%)	1 (2%)	
PACS	2 (6%)	42 (84%)	
Combination	11 (35%)	7 (14%)	

Note: MDCT - multi detector computed tomography

Table 3

Perceived quality and general appreciation of radiologist's report

	Azerbaijan	Netherlands	
The report of the radiologist answers my question (1-5)	3.9	4.2	p=0.11
The report of the radiologist is understandable (1-5)	4.0	4.4	p=0.017
The report of the radiologist contains a useful advice (1-5)	3.4	3.5	p=0.66
I concur with the radiologist's report (1-5)	3.5	4.0	p=0.004
General appreciation of the radiologist's report (1-10)	6.8	7.9	p=0.001

MRI in most cases in specialized and private centers) (table 5). By far most Dutch respondents reported that there is no reason not to do an imaging request when there is a medical indication.

In both groups only, few respondents considered reading neuroradiological papers useful to improve their neuroradiological skills (table 6). Attending a weekly multidisciplinary meeting with neurologists

Table 4

Experience of the neurologist with neuroradiology

	Azerbaijan	Netherlands	
Formal neuroradiology training			
Yes	7 (17,5%)	5 (10%)	
No	33 (82,5%)	45 (90%)	
Number of CT examinations ordered every week			
Less than 5	27 (75%)	16 (32%)	
5 – 10	8 (22%)	20 (40%)	
10 – 20	1 (3%)	12 (24%)	
More than 20	0	2 (4%)	
Number of MRI examinations ordered every week			
Less than 5	32 (84%)	12 (24%)	
5 – 10	2 (5%)	22 (44%)	
10 – 20	3 (8%)	14 (28%)	
More than 20	1 (3%)	2 (4%)	
Percentage of cases read by neurologist themselves			
0 – 25%	7 (18%)	2 (4%)	
25 – 50%	9 (23%)	0	
50 – 75%	9 (23%)	3 (6%)	
75 – 100%	14 (36%)	45 (90%)	
Self confidence in case reading (*)			
Brain CT	6.43 (SD 2.80)	8.36 (SD 0.85)	p<0.001
Brain MRI	7.31 (SD 2.26)	7.62 (SD 0.92)	p=0.377
Lumbar spine MRI	7.41 (SD 2.30)	7.50 (SD 1.39)	p=0.829
(*) 10-point scale			

Table 5

Reasons to omit imaging, even though there is an indication

	Azerbaijan	Netherlands
Patient can't pay	37 (86%)	1 (2%)
No insurance coverage	1 (2%)	1 (2%)
No CT available	2 (5%)	0
No MRI available	2 (5%)	0
Long waiting lists	0	1 (2%)
Other reasons	1 (2%)	5 (10%)
No reasons to omit imaging	0	42 (84%)

and radiologist to discuss cases was considered useful by most respondents in both groups.

Discussion. Research in radiology frequently focuses on the accuracy of imaging modalities. New

techniques are compared with present techniques or another gold standard is used to calculate sensitivity and specificity values. However, assessing the role of an existing imaging technology in a healthcare

Table 6

Desired future training (multiple answers were possible)

	Azerbaijan	Netherlands
Neuradiological papers	7 (16%)	14 (28%)
Workshop	16 (36%)	23 (46%)
Course	21 (48%)	28 (56%)
Teaching website	11 (25%)	24 (48%)
Weekly clinical conference	33 (75%)	39 (78%)

system demands a broader view, that also includes items as availability of the technique and the experience of the physicians who request the imaging.

Thornburry J.R. [5] describes a hierarchical model with six levels which sees diagnostic radiology as a part of a system that has its goal in effective patient care. This model extends from the acquisition of radiological images, through clinical use in decisions about diagnosis and treatment, to patient outcome and societal issues. In line with this we chose to investigate neuroradiological healthcare from the viewpoint of neurologists, as they are in a position to overview both the diagnostic part of patient care, as well as the consequences and impact of the quality and availability of diagnostic imaging on patient outcome [16]. As the broad view of the model, the survey was developed to obtain information on several levels. We believe that research from different viewpoints is needed to improve healthcare at different levels. An example of another viewpoint is provided by Balabanova D. [12], who investigated healthcare in Azerbaijan and other former Soviet Union countries by using a cross-sectional household survey.

The Azerbaijan data shows a striking lower response rate of the items dealing with the neurologist's contentment with the reports of radiologists, compared with the other items of the survey. There are several possible explanations for this low response rate on this item; perhaps the introduction to the survey was not clear enough. Another explanation might be a language barrier between the Azerbaijan respondents and the Dutch researcher who coordinated the surveys. A third explanation might be the cultural defined threshold to give feedback to each other's work. However, a low response rate on this item is not a reason to omit questions like this. Providing constructive feedback can be difficult, but also has a great potential to help a colleague to become better.

Examples of professional implementation of feedback mechanisms in radiology are the RadPeer feedback system [17] or consensus-oriented group peer review [18]. In a similar fashion, the findings of this survey can be used in the feedback process between neurologists and radiologist to strengthen their collaboration and improve patient care.

In the Dutch data all questions showed an equal response rate, because in a web-based survey items can be made compulsory. In case a person does not want or cannot fill in questions, probably he will not send back the survey at all. This might be reflected by the lower overall response rate for the Dutch survey. The online system did not provide information about uncompleted surveys. Therefore, the number of respondents who did not finish the survey is unknown.

CT and MRI availability. The Azerbaijan neurologists report a lower availability of imaging resources compared with their Dutch colleagues. The World Stroke Organization recognizes that limited resources contribute to less effective stroke care. Availability of CT is considered part of essential stroke service [19]. Our data cannot be generalized to Azerbaijan as a whole, indeed there are 64 slice MDCT's and 3 Tesla MRI machines in Azerbaijan, but they do indicate the differences in availability between both countries. As our data is based on the viewpoint of neurologist and not the radiologists, it is possible that there is underscoring in the presence of scanners in each country. To accurately assess the number of CT and MRI in Azerbaijan another study design is needed, for example as used in the study of the equity in the distribution of CT and MRI in China [20].

Our study did not focus on imaging of specific types of pathology, but differences herein are to be expected, because healthcare expenditures, including imaging for neurologic patients, vary between

countries and between type of pathology [21].

Another important difference between both healthcare systems is the availability of PACS systems. In the Netherlands neurologists in general read MRI and CT cases by using their hospital network PACS connected computer. This makes it easier for the Dutch neurologists to read cases by themselves, which they also do more frequently compared to their Azerbaijan colleagues.

Radiology report. Both Azerbaijan and Dutch respondents are reasonably satisfied with the reports of the radiologists. The Dutch neurologist gave a slightly higher general appreciation score. Even though the radiologists generally provide reasonable quality reports, there is room for improvement.

By asking feedback to referring clinicians, the quality of a radiological report can be improved [22]. Neurologist can use data generated by a survey like ours to discuss with radiologist and explore improvements.

Experience of neurologists. Very few Azerbaijan and Dutch respondents have had a formal neuroradiological training. As mentioned the Dutch neurologist do more requests for imaging, and they read more of the cases by themselves. The significant higher self-confidence score on reading brain CT cases is therefore as expected. The differences in availability of MRI, differences in number of requested MRI examinations per week and the differences in percentage of cases what are read by themselves did not alter the self-confidence scores for reading MRI of brain and lumbar spine. Our study design is not suitable to give an opinion on the relation between reported self-confidence and actual diagnostic skills.

Reasons to omit imaging. As opposed to the Dutch neurologists, most Azerbaijan respondents report that financial reasons contribute to omitting imaging even though there is an indication. This demonstrates the major impact of health care system and personal financial situation on individual patient care. No data is available what this means for patient outcome. As imaging is only one factor beside other factors that may contribute to individual patient care, it is difficult to assess whether reduced imaging negatively impacts patient outcome or not. Differences in resources may lead to differences in mortality in neurological patients, but this depends also on type and severity of pathology [23].

In case of further economical and healthcare development in Azerbaijan, our data suggest that a major increase in imaging requests is to be expected. The lack of waiting list, as now is reported by the Azerbaijan respondents, may also change to the Dutch situation with long waiting lists for MRI examinations in case the financial thresholds are lowered.

Future training. In both Azerbaijan and the Netherlands most respondents reported that a weekly clinical conference with radiologists and neurologist could be a good opportunity to increase their neuroradiological skills. Even though the number of multidisciplinary team meetings increase and have an considerable impact on workflow of radiology departments [24], these meetings contribute to good communication between referring physicians and radiologist and thereby contribute to patient safety [25,26]. Therefore, the current data may encourage radiologists and neurologists to participate in these neuroradiological clinical conferences. In case of lack of local neuroradiological expertise, telemedicine can make a valuable contribution [27,28] to peer review and feedback.

Conclusion. The presented survey allows comparison of neuroradiological healthcare between countries in general, and identification of required preconditions to improve collaboration between neurologists and radiologists. The data demonstrates the higher availability of advanced CT and MRI machines in the Netherlands, and a higher experience with requesting imaging and case reading for the Dutch respondents. A future lower financial threshold for imaging and a future increase in availability of PACS will facilitate the improvement of neuroradiological skills of Azerbaijan neuroradiologists. Both Dutch and Azerbaijan neurologist consider weekly clinical neuroradiological conferences together with radiologist useful to improve their skills.

Conflict of interest. The authors declare no financial or other conflict of interests.

Availability of Data and Materials (for any information please contact A.W.Olthof)

The survey is as additional file available in English, Azerbaijani and Dutch.

The data is available in an additional file.

Additional file 1 Neuroradiology Assessment Survey

Additional file 2 Data.csv

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XÜLASƏ

AZƏRBAYCANDA VƏ NİDERLAND KRALLIĞINDA NEYRORADIOLOGİYA: NEVROLOQUN BAXIŞI İLƏ SƏHİYYƏNİN QIYMƏTLƏNDİRİLMƏSİ

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Giriş. Həkim rəyləri radiologiyanın keyfiyyətini yaxşılaşdırmaq məqsədi ilə radioloqlar üçün qiymətli informasiya mənbəyidir. Müxtəlif səhiyyə sistemlərində neyroradiologiya müxtəlif səviyyədə inkişaf etmişdir. Azərbaycan səhiyyəsi günbəgün inkişaf edir və investisiyalar həm infrastruktura, həm də elmə qoyulur. Azərbaycanda və qərbi ölkələrində səhiyyənin inkişafının müqayisəsi üçün istiqamətlər konkret sahə haqqında geniş informasiya verərək, bu inkişafa rəhbərlik etməyə kömək edə bilər ki, bu da daha məqsədyönlü yanaşmaya gətirib çıxaracaq.

Metodlar. Neyroradiologiya sahəsində müayinənin əlçatanlığı, radioloji nəticə ilə qane olmağı, nevroloqun təcrübəsini və neyrovizualizasiyanı istisna edən amilləri özündə birləşdirən, bir neçə istiqamətdə sorğu hazırlanmışdır. Məlumatlar həm Azərbaycanda, həm də Niderland Krallığında toplanmışdır.

Nəticələr. Hər iki ölkədə nevroloqların çoxu formal neyroradioloji təlimlər keçmir. Əldə edilmiş nəticələr müasir kompüter tomoqrafiya (KT) və maqnit rezonans tomoqrafiyası (MRT) cihazlarının Niderlandda Azərbaycan ilə müqayisədə yüksək əlçatanlığını və hollandiyalı respondentlər üçün neyrovizualizasiyaya göndəriş və hadisələrin təhlili ilə əlaqədar yüksək təcrübəyə malik olmanı göstərdi. Pasiyentlərin maddi vəziyyətini Azərbaycan nevroloqlarının neyrovizualizasiyadan az hallarda istifadə etməsinin səbəbi kimi göstərmək olar (KT və MRT qurğularının daha çox ixtisaslaşmış və ya özəl mərkəzlərdə yerləşməsi səbəbindən).

Yekun. Təqdim edilmiş araşdırma iki ölkə arasında neyroradiologiyayı bütövlükdə müqayisə etməyə imkan verir və nevroloqlar ilə radioloqlar arasında əlaqələrin yaxşılaşdırılması imkanları üçün zəmin yaradır. Gələcəkdə vizualizasiya üçün daha aşağı maliyyə xərcləri və PACS sisteminin (təsvirlərin arxivləşdirilməsi və ötürülməsi sistemi) əlçatanlığının artması Azərbaycan nevroloqlarının neyroradioloji biliklərinin təkmilləşdirilməsinin artmasına kömək edəcək. Həm Azərbaycan, həm də Hollandiya nevroloqları radioloqlarla birlikdə təşkil edilən həftəlik klinik neyroradioloji konferensiyaları onların bilik səviyyələrinin artırılması üçün xeyirli olmasını hesab edirlər.

Açar sözlər. Səhiyyənin keyfiyyətini qiymətləndirmə, Beynəlxalq təlim mübadiləsi, neyroradiologiya, Azərbaycan, Niderland Krallığı.

РЕЗЮМЕ

НЕЙРОРАДИОЛОГИЯ В АЗЕРБАЙДЖАНЕ И НИДЕРЛАНДАХ: ОЦЕНКА ЗДРАВООХРАНЕНИЯ С ТОЧКИ ЗРЕНИЯ НЕВРОЛОГА

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Введение. Отзывы врачей являются ценными источниками информации для радиолога для улучшения качества радиологии. В разных системах здравоохранения нейрорадиология развивалась по-разному. Здравоохранение в Азербайджане развивается с каждым днем и инвестиции вкладываются как в сферу инфраструктуры, так и в науку. Инструменты для сравнения здравоохранения в Азербайджане и западных странах могут помочь в руководстве этими улучшениями, предоставив подробную информацию о конкретной области, что приведет к более целенаправленному подходу.

Методы. Был разработан опросник, посвященный области нейрорадиологии, с множеством предметов, включая доступность оборудования, удовлетворенность радиологическим заключением, опыт невропатолога и факторы, исключающие неврологическую визуализацию. Данные были собраны как в Азербайджане, так и в Нидерландах.

Результаты. В обеих странах большинство неврологов не получают формального обучения по нейрорадиологии. Данные демонстрируют более высокую доступность современных компьютерных томографов (КТ) и магнитно-резонансных томографов (МРТ) в Нидерландах по сравнению с Азербайджаном, а также более высокий опыт с запросами визуализации и интерпретации случаев для голландских респондентов. Финансовое положение пациента может быть причиной того, что азербайджанские неврологи обходят нейровизуализацию (по причине установления КТ и МРТ, в большинстве случаев, в специализированных и частных центрах).

Вывод. Представленный опрос позволяет сравнивать нейрорадиологию между странами в целом и выявлять необходимые предпосылки для улучшения сотрудничества между неврологами и радиологами. Будущий более низкий финансовый расход для визуализации и будущего увеличения доступности PACS (система архивирования и передачи изображений) будет способствовать улучшению нейрорадиологических навыков азербайджанских неврологов. Как голландские, так и азербайджанские неврологи вместе с радиологами, рассматривают еженедельные клинические нейрорадиологические конференции которые способствуют улучшению их профессиональных навыков.

Ключевые слова. Оценка качества здравоохранения, Международный образовательный обмен, нейрорадиология, Азербайджан, Нидерланды.

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