DEVELOPMENT OF THE PUBLIC HOSPITAL PHARMACIST WORKFORCE IN THE RED RIVER DELTA, VIETNAM: A CROSS-SECTIONAL AND RETROSPECTIVE STUDY

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ABSTRACT

Objectives: This study aims to assess the current status of pharmacists in public hospitals in the Red River Delta (**RRD**), providing evidence for policymaking and workforce management. **Methods:** A cross-sectional study was conducted on 1,811 pharmacy personnel across 168 public general hospitals in the Red River Delta (**RRD**) in 2022. The study examined the structure and distribution of pharmacy personnel within hospitals, including workforce distribution by qualification level (**DSSDH, DSDH, DCD, DT**), pharmacist-to-bed ratio (**P/BR**), pharmacist-to-doctor ratio (**P/DR**), pharmacist-to-hospital ratio (**P/HR**), pharmacist-to-physician ratios (**P/PR**) and urban-rural distribution. The Gini and Theil indices were not calculated. **Results:** The pharmacy workforce exhibited significant imbalances, with college and technical secondary pharmacists (**DCD**) comprising 59.8%, while undergraduate and postgraduate pharmacists (**DSDH & DSSDH**) accounted for only 38.9%. Notably, 25.6% of hospitals lacked pharmacists. There were major disparities between urban and rural areas, with urban hospitals having higher concentrations of qualified personnel. The **P/BR** and **P/PR** ratios varied widely across provinces, reflecting uneven workforce distribution. **Conclusion:** The number of pharmacists, particularly clinical pharmacists, remains low compared to regional and global standards. Addressing these challenges requires specific policies to optimize workforce structure, ensure rational distribution - especially in rural areas, and enhance pharmacist training to meet healthcare demands.

Keywords: *pharmacy workforce, public hospitals, pharmacist distribution, Red River Delta, Vietnam.*

I. INTRODUCTION

In recent years, the number of pharmacists (**P**) per 10,000 population in the Red River Delta (**RRD**) has increased from 1.76 in 2010 to 2.8 in 2022 [1], [2]. However, this figure remains below the target of 4 pharmacists per 10,000 population set by the National Health Workforce Development Plan for 2030 [3]. This plan aims to optimize healthcare organization, strengthen primary healthcare networks, enhance training, and improve the professional competence, medical ethics, and responsibility of healthcare personnel [3], [4]. Currently, the pharmacy workforce in the **RRD** faces several challenges, including shortages in both quantity and quality, as well as an imbalanced professional structure. In some areas, localized surpluses and shortages lead to difficulties in clinical pharmacy services and healthcare delivery [5]. The strategic development of the pharmacy workforce also includes strengthening management capabilities and optimizing workforce utilization within the healthcare system.

This study, titled *"The Development of Public Hospital Pharmacist Human Resources in the Red River Delta, Vietnam: A Cross-Sectional Study in 2022"*, aims to assess the current distribution of pharmacy personnel in hospitals across the region. It provides a comprehensive comparison with regional and global contexts, identifies inefficiencies in workforce allocation, and proposes effective solutions to improve pharmacy workforce development. The study is expected to contribute to enhancing the quality of healthcare services, particularly in the **RRD**, a crucial region in Vietnam.

II. METHODS

2.1. Study Subjects

The pharmacy workforce examined in this study includes pharmacists with a university degree or higher (**DS**), college and intermediate-level pharmacists (**CDD**), and pharmacy assistants (**DT**) working in provincial and district-level general hospitals (**H**) within the public healthcare system in the **RRD** region and across Vietnam as of December 31, 2022.

2.2. Research Methods

- Study Design: A cross-sectional study.

- This method was used to synthesize information from previous studies and reports by

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the World Health Organization (**WHO**) and the Ministry of Health on the pharmacy workforce in Vietnam and globally. It aimed to identify trends, challenges, and opportunities in pharmacy workforce development.

- A comparative analysis was conducted between Vietnam and other countries in the region regarding pharmacist density, training quality, support policies, and workforce distribution.
- Data were collected from reputable organizations such as the WHO and the Ministry of Health of Vietnam, and other regional healthcare institutions to ensure accuracy and reliability.

Secondary data were obtained from the Department of Medical Service Administration - Ministry of Health, Vietnam in 2023. An analysis of reports from public general hospitals at the provincial and district levels across Vietnam was conducted to understand the situation, structure, and distribution of pharmacists. This was complemented by a more detailed survey of pharmacists in 168 general hospitals throughout the **RRD** (Hanoi, Hai Phong, Hai Duong, Hung Yen, Vinh Phuc, Bac Ninh, Thai Binh, Nam Dinh, Ha Nam, Ninh Binh, and Quang Ninh), a region considered to be both the most developed and a representative example for the country.

The study focused on analyzing the structure and distribution of pharmacy personnel within hospitals, including workforce distribution by qualification level (**DSSDH, DSDH, DCD, DT**), pharmacist-to-bed ratio (**P/BR**), pharmacist-to-doctor ratio (**P/DR**), pharmacist-to-physician ratios (**P/PR**) and pharmacist-to-hospital ratio (**P/HR**). The findings of this study will serve as a foundation for proposing solutions to improve the efficiency of pharmacist workforce allocation and development in the **RRD**.

2.3. Data Processing Methods

The collected data were entered and analyzed using SPSS 22.0 statistical software for biomedical research.

III. RESULTS

3.1. Current Status of the Pharmacy Workforce in the Red River Delta – A Case Study in Northern Vietnam

Table 1. RRD Pharmacy Workforce Structure, 2022

Region	No. of H	DSSDH (1)		DSDH (2)		DCD (3)		DT (4)		Total	P/HR	Value (1+2)/3
		SL	TL (%)	SL	TL (%)	SL	TL (%)	SL	TL (%)	SL		
Ha Noi	31	60	13.0	101	21.9	298	64.5	3	0.6	462	5.2	1/1.9
Hai Phong	22	24	10.3	64	27.4	141	60.3	5	2.1	234	4.0	1/1.6
Hai Duong	15	21	7.9	65	24.5	178	67.2	1	0.4	265	5.7	1/2.1
Hung Yen	12	16	17.0	31	33.0	47	50.0	0	0.0	94	3.9	1/1.0
Vinh Phuc	13	17	14.8	40	34.8	56	48.7	2	1.7	115	4.4	1/1.0
Bac Ninh	10	13	17.6	35	47.3	26	35.1	0	0.0	74	4.8	1/0.5
Thai Binh	17	15	14.3	27	25.7	59	56.2	4	3.8	105	2.5	1/1.4
Nam Dinh	12	10	7.2	35	25.2	92	66.2	2	1.4	139	3.8	1/2.0
Ha Nam	9	12	18.2	20	30.3	33	50.0	1	1.5	66	3.6	1/1.0
Ninh Binh	9	13	10.0	21	16.2	92	70.8	4	3.1	130	3.8	1/2.7
Quang Ninh	18	26	20.5	40	31.5	61	48.0	0	0.0	127	3.7	1/0.9
Total	**168**	**227**	**12.5**	**479**	**26.4**	**1083**	**59.8**	**22**	**1.2**	**1811**	**4.2**	**1/1.5**
Urban	37	123	17.2	169	23.7	411	57.6	11	1.5	714	7.89	1/1.4
Rural	131	104	9.5	310	28.3	672	61.3	11	1.0	1097	3.16	1/1.6

In 2022, out of a total of 1,811 pharmacy personnel working in 168 public general hospitals (**PGHs**) in **RRD**, the majority held junior college and technical secondary pharmacy qualifications **DCD** accounting for 59.8% (*refer Table 1*). This proportion was highest in Hai Duong (67.2%) and Ninh Binh (70.8%), while the lowest was in Bac Ninh (35.1%) and Quang Ninh (48.0%).

The number of pharmacists (including postgraduate and undergraduate levels, **DSSDH** & **DSDH**) reached 706, accounting for 39.0%, but distribution varied significantly across provinces. The highest pharmacist proportions

were found in Quang Ninh (52.0%) and Bac Ninh (64.9%), whereas the lowest were in Hai Duong (32.1%) and Nam Dinh (32.4%). Pharmacy assistants made up only a small fraction (1.2%), ranging from 0% (Quang Ninh, Bac Ninh) to 3.8% (Thai Binh).

The average **P/HR** was 4.2, with the highest in Hanoi (5.2 **P/HR**) and the lowest in Thai Binh (2.5 **P/HR**) (*refer Table 1*). The pharmacist-to-junior college and technical secondary pharmacy personnel ratio (Value (1+2)/3) averaged 1/1.5, varying from 1/0.9 in Quang Ninh (best) to 1/2.7 in Ninh Binh (worst). Provinces such as Hanoi, Quang Ninh, and Bac Ninh had better pharmacy workforce structures due to higher pharmacist proportions and balanced **Value (1+2)/3** ratios. In contrast, provinces like Ninh Binh, Nam Dinh, and Hai Duong relied heavily on junior college and technical secondary personnel, leading to lower **P/HR** and **P/PR** ratios, affecting healthcare service quality.

3.1.1. Disparities in Pharmacy Workforce Distribution Between Urban and Rural Areas

An analysis of pharmacist distribution between urban and rural hospitals in the **RRD** revealed significant imbalances. The proportion of postgraduate pharmacists (**DSSDH**) remained low in both areas, averaging only 12.5%, with a higher percentage in urban areas (17.2%) compared to rural areas (9.5%) (*refer Table 1*). This indicates that highly qualified pharmacy professionals are concentrated in cities and developed regions, while rural hospitals struggle to attract high-quality personnel.

Pharmacy assistants represented the smallest workforce proportion in both urban and rural settings, averaging only 1.2%, with 1.5% in urban areas and 1.0% in rural areas. Although these figures are small, the lower **DT** proportion in rural areas further highlights the shortage of supporting pharmacy personnel in these regions. Overall, the unequal distribution of pharmacy personnel between urban and rural areas in the **RRD** poses a significant challenge in ensuring a high-quality pharmacy workforce, particularly in rural areas where the demand for healthcare services and pharmaceutical supply is substantial.

3.1.2. Distribution of Pharmacists by Urban and Rural Hospitals

The average pharmacist-to-hospital ratio (P/HR) was 4.2, with a significant gap between urban and rural areas - 7.9 pharmacists per hospital in urban areas compared to just 3.2 in rural areas. Despite having more pharmacists, urban hospitals had a lower pharmacist-to-bed ratio (P/BR) of 1 per 97.0 beds, while rural hospitals had 1 per 69.4 beds. Similarly, the pharmacist-to-physician ratio (P/PR) was lower in urban areas (1 per 14.9) than in rural areas (1 per 12.3). As shown in *Table 1*, this distribution pattern indicates that while pharmacists are more concentrated in urban areas, their allocation remains inefficient, and rural hospitals continue to face pharmacist shortages.

3.1.3. Pharmacists as a Percentage of the Healthcare Workforce

Table 2. Summary of Pharmacist Workforce in the Healthcare System in RRD in 2022

No.	Province	GB	Dr	P	P/BR	P/DR	H0 (%)	H1 (%)	H2 (%)	H3 (%)
1	Ha Noi	12394	1712	161	1/77.0	1/10.6	4.2	2.4	1.8	10.1
2	Hai Phong	7067	1223	88	1/80.3	1/13.9	3.6	1.2	2.4	6.0
3	Hai Duong	4450	1262	86	1/51.7	1/14.7	0.0	0.0	1.8	7.1
4	Hung Yen	3619	441	47	1/77.0	4/9.4	1.2	1.2	1.8	3.0
5	Vinh Phuc	4343	761	57	1/76.2	7/13.4	2.4	0.6	1.2	3.6
6	Bac Ninh	3003	630	48	1/62.6	6/13.1	3.0	0.0	0.0	3.0
7	Thai Binh	5851	906	42	1/139.3	9/21.6	3.6	2.4	3.6	0.6
8	Nam Dinh	3795	527	45	1/84.3	5/11.7	0.6	0.6	1.8	4.8
9	Ha Nam	1660	258	32	1/51.9	2/8.1	3.6	0.0	0.0	1.8
10	Ninh Binh	3003	560	34	1/88.3	5/16.5	1.2	1.8	0.6	1.8
11	Quang Ninh	7879	1153	66	1/119.4	1/17.5	2.4	3.0	1.8	3.6
Total		**57064**	**9433**	**706**	**1/80.8**	**1/13.4**	**25.6**	**13.1**	**16.7**	**45.2**

Note: *H0, H1, H2, and H3 represent hospitals with no pharmacists, hospitals with one, two, and three university-trained pharmacists, respectively.*

Distribution of Pharmacist by each key indicator

The distribution of pharmacists across hospitals in **RRD** shows significant imbalances. Hospitals without pharmacists (**H0**) accounted for 25.6% (43 hospitals), with the highest proportions in Ha Nam (66.7%), Thai Binh (35.3%), and Bac Ninh (50.0%), while Hai Duong was the only province where all hospitals had at least one pharmacist. Hospitals with one or two pharmacists made up 13.1% (22 hospitals) and 16.7% (28 hospitals), respectively, with Ninh Binh (33.3%) having the highest proportion of hospitals with one pharmacist, and Thai Binh (35.3%) and Nam Dinh (25.0%) leading in hospitals with two pharmacists. Hospitals with three or more pharmacists comprised 45.2% (76 hospitals), with the highest proportions in Hai Duong (80.0%) and Nam Dinh (66.7%), while Thai Binh had the lowest (5.9%). As shown in *Table 2*, these disparities highlight the need for improved pharmacist distribution policies.

3.1.4. Analysis of Pharmacist Distribution by Hospital Classification

In 2022, the Red River Delta had 57,064 hospital beds, 9,433 physicians, and 706 pharmacists, with notable disparities in pharmacist distribution. Hai Duong and Ha Nam had the best **P/BR** (around 1/51), while Thai Binh and Quang Ninh had the worst (over 1/119), indicating severe shortages. Ha Nam and Hung Yen had the most favorable **P/PR** (around 1/8), whereas Quang Ninh and Thai Binh had the lowest (over 1/17) (*refer Table 2*). Despite having the highest number of healthcare professionals, Hanoi and Hai Phong still showed suboptimal pharmacist allocation. Thai Binh and Quang Ninh exhibited the most critical workforce imbalances, requiring urgent intervention.

Table 2 demonstrates that the pharmacist shortage remains a major issue in the Red River Delta (**RRD**), with over 25% of hospitals lacking pharmacists and nearly 30% having only one or two. Severe shortages were seen in Ha Nam, Thai Binh, and Bac Ninh, while Hai Duong and Nam Dinh had better pharmacist distributions. More developed provinces had a higher percentage of hospitals with at least three pharmacists, yet the overall rate of 45.2% highlights the need for further investment in pharmacy human resources.

Hospital classification analysis shows that Level I hospitals have the highest proportion of pharmacists (48.6%), including 16.9% postgraduate pharmacists (**DSSDH**) and 31.7% undergraduate pharmacists (**DSDH**), whereas Level II hospitals have the lowest proportion of postgraduate pharmacists (13.7%). Junior college and technical secondary pharmacists (**DCD**) are slightly more prevalent in Level II hospitals (52.0%) than in Level I (50.5%). Pharmacy assistants (**DT**) remain very limited in both hospital levels (0.4%–0.9%). The **P/PR** is more favorable in Level I hospitals than in Level II - reflecting a better balance of highly qualified pharmacy personnel at higher-level hospitals.

Table 3. Trends in Pharmacist Distribution and Structure (2012-2022)

Year	**2012**						**2022**					
Indicators	***KV 1**	***KV 2**	***KV 3**	***KV 4**	***KV 5**	***KV 6**	***KV 1**	***KV 2**	***KV 3**	***KV 4**	***KV 5**	***KV 6**
P (%)	20.92	18.97	14.41	29.03	18.09	13.97	30.93	35.82	30.87	31.11	30.45	34.06
DSSDH **(%)**	0.82	1.34	0.42	0.00	2.05	0.92	11.57	10.73	10.84	6.67	9.26	11.99
DSDH **(%)**	20.11	17.63	13.99	29.03	16.04	13.04	19.35	25.09	20.03	24.44	21.19	22.07
DCD **(%)**	50.82	58.04	59.08	4.84	58.02	66.01	37.76	28.00	37.20	36.11	38.89	31.59
DT **(%)**	7.34	4.02	12.11	37.10	5.80	6.06	0.38	0.36	1.05	1.67	0.21	0.29
Dr	1673	1531	1796	561	1226	1892	861	832	1065	228	662	1066
Total	6392	8948	9088	1669	8068	7543	10653	14914	15147	2782	13446	12422
H	11	14	14	5	6	13	11	14	14	5	6	13
B	8636	7331	9132	2923	5161	10865	14214	13095	18094	5418	4973	14975
P/HR	7	6.1	4.9	3.6	8.8	8.2	14.8	14.1	14.6	11.2	24.7	27.5
P/BR	0,009	0.012	0.008	0.006	0.010	0.010	0.011	0.015	0.011	0.010	0.030	0.024
P/DR	1/21.7	1/18.0	1/26	1/31.2	1/23.1	1/17.8	1/5.3	1/4.2	1/5.2	1/4.1	1/4.5	1/3.0
P/Total	1/83.3	1/111.1	1/142.8	1/93.4	1/166.6	1/71.4	1/66.6	1/76.9	1/74.1	1/100	1/90.9	1/34.7

**KV1 to KV6 with the note *Key: Region Key: KV1 - Red River Delta (RRD); KV2 - Northern Midlands and Mountains (NMM; KV3 - North Central and Central Coast (NCC; KV4 - Central Highlands (CH); KV5 - Southeast (SE); KV6 - Mekong River Delta (MRD)*

Regional differences further highlight workforce imbalances. A comparison between major cities (Hanoi, Hai Phong, Quang Ninh) and smaller provinces shows that 33% of inequality stems from differences between these groups, while 67% is due to disparities within each group. This calls for targeted policy interventions, including incentives to attract pharmacists to underdeveloped areas, improving workforce allocation, and ensuring equitable access to pharmaceutical services.

3.2. Pharmacist Density: A Regional and Global Comparison

Table 4. Pharmacist Density: Regional and Global Benchmarks

Year	United Kingdom	United State	Singapore	Philippine	Vietnam	Thailand
2012	7.78	8.88	3.74	2.72	1.54	1.4
2019	8.68	10	6.11	4.63	2.88	2.1
2022	8.97	11.13	6.65	4.81	3.06	2.24

According to WHO data from 2016, the number of pharmacists (including university pharmacists, college pharmacists, and intermediate-level pharmacists) per 10,000 people in Vietnam was 3.4, a low figure compared to many countries in the region and worldwide. The number of university pharmacists per 10,000 people was only 2.6 (*Table 4*). This reflects limitations in the development of Vietnam's pharmacy workforce, including issues related to quantity, quality, and distribution. By 2022, the ratio of pharmacists per 10,000 people in Vietnam was 3.06, still lower than the global average of 4.8 and lagging behind other countries in the region. The Red River Delta, one of Vietnam's most developed regions, had a pharmacist-to-hospital ratio of 4.6, which remains low. This indicates that Vietnam still needs to focus on expanding and promoting pharmacist training programs.

Thailand's pharmacist ratio grew from 1.4 to 2.24 per 10,000 people (2012–2022) but still lags behind Vietnam, reflecting limited healthcare investment. Singapore saw a sharp increase from 3.74 to 6.65, emphasizing high-quality workforce development. The UK maintained a strong pharmacist presence, rising from 7.78 to 8.97, indicating a well-established healthcare system. The U.S. follows a similar trend, highlighting structured pharmacist training and workforce planning.

Although Vietnam's pharmacist-to-population ratio has grown faster than in some other countries, such as Thailand, the overall numbers still do not meet healthcare demands, especially amid population growth and the expansion of medical services. Compared to developed countries, the disparity is even more evident. The UK and U.S. had ratios of 7.78 and 8.88 per 10,000 people in 2012, rising to 8.87 and 11.13 in 2022, reflecting significant investment in a high-quality and sustainable healthcare workforce.

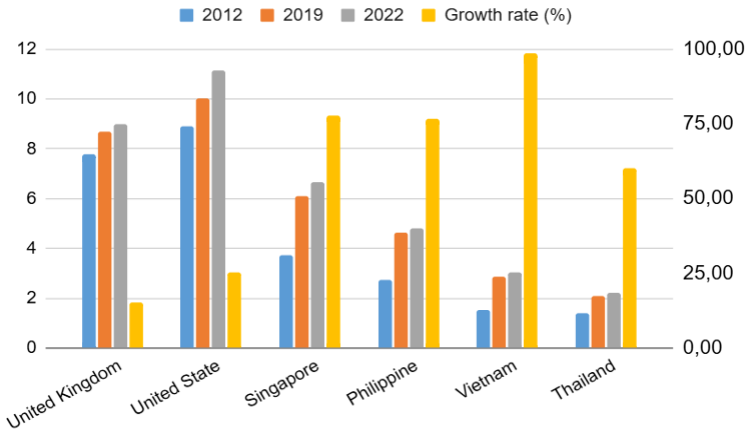

Figure 1. Pharmacist Density (per 10,000 Population): Regional and global changes from 2012 to 2022, with growth Rates

From 2016 to 2022, the number of pharmacists per 10,000 people in the Red River Delta increased from 2.8 to 4.2, a 50% growth rate, exceeding the national average growth of 17.6% (from 3.4 to 4.0). However, this improvement still falls short of expectations compared to actual healthcare needs and international standards (*Fig. 1*).

IV. DISCUSSION

Currently, Vietnam's pharmacist-to-population ratio is higher than Thailand's but lower than the Philippines (11.13), Singapore, the UK (8.97), and the U.S. (developed countries). Vietnam's pharmacy workforce is imbalanced in terms of both qualification levels and distribution. The proportion of intermediate and college-level pharmacists (**CDD**) remains high, while the number of university and postgraduate pharmacists (**DSDH & DSSDH**) is low[2, 19]. This is due to limited investment in pharmaceutical education and the lack of a long-term strategy for developing high-quality pharmacy professionals.

The pharmacy training system is not well-balanced, focusing more on intermediate and college-level education than on university and postgraduate levels. There is also a lack of incentives for pharmacists to pursue higher education (scholarships, benefits) [7], [8].

Disparities in workforce distribution are evident in Vietnam's pharmacy sector, particularly between urban and rural areas. Working conditions, income levels, and infrastructure in rural regions are less attractive, leading to a high concentration of pharmacists in cities while remote areas struggle to retain qualified professionals due to insufficient incentives. Resources are heavily concentrated in major cities like Hanoi and Hai Phong, while rural provinces face challenges in attracting and retaining pharmacists due to uncompetitive salaries and allowances. Furthermore, pharmacy as a profession has not received sufficient investment or attention from both the government and society. The combination of high work pressure and low financial incentives has led many pharmacy students to shift to alternative career paths, exacerbating the workforce imbalance [9], [10].

To address disparities in the distribution of pharmacists, several solutions can be implemented. Improving training quality is essential, including expanding university and postgraduate pharmacy programs while promoting continuous professional development for practicing pharmacists. Workforce distribution can be balanced by introducing preferential policies such as salary increases, special allowances, and housing support for those working in rural areas. Additionally, investing in modern healthcare infrastructure, particularly in provincial and district hospitals, will help attract pharmacists to underserved regions. Learning from international best practices is also crucial, which involves increasing the pharmacist-to-population ratio by expanding training programs and fostering partnerships with pharmaceutical enterprises. Lastly, aligning pharmacy education with practical needs by integrating research and technological applications will ensure that graduates are well-equipped to meet industry demands.

V. CONCLUSION

The study of 168 public hospitals in the Red River Delta (2022) reveals significant imbalances in the pharmacy workforce, with lower-qualified pharmacists (59.8%) outnumbering university and postgraduate pharmacists (38.9%). Urban areas concentrate more highly qualified professionals, creating disparities in pharmacist-per-bed and pharmacist-per-doctor ratios. Pharmacist density remains below regional and global standards, indicating a critical shortage. Addressing these challenges requires enhanced training, strategic workforce allocation, and attractive policies such as salary adjustments and rural incentives. Strengthening education, integrating technology, and adopting international best practices will improve pharmaceutical services and healthcare outcomes.

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