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Infectious Diseases Physician Workforce in Korea

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ABSTRACT

This study aimed to evaluate the infectious disease (ID) physician workforce in Korea. We investigated the acquisition of ID physicians from 1992 to 2019 with their current working place in the Health Care System. We defined ID physicians working at general or tertiary-care hospitals as active ID physicians. A total 275 physicians acquired ID as a sub-specialty. Among the 275, 242 were active ID physicians. The density of active ID physicians was 0.47 per 100,000 population. Of all the 17 administrative districts, 11 (64.7%) fell short of 0.47, and 131 medical institutions employed the service of ID physicians. The median number of beds per adult ID physician was 372 (interquartile range, 280–507). It is essential to secure human resources to respond to emerging infectious diseases and perform the inherent work of ID physicians.

Keywords: Workforce; Distribution; Infectious Diseases; Physicians

Infectious diseases (ID) physicians perform various essential roles, ranging from prevention, diagnosis, and treatment of ID, outpatient-based antibiotics therapy, infection prevention and control, antimicrobial stewardship, education, research, and response to emerging ID.¹ In Korea, the influenza pandemic of 2009 and the Middle East respiratory syndrome pandemic of 2015 highlighted the importance of expertise in ID. Further, the deadly outbreak of coronavirus disease 19 (COVID-19) has again raised public interest in the ID physician workforce.^{2,3}

In Korea, the Infectious Diseases Division was established in 1946. After 70 years, there are currently 275 registered ID physicians, accounting for 3.4% of 7,905 sub-specialists of the Internal Medicine Department, and only 86 are registered ID pediatricians.⁴ The shortage of ID physicians is also a rising concern in other countries. In the United States (US), the number of ID physician applications declined to about 40% in 2017 compared to 2009 and failed to meet the yearly quota.⁵ As the global threat of antibiotic-resistant organisms and emerging ID increases, the roles of ID physicians have been emphasized, and several countries have reported their ID physician workforce.⁶⁻⁹ However, there is limited information regarding

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Disclosure

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Park SY. Data curation: Jang Y, Kim B, Lee S. Formal analysis: Jang Y, Park SY, Kim B. Funding acquisition: Park SY. Investigation: Jang Y, Park SY. Methodology: Kim B, Lee E. Project administration: Park SY. Supervision: Jeon MH, Choo EJ, Kim TH. Writing - original draft: Jang Y, Park SY. Writing - review & editing: Jang Y, Park SY, Kim B, Lee E, Lee S, Son HJ, Park JW, Yu SN, Kim T, Jeon MH, Choo EJ, Kim TH.

the ID physician workforce in Korea. This study aimed to evaluate the ID physicians' current working status and distribution according to location, healthcare delivery system, and types of medical institutions to provide fundamental data on ID physicians.

We retrospectively investigated sex, workplace (by 17 administrative districts), and type of medical institution (by healthcare delivery system and category of medical institutions) of each ID physician as of June 2020. We investigated physicians' acquisition with ID sub-specialty from 1992 to 2019 for the first time since the sub-specialty was established in Korea. We also investigated the annual number of total specialists and internal medicine specialists between 2009 and 2019.¹⁰ Population data were obtained from the Population Census Division of the National Statistical Office.¹⁰ To calculate the number of beds per ID physician, we investigated data on the number of beds available in each medical institution, based on facility data reported to the Health Insurance Review and Assessment Service.¹¹ The number of beds calculated excluded those in the delivery room, operation room, and physical therapy clinic.

An ID physician was defined as a physician who has passed the ID board examination recognized by the Korean Association of Internal Medicine. The medical institutions were classified into four subtypes based on their healthcare delivery system: 1) tertiary-care hospital, 2) general hospital, 3) hospital, and 4) medical clinic. Based on the medical service act, the medical institutions were categorized into four subtypes: 1) private/university-affiliated hospital, 2) public/university-affiliated hospital, 3) private/non-university-affiliated hospital, 4) public/non-university-affiliated hospital. The public hospital criterion was based on lists of current public health care institutions' situations, announced on 31st December 2018 by the Ministry of Health and Welfare.¹² Active ID physicians were defined as physicians working at hospitals, including tertiary-care and general hospitals, except medical clinics or non-clinical services. In this study, we considered ID physicians working at medical clinics as not playing ID physicians' roles; therefore, we excluded them. ID physician density was defined as the number of ID physicians per 100,000 population at the country level.

Statistical analysis was performed using Rex version 3.3.2.3 (RexSoft Inc., Seoul, Korea). We compared annual numbers of total specialists, internal medicine specialists, and ID physicians from 2009 to 2019, using negative binomial regression analyses. Continuous variables were expressed as median (interquartile range [IQR]), whereas categorical variables were expressed as frequencies and percentages. Variables with *P* values ≤ 0.05 were considered statistically significant.

In total, 275 physicians completed the ID sub-specialty training from 1992 to 2019 (**Fig. 1**). The median number of ID sub-specialty physicians acquired each year was 10, ranging from 0 to 21. Among them, 242 were currently active ID physicians, excluding those who were not-identified (*n* = 11), deceased (*n* = 5), retired (*n* = 3), taking time off (*n* = 2), working at medical clinics (*n* = 5), and undertaking non-clinical employment (*n* = 7). Working place of non-clinical employments were governmental agencies (*n* = 2), pharmaceutical companies (*n* = 2), non-governmental organization (*n* = 1), chief executive officer (*n* = 1), and research institution (*n* = 1). We observed that 91.8% of ID physicians were employed in tertiary-care or general hospitals. In terms of the category of medical institutions, 47.8% of ID physicians worked in private/university hospitals, followed by 25.9% in private/non-university hospitals (**Table 1**).

The density of ID physicians who were currently active in 2019 was 0.47 per 100,000 population. In terms of geographical distribution, Seoul had the highest density of the

Table 1. Status of infectious diseases physicians in Korea

Variables	Values (n = 254) ^a
Sex, males/females	125 (49.2)/129 (50.8)
Type of medical institution	
Tertiary-care hospital	131 (51.6)
General hospital	102 (40.2)
Hospital	9 (0.04)
Clinic	5 (0.02)
Non clinical	7 (0.03)
Category of medical institution	
Private university-affiliated hospital	118/242 (48.8)
National university-affiliated hospital	43/242 (17.8)
Private hospital; non-university-affiliated	57/242 (23.6)
Public hospital, non-university-affiliated	22/242 (9.1)

Values are presented as number (%).

^aAmong 275 infectious diseases physicians as of 2020, the following were excluded: workplace not confirmed (n = 11), dead (n = 5), retired (n = 3), taken time off (n = 2).

workforce (1.01), followed by Daegu (0.62) and Jeju Island (0.60). Gyeongsangbuk-do had the lowest density of 0.08 (Table 2 and Supplementary Fig. 1). Eleven administrative districts (64.7%) out of seventeen did not attain the average ratio of 0.47. There were 131 hospitals with Infectious Diseases Division, and the median number of beds per ID physician was 372 (IQR, 280–507) (Supplementary Table 1). General hospitals had the highest number of beds per ID physician, followed by tertiary-care hospitals. For the medical institution category, the highest number of ID physicians (65.1%) worked at university hospitals, and up to three quarters (73.6%) of ID physicians practiced at private hospitals.

Total specialists increased from 56,903 in 2009 to 84,470 in 2019, and internal medicine specialists increased from 9,808 in 2009 to 15,697 in 2019. In the same period, the ID physicians increased from 127 in 2009 to 275 in 2019 (Supplementary Fig. 2). The number of ID physicians showed a higher increase rate than total specialists and internal medicine specialties ($P < 0.001$).

This study showed 242 ID physicians currently in practice: 0.47 ID physicians per 100,000 population and a median of 372 beds per ID physician. Two-thirds of ID physicians worked in the national capital region (Seoul, Gyeonggi-do, and Incheon). Most ID physicians were with

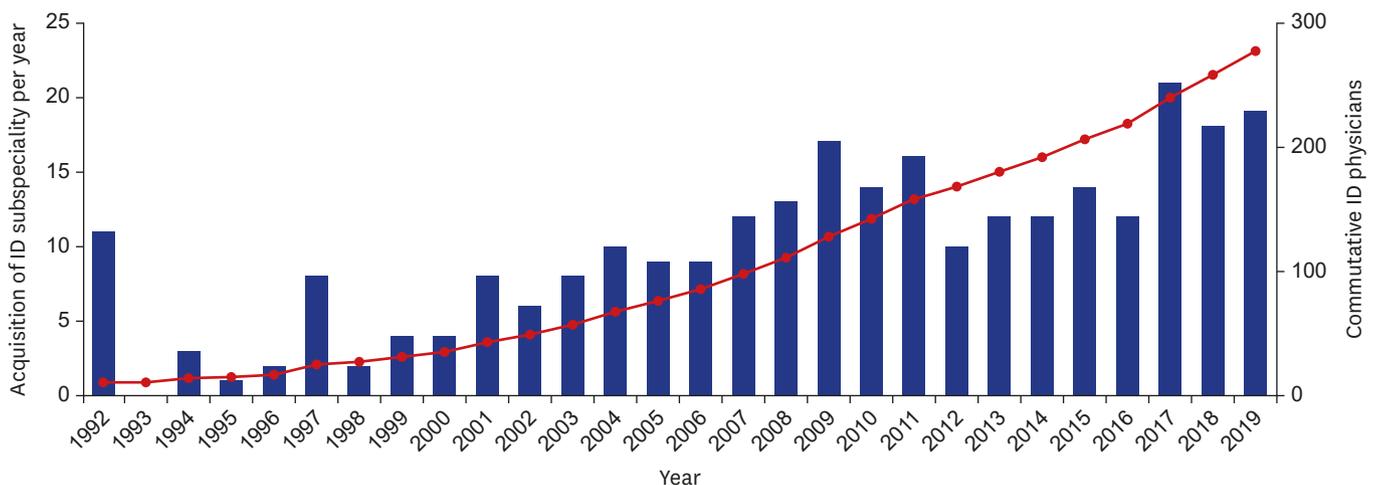


Fig. 1. The accumulated acquisition of physicians with ID sub-specialty by year. ID = infectious diseases.

Table 2. Distribution of active infectious diseases physicians by region

Work area	No. of ID physicians ^a	Inhabitants	Density of ID physicians ^b
Seoul	98	9,729,107	1.01
Busan	11	3,413,841	0.32
Daegu	15	2,438,031	0.62
Incheon	16	2,957,026	0.54
Gwangju	7	1,456,468	0.48
Daejeon	4	1,474,870	0.27
Ulsan	1	1,148,019	0.09
Sejong	2	340,575	0.59
Gyeonggi-do	50	13,239,666	0.38
Gangwon-do	7	1,541,502	0.45
Chungcheongbuk-do	4	1,600,007	0.25
Chungcheongnam-do	4	2,123,709	0.19
Jeollabuk-do	5	1,818,917	0.27
Jeollanam-do	2	1,868,745	0.11
Gyeongsangbuk-do	2	2,665,836	0.08
Gyeongsangnam-do	10	3,362,553	0.30
Jeju-do	4	670,989	0.60
Korea	242	51,849,861	0.47

ID = infectious diseases.

^aThe number of infectious diseases physicians refer to infectious diseases specialists who are active as of June 2020 and only those who work at the hospital level or higher; ^bDensity of infectious diseases physicians is defined as the number of active infectious diseases physicians per 100,000 people.

general or tertiary-care hospitals when classified by the healthcare delivery system level. Most ID physicians in Korea were clinically active in their role as ID specialists.

Only seven ID physicians were in a non-clinical position. Among them, only two were working for a government institution. Due to the lack of ID physicians in government agencies, policy decisions may not reflect the opinions of ID physicians. Since ID physicians assume many exclusive roles, including education, research, antimicrobial stewardship, hospital infection control, and management of complicated and severe ID, it is reasonable that most ID physicians are seen in large-scale hospitals with sufficient medical resources. However, the field of ID specialty is not limited to clinical work. To effectively deal with emerging and epidemic ID outbreaks, more effort is needed to support non-clinical ID physician workforce, such as ID physician-scientists, journalists, and administrators.

The geographical distribution of ID physicians was uneven. Such uneven distribution was also noted in the distribution of other specialists in Korea.^{13,14} The reasons for uneven distribution might be lack of training hospitals in rural areas or individuals' lifestyle decisions. The factors influencing uneven distribution can be objective and subjective, including income according to regions and lifestyle preferences. Further studies are needed on the causes of uneven distribution of ID physician workforce.

There is no authorized standard of staffing for ID physicians, but a few studies suggest guidelines for optimal numbers. According to the survey of 567 hospitals in 61 countries in Europe, between April and July 2015, the median number of ID physicians/Clinical microbiologists/Infection control physicians was 1.12 per 100 beds (IQR, 0.56–2.13).⁷ In hospitals performing regular antimicrobial stewardship programs and infection control activity, the ratio was 1.21 (IQR, 0.56–2.14).⁷ A multicenter retrospective study in Korea revealed that each medical institution required 3 personnel per 1,000 beds to review 25% of the hospitalized cases that underwent antibiotic therapy as an antimicrobial stewardship activity.¹⁵ Based on recent research from the US, the national average density of ID physicians was 1.76 per 100,000

population in 2017.⁹ In Brazil, the number of ID physicians was 3,229, with a density of 16.06 per million inhabitants.⁸ Although the number of ID physicians in Korea has been increasing more rapidly than internal medicine and total specialists over the past decade, the current workforce seems to be far lesser (0.47 per 100,000 populations) than in other countries.

We suggest establishing reasonable policies that can attract physicians to choose ID as their specialty is necessary. For example, fair compensation is needed in the economic evaluation of the invisible activities of ID physicians, especially activities of infection control and antimicrobial stewardship. Moreover, as the importance of infection control is more evident due to continuous epidemics of emerging ID, designating the required number of ID physicians according to the number of beds, apart from infection control doctors, might be a strategy to overcome the current situation.

This study had some limitations. The study population was limited to ID physicians treating adults only; therefore, we could not estimate the infection-related specialist workforce, including pediatric ID specialists and clinical microbiologists. Second, we did not assess all aspects of the assignment, such as the actual scope of work, workloads, and compensations. Further studies with in-depth surveillance or interview are needed to overcome these limitations.

The increasing significance, scarcity, and wide regional disparity of ID physicians have been highlighted, emphasizing the current domestic status, particularly with the COVID-19 pandemic. It is crucial to secure qualified experts to properly deal with community and hospital-acquired ID, antimicrobial resistance, and emerging ID, including COVID-19, and execute exclusive tasks of ID physicians.

Ethics statement

This study was approved by the Institutional Review Board (IRB) and Ethics Committee of Soonchunhyang University Seoul Hospital (IRB No. 2020-05-016). Informed consent was waived by the board.

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SUPPLEMENTARY MATERIALS

Supplementary Table 1

Bed numbers per infectious diseases physician

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Supplementary Fig. 1

Distribution of active infectious diseases physicians by region.

[Click here to view](#)

Supplementary Fig. 2

The number of total specialists, internal medicine specialists, and infectious diseases physicians by year.

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REFERENCES

1. Petrak RM, Sexton DJ, Butera ML, Tenenbaum MJ, MacGregor MC, Schmidt ME, et al. The value of an infectious diseases specialist. *Clin Infect Dis* 2003;36(8):1013-7.
[PUBMED](#) | [CROSSREF](#)
2. Yang TU, Noh JY, Song JY, Cheong HJ, Kim WJ. How lessons learned from the 2015 MERS outbreak affected the effective response to the COVID-19 epidemic in the Republic of Korea. *Korean J Intern Med*. Forthcoming 2020. DOI: 10.3904/kjim.2020.371.
[PUBMED](#) | [CROSSREF](#)
3. Peck KR. Early diagnosis and rapid isolation: response to COVID-19 outbreak in Korea. *Clin Microbiol Infect* 2020;26(7):805-7.
[PUBMED](#) | [CROSSREF](#)
4. Korean Academy of Medical Sciences. E-NEWSLETTER. No. 106 June 2019. <http://kams.or.kr/webzine/19vol106/sub02.php>. Updated 2019. Accessed December 1, 2020.
5. Association of American Medical Colleges. 2018 Physician specialty data report, 2018, Association of American Medical Collegebook. <https://www.aamc.org/data-reports/workforce/report/physician-specialty-data-report>. Updated 2018. Accessed December 1, 2020.
6. Zhang C, Li S, Ji J, Shen P, Ying C, Li L, et al. The professional status of infectious disease physicians in China: a nationwide cross-sectional survey. *Clin Microbiol Infect* 2018;24(1):82.e5-10.
[PUBMED](#) | [CROSSREF](#)
7. Dickstein Y, Nir-Paz R, Pulcini C, Cookson B, Beović B, Tacconelli E, et al. Staffing for infectious diseases, clinical microbiology and infection control in hospitals in 2015: results of an ESCMID member survey. *Clin Microbiol Infect* 2016;22(9):812.e9-17.
[PUBMED](#) | [CROSSREF](#)
8. Cassenote AJ, Scheffer MC, Segurado AA. Brazilian infectious diseases specialists: who and where are they? *Braz J Infect Dis* 2016;20(2):141-8.
[PUBMED](#) | [CROSSREF](#)
9. Walensky RP, McQuillen DP, Shahbazi S, Goodson JD. Where is the ID in COVID-19? *Ann Intern Med* 2020;173(7):587-9.
[PUBMED](#) | [CROSSREF](#)
10. National Health Insurance Statistical Yearbook. 2018, National Health Insurance Service, Korean Statistical Information Service. <http://kosis.kr/index/index.do>. Updated 2018. Accessed December 1, 2020.
11. Medical Institution Detail Information Service. Health Insurance Review & Assessment Service. <https://www.hira.or.kr/rd/hosp/getHospList.do?pgmid=HIRAA030002020000>. Updated 2020. Accessed December 1, 2020.
12. Ministry of Health and Welfare. Current situation of institution, Dec 2018. <http://www.mohw.go.kr/>. Updated 2019. Accessed December 1, 2020.
13. Song YS, Shim SR, Jung I, Sun HY, Song SH, Kwon SS, et al. Geographic Distribution of Urologists in Korea, 2007 to 2012. *J Korean Med Sci* 2015;30(11):1638-45.
[PUBMED](#) | [CROSSREF](#)
14. Park HR, Park SQ, Kim JH, Hwang JC, Lee GS, Chang JC. Geographic analysis of neurosurgery workforce in Korea. *J Korean Neurosurg Soc* 2018;61(1):105-13.
[PUBMED](#) | [CROSSREF](#)
15. Park SY, Chang HH, Kim B, Moon C, Lee MS, Kim JY, et al. Human resources required for antimicrobial stewardship activities for hospitalized patients in Korea. *Infect Control Hosp Epidemiol* 2020;41(12):1429-435.
[PUBMED](#) | [CROSSREF](#)