



Italian census on neurosciences: the ICoNe2 study

Arturo Consoli^{1,2} · Bruno Zanotti³ · Giovanni Carbotta⁴ · Giovanni Franco⁵ · Francesco Galati⁶ · Franco Galati⁵ · Paolo Postorino⁷ · Giuseppe Miceli⁷ · Salvatore Mangiafico² · Danilo Toni⁸ · Domenico Consoli⁵  · on behalf of SNO (Società Italiana di Neuroscienze Ospedaliere) iCoNe2 Study Group¹

Received: 26 July 2018 / Accepted: 15 November 2018 / Published online: 23 November 2018

© Springer-Verlag Italia S.r.l., part of Springer Nature 2018

Abstract

Background The growing impact of the emergency neurology of trauma centers and of mechanical thrombectomy for the treatment of acute ischemic stroke is revolutionizing the domain of eurosciences.

Methods A census focused on the demographic distribution of the three main cohorts of neurosciences (neurologists, neuroradiologists, and neurosurgeons) was conducted in Italy between December 2015 and February 2017, and results were compared to the estimated retirement rates and loss for other reasons.

Results The total number of neurosciences specialists active in Italy was 4394 at the end of the period of the survey.

The estimated retirement rates and losses seem not be supplied by the physicians in training in the same period.

Conclusions A proper redistribution of the resources and the modification of the training programs seem to be mandatory to maintain acceptable standards of care for the Italian neurosciences during the next decade.

Keywords Neuroscience · Demographics · Training programs · Organization · Model

Introduction

The world of neurosciences is undergoing a historic phase of evolution. In particular, the growing impact of the “emergency neurology,” the development of trauma centers and the spread of the endovascular treatment for acute ischemic stroke are changing the way in which specialists in the clinical neurosciences are allocated. At present, in Italy, there is a legal requirement for one stroke unit per 150,000–300,000 inhabitants, one

interventional neuroradiology unit per a million inhabitants, and one neurosurgery department per 600,000–1.2 million inhabitants [1]. However, in 2015, the Italian national residency program trained only 154 residents in neurology and 64 in neurosurgery [2]. No definite residency program has yet been established for training in interventional neuroradiology. The aim of this paper is to critically analyze the current demographic status of the neuroscience specialists in Italy, and to hypothesize future scenarios based on these figures.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s10072-018-3649-y>) contains supplementary material, which is available to authorized users.

✉ Domenico Consoli
neurologiavv@live.it

- ¹ Diagnostic and Interventional Neuroradiology, Department of Neurosciences, Foch Hospital, 40 rue Worth, 92151 Suresnes, Paris, France
- ² Interventional Neurovascular Unit, Careggi University Hospital Florence, Largo Palagi 1, 50134 Florence, Italy
- ³ Neurosurgery Unit; Neuroscience Department, C. Poma Hospital, Lago Paolino 10, 46100 Mantova, Italy
- ⁴ Department of Surgical Sciences, Sapienza University, Viale Regina Elena 324, 00161 Rome, Italy

⁵ Chief Emeritus Department of Neurology, Iazzolino Hospital, Piazza Alexander Fleming 1, 89900 Vibo Valentia, Italy

⁶ Cattolica University, A. Gemelli Hospital, Largo Agostino Gemelli 8, 00168 Rome, Italy

⁷ Emergency Neurology Department, IRCCS National Neurological Institute C. Mondino Foundation, Via Mondino 2, 27100 Pavia, Italy

⁸ UTVN (Neurovascular Therapy Unit), Neurology and Psychiatry Department, Sapienza University, Piazzale Aldo Moro 5, 00185 Rome, Italy

Materials and methods

A national cross-sectional study was carried out between December 2015 and February 2017 in order to describe the demographics of the neurological, neurosurgical, and neuro-radiological departments of the Italian Public Health System and affiliated facilities. The principal investigator (DC) designated a coordination board (CB) and a review board (RB) (Appendix 1—Supplementary Material), the former to collect and process data, and the latter to review the data, verify its accuracy, and to identify any missing information. The RB consisted of at least one representative for each Italian region. A preliminary study, using the same methodology, named ICoNe [3], had been carried out in 2014, and this represented the basis to consolidate the data of the present study.

Data collection and analysis

Data were collected from several different sources:

- Requests for specific data from the official medical federations and organizations and reference scientific societies, namely the National Federation of Doctors and Dentists (FNOMCEO, Federazione Nazionale Ordine dei Medici Chirurghi ed Odontoiatri), the Unified Syndicate of Outpatient Physicians (SUMAI, Sindacato Unico di Medicina Ambulatoriale Italiano), the National Insurance Service (INPS, Istituto Nazionale della Previdenza Statale), the National Physician's Assistance and Insurance Agency (ENPAM, Ente Nazionale Assistenza e Previdenza Medici), and the Italian Association of Neuroradiology (AINR, Associazione Italiana di Neuro Radiologia);
- Direct phone interviews to neurological, neurosurgical, and neuroradiological departments across the country;
- Consultation with regional health authorities;
- Consultation with the general managers of public hospitals and affiliated facilities;
- Consultation with the regional coordinators and collaborators of the Society of Hospital Neurologists, Neurosurgeons, and Neuroradiologists (SNO).

All interlocutors were asked to fill in a form (Fig. 1) and to send it back to the CB in order to provide specific data, otherwise phone interviews were performed. No specific statistical analysis was performed, but the collected data were used to provide overall figures and subgroups analyses specific to each region. The survey published by AANAO ASSOMED [4] (Association of the Physicians belonging to the National Health System), which focused on the retirement rates of the physicians and future National Health System needs for the period 2014–2023, was used for the calculation of future scenarios.

Results

In order to focus on the national scenario, regional data are neither presented nor discussed here. In 2017, the total number of active neurosciences specialists in Italian hospitals, university hospitals, and affiliated facilities was 4394. Among these, 2813 were neurologists, 1069 were neurosurgeons, and 512 serving as neuroradiologists.

Distribution by sex and age (Fig. 2)

Among the 2813 neurologists, 1452 were females (48.4%). The distribution by age group revealed that 18% of neurologists were between 55 and 60 years old, while 15% were older than 60, and only 19% were younger than 40. Among neurosurgeons, the M:F ratio was 4.2:1 (865/1069 males, 81%), of which 20% were 55–60 years of age, 15% were older than 60, and only 17% were younger than 40. Among those serving as neuroradiologists, 184/512 were females (36%) and 49% were in the 55–60 age interval, while 11% were older than 60 years of age and 22% were younger than 40.

Discussion

Neurosurgeons

The total population of this subgroup is distributed through 127 neurosurgery wards across the country, with an average number of 8 ($1069/127 = 8.4$). As the current organization establishes the presence of one neurosurgical ward/0.6–1.2 million inhabitants, at a first glance, it may be supposed that the supply could be largely sufficient to meet the demand. However, to consider only the nationwide average would not allow us to distinguish well-staffed centers from those without a sufficient staff to fulfill the requirements imposed by the European Directive 2003/88, imposing an interval of 11 h after each duty or work shift. Moreover, data reported in Fig. 2 provide limited information about the national distribution of neurosurgery centers, which are largely confined to metropolitan areas. Furthermore, a large portion of the rural population has little or no access to such services within a reasonable traveling distance. Attempts are being made to deal with these limitations through a structural reorganization of the healthcare system into a system of “hubs” and “spokes.” However, although the neurosurgical wards are constantly present in the hub centers, neurosurgeons are also required to staff trauma center spokes. Indeed, in Italy, there are roughly 250–300 head trauma cases per 100,000 inhabitants/year [5] and although many of these involve minor trauma, there is an incidence of 20–25 coma per 100,000 cases, and 6–8 of these require neurosurgery. Therefore, while current staffing levels may be sufficient to

Fig. 1 Questionnaire used for the survey. All the filled forms were sent to the coordination board

ICoNe Study

QUESTIONNAIRE

REGION _____

DEPARTMENT NEUROLOGY NEUROSURGERY NEURORADIOLOGY

H U P A

CITY _____

TOTAL NUMBER OF PHYSICIANS IN THE DEPARTMENT _____

MALES _____ FEMALES _____

N° PHYSICIANS WITH FIXED-TERM CONTRACT _____

N° PHYSICIANS WITH OPEN-ENDED CONTRACT _____

N° FELLOWS/OTHER _____

AGE OF I LEVEL PHYSICIANS _____

AGE OF II LEVEL PHYSICIANS _____

AGE GROUPS	MALES	FEMALES
<40 YEARS OLD		
41-50 YEARS OLD		
51-55 YEARS OLD		
56-60 YEARS OLD		
>60 YEARS OLD		

PHYSICIANS ON CALL? Y NO

EXEMPTION FROM NIGHT SHIFTS FOR PHYSICIANS OLDER THAN 55 Y.O. ? Y NO

guarantee adequate care in a well-organized system, our data about the age distribution indicate that this may not be possible for a long time. Indeed, we found that about 35% (Fig. 2) of active neurosurgeons are above the age of 50, with only 17% being younger than 40 years old. If the estimated retirement rate of about 70 neurosurgeons/year during the next 5 years [5] will be confirmed, the number of 64 residents in training/year would not be sufficient for a proper turnover. The estimated loss of 430 out of the existing 1069 specialists over the next 10 years (342, i.e., 32%, through retirement and 85, i.e., 5%, due to other reasons), would be replaced by about 640 residents that will be trained at the end of the same period. However, in Italy the current average amount of neurosurgical interventions/center/year ranges from 500 to 1500, which are performed by an average of 8 specialists/center, meaning an average of

about one intervention/week/operator. These numbers would be woefully insufficient for skills development and training purposes; according to a recent survey by the Italian Neurosurgery Society (SINCH) [6], which concluded that a mean of less than 100 surgeries per year not only has a negative effect on the expertise of the existing specialists but also means that newly qualified neurosurgeons will not have the experience required to practice their profession. In other words, in order to guarantee adequate care provision, more resources should be channeled into training, as each resident needs careful supervision and tutoring by an experienced neurosurgeon. In this direction, the reduction of the number of operational facilities and the reorganization of the healthcare networks should be considered in order to optimize the distribution of available resources (hub and spoke model).

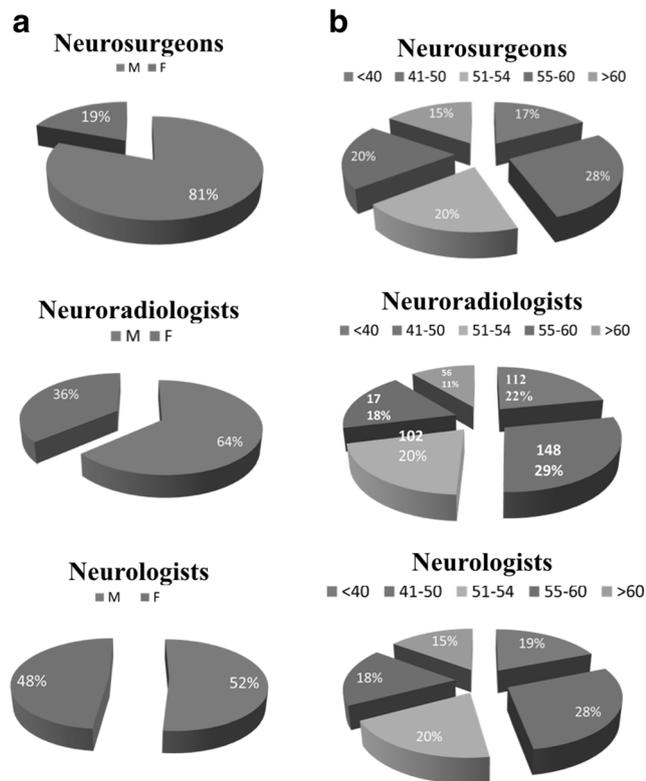


Fig. 2 Distribution by sex (left column, A) and age (right column, B) of the neurosurgical, neuroradiologic, and neurologic cohorts

Neuroradiologists

The census of this category resulted more complicated to conduct primarily because of the lack of a specific qualification or specialty. In Italy, neurovascular procedures are performed by interventional neuroradiologists, where available, and by interventional radiologists, where not. However, in exceptional situations, such procedures may be undertaken by neurologists or neurosurgeons and the heterogeneity of this organization may cause some misclassification biases. Nevertheless, our data suggest that the total population of “neuroradiologists” is made up of 512 physicians, including those practicing in 86 neuroradiology departments, interventional neuroradiology units, and general radiology departments. Unpublished data provided by the Italian Association of NeuroRadiology (AINR) indicate that 65 endovascular centers in Italy are considered as “active” ones, meaning that these centers perform neurovascular procedures on a continual basis (although these are not necessarily high-volume centers), but only 22 of these provide a 24/7 coverage. Furthermore, 21 centers not specifically dedicated to neuro-interventional procedures are known to offer such services, which brings the overall population of active operators to 173, distributed across 86 centers. However, it should be mentioned that data provided by the Italian Endovascular Registry (REI, Registro Endovascolare Italiano) reveal that in 2016,

50% of the total number of mechanical thrombectomy procedures were performed in only eight centers, and that only 13 centers were performing more than 40 procedures/year. In addition to this imbalance, we need to consider that in this subgroup almost 50% of the physicians belongs to the 55–60-year age group, and that there is no specific residency program dedicated to the training of interventional neuroradiologists. The high heterogeneity of this subgroup did not allow to extrapolate data about the retirement rate, nevertheless the demographic distribution in this restricted cohort underlines a major risk of a poor turnover. Although advanced training courses have been established by the Italian neuroradiology, radiology, neurology, and neurosurgery associations, their impact on the training pathway looks like slow to be felt. Thus, it is crucial to find solutions to meet the growing demand for such operators, training them not only the technical aspects of the profession but also the clinical and physiopathological factors involved. It is interesting to report that only 35% of the 65 neuroradiologic dedicated facilities surveyed by AINR performed barely acceptable levels of procedures, and only 13 of these had treated more than 40 stroke cases in 2016. An additional number of 16 general radiology facilities performing neurointerventional procedures should be considered, bringing the total to 81. Although these are equipped by a total of 512 physicians, only 173 of them are interventional neuroradiologists, with the remainder being classed as “non-interventional neuroradiologists” and/or “general radiologists who perform neurointerventional procedures.” The lack of any formal training program makes it difficult for specialists in other similar areas, hopefully belonging to the field of the Neurosciences, to gain some expertise in this discipline.

Neurologists

As reported above, the active neurologists practice their profession in 301 neurological departments across the country, and about 65% of them (1531/2813) are distributed in 176 centers with a stroke unit (SU; 95% of the overall number of SUs in Italy, 176/185). However, also, other figures should be considered, namely 315 neurologists working in local facilities (data provided in 2016 by the Unified Syndicate of Outpatient Physicians, SUMAI), and those employed in emergency medicine, rehabilitation, social and preventive medicine, and insurance and legal medicine departments and facilities. This raises the total number of neurologists to be taken into account to about 3500. Considering the demographics of this population, one could estimate that globally more than 50% of these additional professionals are older than 50 years old. According to published projections [4], these are likely to retire at a rate of 150–160/year over the next five years. Furthermore, 25% of the active neurology departments (77/301) has a workforce numbering ≤ 5 physicians, which does not meet the legal requirement of a team of at least six

neurologists to provide the minimum standard of care. It is also important to note that the current model is increasingly focused on the emergency care, opposed to the presence of neurology departments per se, and these numbers are unlikely to be sufficient to sustain the development of the SUs provided by the law. In an attempt to better organize the resources that are available, the Italian Association of Emergency/Urgent Care Neurologists (ANEU, a member of both the Italian Neurological Societies, SIN, and SNO) has recently defined three organization models on the basis of healthcare setting [7]:

- Emergency neurology, performed in emergency neurology operative units and stroke units
- Complex case neurology, practiced by specialists in neurology “hubs” (which may be the same as above but with dedicated resources, e.g., beds, expertise, staff)
- Local neurology support “spokes,” primarily concerned with continuous care, and chronic, degenerative, and/or age-related pathologies.

However, even such an organized system would require, in the immediate future, the setting up of at least 120 new SUs (considering the legal requirement of 1 SU/200,000 inhabitants and the geographical peculiarities of the country) with at least 14 neurologists per facility, leading to an estimated requirement of about 4200 specialists. At least 100 of these new SUs should be linked to the university to serve as teaching facilities with an additional number of 400 required physicians. Furthermore, about 150 local or provincial facilities should be considered in order to comply with EC regulations, with a need for four additional physicians per facility in order to deal with the complex neurological caseload to serve cities and/or provinces with a high-population density and to provide continuous care for patients with chronic neurological issues (further 600 additional physicians would be required). The total amount of specialist neurologists would be 5200. However, at least 1330 out of the current 3500 neurologists are likely to be lost over the next 10 years (specifically 1155, corresponding to the 33%, through retirement and 175, i.e., 5%, due to other reasons such as early retirement, illness, accidents, and injury, etc.) [5] meaning that both the existing facilities and those that should be activated would not be sufficiently equipped.

Limitations

The cross-sectional nature of this study, the wide heterogeneity of the population of neuroscience specialists, and the lack of published data represent the main limitations of this paper. Furthermore, misclassification biases should be considered, particularly for the neuroradiological subgroup. We reported

data related to the period 2015–2017 and it should taken into account that the number of working and retired physicians might have changed during the last year, as well as for those in training. However, the trend is not expected to be modified.

Conclusions

The current status of neurosciences in Italy looks difficult to be managed because of the demographic distribution of the physicians. The turnover would be insufficient in some cases because of the lack of trained personnel (neurologists), dedicated training programs (neuroradiologists), and unbalanced distribution of the facilities (neurosurgeons). It is mandatory that politicians and decision-makers drive this phase in a timely and effective fashion. Should such changes not be forthcoming, the effectiveness and safety of the healthcare system would be reasonably expected to get worsened. It is hoped that this paper will serve as a generator for a constructive debate.

Acknowledgments These are the members of the iCoNe 2 SNO (Società Italiana di Neuroscienze Ospedaliere) study group. Principal investigator: Domenico Consoli. Coordination board: Giovanni Carbotta, Arturo Consoli, Enrico Cotroneo, Giovanni M. Franco, Annabella Francolino, Franco Galati, Gaetano Grillo, Mattia Iellamo, Giuseppe Neri, Paolo Postorino, Christian Ramondino, Antonino Vecchio, Bruno Zanotti. Review board: Elio Agostoni, Marco Aguggia, Marcello Bartolo, Emanuele Caggia, Maria Vittoria Calloni, Mauro Campello, Gabriele Ciucci, Antonio Colombo, Erminio Costanzo, Fabrizio de Falco, Cinzia Finocchi, Carlo Gandolfo, Filippo Io Presti, Antonio Matera, Maurizio Melis, Cristina Paci, Pasquale Palumbo, Marina Rizzo, Simona Sacco, Carlo Serrati, Stefano Ricci, Luca Valvassori, Simone Vidale, Gaetano Zaccara and Davide Zarcione

Compliance with ethical standards

Conflicts of interest The author declares that they have no conflicts of interest.

References

1. Italian Ministry of Health (2015) Legislative Decree No. 70, dated 2 April 2015 www.camera.it/temiap/2016/09/23/OCD177-2353.pdf, also published in the Official Bulletin No. 127, dated 4th June 2015 www.gazzettaufficiale.it/eli/id/2015/06/04/15G00084/sg. Documents in Italian. Accessed 25/07/2018
2. Italian Ministry of Education, Universities and Research (2015), Ministerial decree N° 315 dated 26 May 2015 - Attachment 2 <http://attiministeriali.miur.it/anno-2015/maggio/dm-26052015.aspx>. Document in Italian
3. Consoli D (2016) IcoNe indagine conoscitiva sulle neuroscienze in Italia Quel che resta tra omissioni, assenza di regole e di progettualità. New Magazine, Trento, Italy. (Book in Italian). ISBN 978-88-8041-109-3
4. Palermo C, Montemurro D, Ragazzo F, (2014) La programmazione del fabbisogno di personale medico nel decennio 2014–2023: curve di pensionamento, fabbisogni specialistici e numero chiuso per l’accesso alle scuole di Medicina e Chirurgia AANAO ASSOMED

- Survey (2014) <http://www.quotidianosanita.it/allegati/allegato526683.pdf>. (Article in Italian). Accessed 25/07/2018
5. Tagliaferri F, Compagnone C, Korsic M, Servadei F, Kraus J (2005) A systematic review of brain injury epidemiology in Europe. *Acta Neurochir* 148(3):255–268
 6. Italian Society of Neurosurgery (SINCH) (2016) Survey to assess conformity to the EC directives on work days in Italian neurosurgery (EC Directives 104/1993, 34/2000 and 88/2003). <http://www.sinch.it/nuovo/sites/default/files/pdf/Analisi-survey-2016.pdf>. Article in Italian. Accessed 25/07/2018
 7. Miceli G, De Falco F, Consoli D, Inzitari D, Sterzi R, Tedeschi G, Toni D (2012) The role of emergency neurology in Italy: outcome of a consensus meeting for a intersociety position. *Neurol Sci* 33:297–304